GTSLink

Plug-in, fully programmable Engine Management System for the Nissan GTS

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By Link ElectroSystems Ltd.

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1. SYSTEM INSTALLATION

The factory computer is located in the front of the passengers foot well (right hand drive vehicles) as shown in Figure 1.1. To gain access, carefully remove the kick plate trim. 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 socket) in the connector. Unbolt the computer (ECU) and remove it from the vehicle.

Figure 1.1 - ECU Location

Board Replacement

1. Remove both ECU covers by removing the eight (sometimes twelve) screws. These are factory "Loctited" and usually difficult to undo.

Caution
Static Electricity Hazard

2. Remove all screws retaining the circuit boards. Lift the boards clear of the aluminium case. Insert the GTSLink board and replace the retaining screws. The GTSLink board may have transit screws and nuts in some locations. Remove these if necessary.

3. Replace the bottom ECU cover and plug the ECU into the wiring harness. Leave the ECU sitting on the floor facing up at this stage.

The manifold air pressure sensor (MAP 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 plug into the AFM connector) so a three wire terminated lead set is used to connect the sensor. Incorrect wiring will not cause any damage. The red wire is a power supply for the sensor and should be connected to 12 volts. The black wire in an earth/ground and the white wire caries the MAP signal back to the ECU. A wiring diagram for various models is shown below in Figure 1.2.

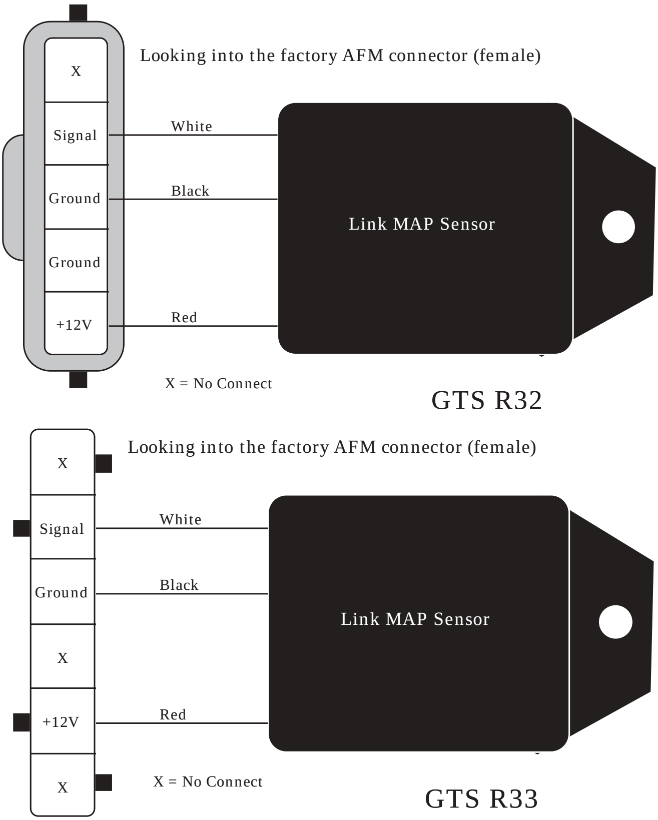


Figure 1.2 - AFM Connectors

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 in the vacuum hose connected to the fuel pressure regulator. This is shown in Figure 1.3.

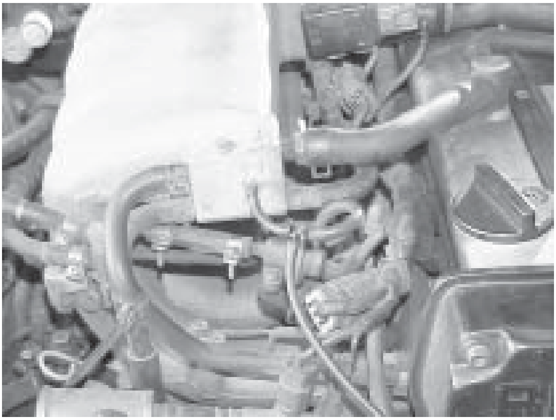


Figure 1.3 - Typical MAP takeoff point

5. DO NOT under any circumstances try to start the engine. There are several basic tests to be carried out first. Refer to Section 2 for information. Once the pre-start setup procedure and tuning have been completed, replace the top ECU cover, fit the ECU into its mounting position and fit the kick plate trim.

2. PRE-START SETUP PROCEDURE

The aim of this procedure is to ensure ALL sensors are connected and configured correctly. Firstly install the GTSLink as detailed in Section 1. DO NOT attempt to start or drive the vehicle. The Tuning Module or PCLink software can be used to setup the GTSLink, but the Tuning Module is recommended for first time users. For information on the Tuning Module and location of various functions refer to Section 3. For information on connecting the GTSLink to the Windows PC tuning software, refer to Section 19.

Carefully follow the step by step instructions ensuring all the readings are within the specified values.

Step 1: Plug in the Tuning Module or connect the PCLink software. Switch ignition ON.

Step 2: Manifold Air Pressure - Check the MAP reading shows atmospheric pressure. This should read 100kPa ±5 at sea level. If not, make sure that the MAP sensor has been connected to the airflow meter plug as described in Section 1.

Step 3: Engine Temperature - If the engine is cold, check that the reading is consistent with this (i.e. less 30 degrees). Likewise a hot engine should reflect a reading >70 degrees.

Step 4: Inlet Air Temperature - If the engine is cold this should reflect ambient air temperature. If the engine is hot, heat soak can cause inlet air temperatures to rise above 50 degrees.

Step 5: System Voltage - A reading higher than 11.5V is acceptable. A lower reading indicates a possible power supply problem.

The following 3 steps are ABSOLUTELY COMPULSORY.

Step 6: TPS SPAN Setup - The position of the TPS may vary from engine to engine and MUST be checked. It is particularly important the “low” value equals 20 as this effects idle speed and fuelling. The Utilities Section describes the function of the TPS sensor and how to set the span. This information is duplicated below.

TPS SPAN Requirements - This should read 20 at closed throttle and 100 ±2 at full throttle.

TPS SPAN Adjustment - Move to the Utilities heading. Observe the TPS Span at closed throttle. If this does not read 20 use the ADJUST keys (Tuning Module) or mouse (PCLink) to select 20. Next fully open the throttle. This should read 100. If this is not correct, adjust it. Once satisfied, return the throttle to the closed position and observe the “low” value. This may have changed so reset it to 20. The “low” and “high” values interact so it will be necessary to repeat the procedure until the Span is set correctly. Select STORE and hold down both adjust keys to store this setting before proceeding.

Note: If the TPS is used for Mixed Mode Scheduling (see Section 13) NEVER readjust the closed throttle value of 20.

Also, the values in zones 10 and 11 (TPS LOW and HIGH) will read differently when viewed in the zone edit mode. These numbers are coefficients in a calculation and will not necessarily be the previously set 20/100 span.

Step 7: Base Timing Adjustment - The base timing of the engine should now be retarded. With the Crank Angle Sensor (CAS) in its original position the GTSLink will produce a base timing which is far too advanced and may cause the engine to detonate. Figure 2.1 illustrates the location of the CAS. Loosen the three bolts and rotate the CAS to the FULLY ANTI-CLOCKWISE direction to retard the spark. Next select the ADV LIMIT menu from the * IGNITION * menu and set to zero (but do not STORE). This will prevent the GTSLink scheduling any electronic advance and will provide spark at base timing. Now start the engine. At idle adjust the timing to approximately 10°BTDC with a timing light. Each timing mark is 5° apart with yellow mark being TDC. Be aware that the timing light will produce two different values depending on the way the timing light pickup is orientated. The orientation, which produces the MOST RETARDED value, is the correct one. Because the engine has a coil directly on top of each plug, it is recommended that the no 1 coil be removed and an HT lead placed between the coil and engine. The timing light pickup can then be placed around the HT lead as shown in Figure 2.2. When finished re-tighten the bolts and switch off the engine.

Note - The ADV LIMIT will return to its default value when the engine is switched off provided a STORE has not been initiated.

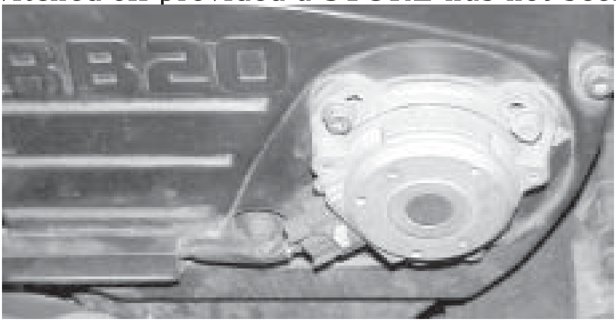


Figure 2.1 - Location of Crank Angle Sensor

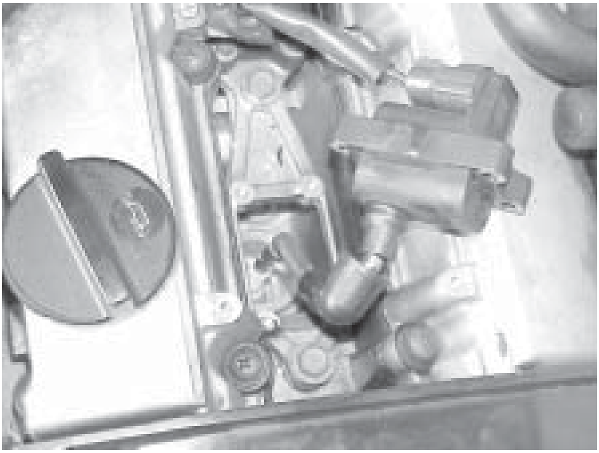


Figure 2.2 - Timing Light Setup

Step 8: Sync Setting Procedure - Observe the small sub-board sitting above the main circuit board on the GTSLink.

A picture of this board is shown in Figure 2.3. This board will have one or two rotary switches and a red LED.

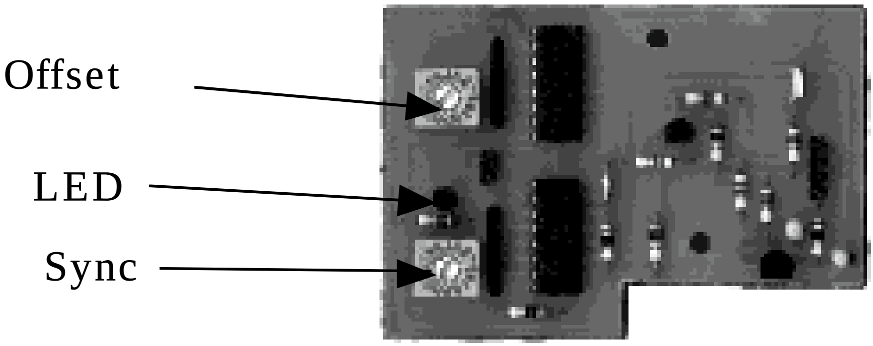


Figure 2.3 - CAS decoding sub-board

The offset switch allows for base timing adjustments which are outside the range of the crank angle sensor adjustment. In most cases this is not required, so the switch should be set to the 0 position if present.

The sync switch is set to the B position in most cases. However it must be tested that this position is correct. To do so, select the SYNC/CYL ERR from the * DIAGNOSTICS * menu. Again start the car, this time observing the SYNC/CYL ERR number. It should go to approximately 1 or 2 on startup and then stabilise. If instead this number is continuously incrementing while the engine runs, then the sync rotary switch must be turned clockwise until this number is stable. Ensure that the LED is still flashing while the engine runs. If not the switch must be turned anti-clockwise until the LED flashes.

Note - The car will continue running but will not be able to be started if the switch is turned clockwise too far.

Once Step 8 has been completed the vehicle can be driven and tuning can begin if required.

Chapter 3-14 detail the available tuning functions, while Chapter 15 gives a typical tuning procedure.

3. TUNING MODULE FUNCTIONS

The Link Tuning module allows all aspects of fuel, ignition, boost and utility functions to be adjusted, edited and stored. This section will describe the functions available on the GTSLink.

Menu Structure

Each function is allocated a menu from which adjustments can be made. The first 5 menus are read only providing real-time information about the engine. The remaining adjustable functions for simplicity have been grouped under an appropriate heading, designated by the '* ' symbol. For example, all functions related to the fuel map such as MASTER, ROWFUEL, ZONEFUEL have been grouped under one heading. These tuning functions can only be accessed from this heading using the EDIT buttons. All read only menus and headings are displayed in upper case and all adjustable functions displayed in lower case. Figure 3.1 illustrates this menu structure.

Tuning Module Buttons

The SELECT Buttons allow scrolling through the read only menus and main headings. From any main heading (shown by the * symbol), pressing EDIT down will allow access to the grouped tuning functions. Pressing EDIT up will return the menu to its main heading. The EDIT buttons are also used to move through the Zone Editor, which appears as the last menu. (See Section 17 for more information on the Zone Editor.) To change a value use the ADJUST buttons.

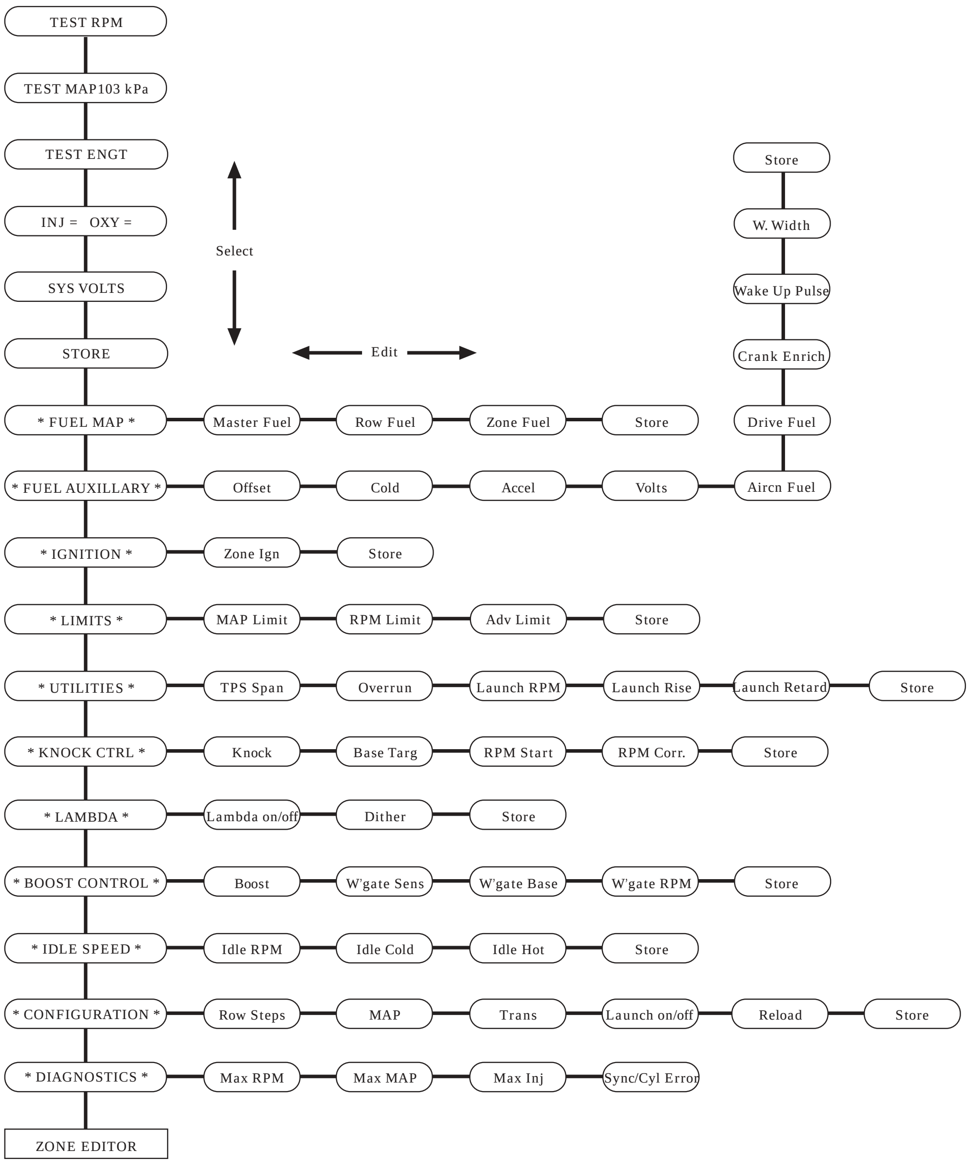


Figure 3.1 GTSLink Menu Structure

Read Only Functions

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

TEST MAP shows the current Manifold Air Pressure (MAP) in kPa. With the engine stationary, the value should show 101 kPa +/-5 at sea level.

TEST ENGT shows the current engine coolant temperature in degrees Celsius.

INJ/OXY this displays the actual injector duty cycle as a percentage e.g. 28% indicates that the injectors are flowing 28% of their maximum volume. The OXY display shows the output signal of the oxygen sensor in hundredths of volts. e.g. 70 is displayed for a sensor voltage of 0.7V.

SYSTEM VOLTS This menu displays the current operating voltage of the battery.

Storing/Writing to Memory

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 be stored.

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

4. FUEL

Functions

MASTER FUEL Controls overall fuel injection scheduling and adds or subtracts fuel throughout the entire operating range from idle to full power. The scale ranges from 0-255, the higher the value, the greater the overall fuel.

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 200 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.

ZONEFUEL There are 200 fuel zones arranged in a rectangular grid consisting of 10 ROWS by 20 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, 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..255

Note: The fuel pump can be activated with the engine off. To start move to the “TEST RPM” menu, then press and hold down the EDIT DOWN button. This will force the pump into high speed mode for the purpose of a fuel flow test.

5. FUEL AUXILIARY

Functions

OFFSET control replaces CLAMP and 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.

COLD (POST-START WARM-UP) 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. Note this is the temperature-decayed-value rather than the full cold value. The number shown in parenthesis (xxx) is the actual engine temperature for monitoring purposes.

ACCEL When the throttle is abruptly opened, the air-mixture is leaned out briefly. To achieve good throttle response acceleration, enrichment is required. There are 4 ACCEL zones, the first 3 covering a 2000 RPM span, the last zone covering a 4000 RPM span. By definition:

ACCEL zone 1 covers 0 - 2000 RPM

ACCEL zone 2 covers 2000 – 4000 RPM

ACCEL zone 3 covers 4000 – 6000 RPM

ACCEL zone 4 covers 6000 – 10000 RPM

By using 4 zones it allows the enrichment to be optimised and set for varying conditions. The amount of enrichment is dependent on rate of change, and engine temperature. 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 active zone. e.g. Z=2 indicates transient zone 2 (2000..4000 RPM range). A “*” will appear on the ACCEL menu when the acceleration enrichment is active.

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 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.

AIR CONDITIONING FUEL From this menu extra fuel can be added when the Air conditioning is switched on. When the AirCon compressor is engaged the extra load can cause unstable idle, so extra enrichment can be introduced to help stabilise this. The default value is 0 implying no added fuel. The enrichment is only active below 1500 RPM. To change this setting use the adjust buttons.

DRIVE FUEL (Automatics Only) This is the amount of extra fuel added when the transmission is moved into drive. A larger number gives more enrichment.

CRANK ENRICHMENT This is the amount of extra fuel added while the engine is cranked and for a short period after starting. It is a temperature dependent enrichment and only effective when the engine temperature is below 50°C. The actual value used by the GTSLink will provide more crank enrichment with decreasing engine temperature and will decay with time.

The SMALLER the number, the GREATER the enrichment. The base default value is 60.

WAKE UP WIDTH Wake-Up Injection will fire a short burst of injector pulses per engine TDC when transient enrichment is required. This will improve the engines throttle response and should be used in conjunction with the 4 existing ACCEL Zones. Adjustment is provided for both the width and number of pulses.

"Wakeup Width" will control the width of each WakeUp pulse. The default value is a 1.1ms pulse width. To increase the width, increase this number.

WAKE UP PULSE This controls the number of additional pulses added when transient enrichment is required. The Default value is 1. This means 1 additional closely spaced pulses will be added, each 1.1ms in width.

To switch this function off set the number of pulses to zero.

6. IGNITION

ZONE IGN There are 200 ignition advance zones arranged in an identical manner to the fuel zones (see earlier). 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 in addition to the base timing i.e. ZONE IGN = 27° and base timing = 10° gives 37° BTDC.

7. LIMITS

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. 170 kPa = 9 psi boost

200 kPa = 15 psi boost

Upper limit = 254 kPa. No limit 255 kPa. (Display = OFF)

RPM LIMIT Sets the RPM limit. Limiting is achieved by 100% fuel cut until the RPM drops below the preset value.

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

8. UTILITIES

8.1 Functions

TPS SPAN The Throttle Position Sensor is used in the control of:

- Idle speed control
- Boost control
- Fuel cuts

The TPS Span allows the Throttle Position Sensor (TPS) span to be set. The ADJUST switches are used to set the "low" (throttle closed) 20 and "high" (throttle fully open) 100, values. These values <u>must</u> always be set unless otherwise specified. Refer to Section 8.2.

OVERRUN VACUUM This represents the engines MAP when it is running in overrun vacuum. It is a target value used by the GTSLink to aid in idle speed and fuel control. When the engines manifold air pressure drops below this target, various tasks are actioned. As this value is a function of the engine modification state, it will vary and should always be adjusted as described.

Overrun Vacuum Setup: Observe the engines Manifold Air Pressure as the throttle is fully opened. Allow the engine to reach around 4- 5000 RPM then snap the throttle closed to put the engine in overrun vacuum. Now record the LOWEST MAP. Use this number subtract 2 and enter this value as the overrun vacuum number. The units are kPa.

Launch RPM

The Launch RPM can ONLY be adjusted if this function has been activated from the * CONFIGURATION * heading. This sets the RPM at which the engine will limit when the launch system is activated via a clutch switch or gear knob button. See section 8.3 for setup information.

Launch Rise

Sets the rate of rise of RPM after the clutch has been released. Effective range = 800/sec to 25,000/sec. Default = 3000/sec.

Launch Retard

Sets the amount of ignition timing retard while the clutch is depressed. This value is SUBTRACTED from the current advance angle value right down to zero degrees (TDC), but not beyond. This feature should help improve turbo spooling prior to launch. Set to 0 if no retard is required. Default value = 25 degrees.

8.2 Setting TPS Span using the Tuning Module

With the throttle fully closed, note the displayed value on the Link Tuning Module. Use the ADJUST buttons to set the "low" value of 20, then fully open the throttle and note the new value. The TPS must be spanned 20 to 100. Use the ADJUST buttons again to set the "high" value of 100 and then fully close the throttle and observe the "low" value. This will probably have changed so reset to 20 again. The "low" and "high" interact, so it will be necessary to repeat the procedure until the required values are achieved. Select STORE and store the settings before proceeding.

8.3 Launch Control Setup

This function allows full throttle stationary launching and full throttle upshifts. When launching a vehicle from stationary, the throttle fully open and the clutch engaged, the GTSLink will limit the engine to an adjustable preset RPM. When the clutch is released, the hard limit is turned off, replaced by the "Launch Rise" function which controls the rise in engine RPM. When the next gear is selected by depressing the clutch, the driver can keep full throttle, as the GTSLink limits the engine RPM while the clutch is engaged.

Advantages

On a normally aspirated engine it allows smoother and quicker gearshifts with less wear on gearbox components. On a turbo charged engine as well as the above benefits, it allows boost to be maintained during gearshifts. If the throttle is temporary closed the air in the inlet manifold is stalled which means a small lag in boost recovery when the throttle is opened.

Procedure

There are two options. One option is to use a switch mounted on the steering wheel or dash allowing Launch Control to be set to the ON or OFF position. This type of setup is only suitable for stationary launching. If full throttle up-shifting is also required a clutch switch should be fitted instead.

Dash mounted switch: When using this setup the Launch Control Switch MUST be a NO (Normally Open Switch). With the switch in its ON position the launch-input line is pulled low to ground and the system activated. When the switch is in its resting position the launch input line returns to +5V deactivating the launch function.

Clutch switch: It should be positioned so the switch makes contact when the clutch pedal is fully released. This allows the clutch "weight" to be taken up when the launch system is activated. When the pedal is fully released the switch makes contact which deactivates the launch system. This MUST be a NC (Normally Closed) switch. With the clutch engaged, the switch should be closed circuit. With the clutch fully released the switch should be open circuit.

Wiring of Clutch/Dash Switch: The same ECU input pin used on automatics for the neutral/park switch can be used to feed the clutch position to the GTSLink for manual cars using Launch Control. This is ECU pin number 44 and should be connected as shown in Figure 8.1.

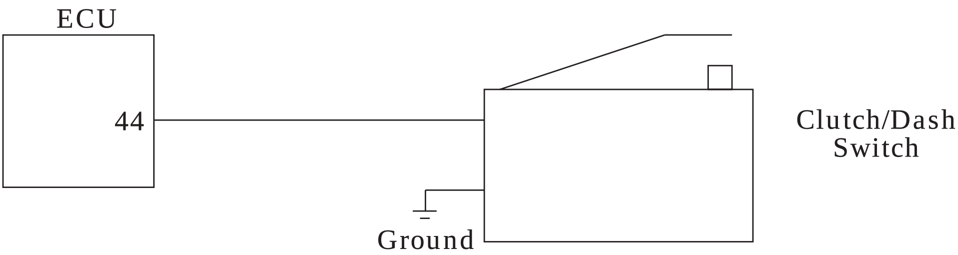


Figure 8.1 - Wiring of Clutch/Dash Switch

To activate launch control: Move to the * CONFIGURATION * heading. Use the EDIT DOWN button to move to the Launch control menu and press the ADJUST UP button. The Tuning Module will display "Launch Ctrl = ON". Next move to the Launch RPM menu under the *UTILITIES * heading.

- The clutch switch should now be checked to ensure it is correctly connected. On the Launch RPM menu a "*" will appear when the clutch is depressed to the floor. Release the clutch.
- The “*” symbol should disappear. If not, re-check the wiring.
- Adjust the Launch Rise and Launch Retard as required.
- Next select the required RPM by using the ADJUST buttons.

9. 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). Analogue filters inside the ECU reject the majority of unwanted signals but the software processing this signal requires a certain amount of discrimination. Once a knock event has been detected, ignition timing is removed from the current ignition zone (1 of 200). The maximum amount of retard is six degrees from any one zone, although the system will not retard beyond zero degrees electronic advance (base timing).

E.g. If original zone value was 5 degrees, then at maximum retard produced by the GTSLink would be ZERO, not -1 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. This means when superior fuel is used or climatic conditions change, the ignition map will have a "clean slate" rather than previously compromised values.

The 3 main adjustments for the knock system are:

- Knock Base Target
- Knock RPM Correction
- Knock RPM Start

Functions

The following functions are available from the Knock heading.

1. Knock Count (Read only)

   A "knock event" occurs when the engine noise, transmitted by the knock sensor exceeds the Knock target. Once detected, the current ignition zone has one degree of timing removed and the Knock Count is incremented by one. To switch knock control OFF press the ADJUST DOWN button and the menu will display "Knock Limit OFF ". Pressing ADJUST UP will reactivate the knock control system displaying "KNOCK (xxx) zzz".

   - xxx = Knock Count. This is the total number of "knock events" detected by the system for this current run.

     zzz = Knock Signal. Shows the actual "processed" knock signal fed into the microprocessor. This value should be small at idle (type less than "10") and increase with RPM and load (boost) as the background noise rises i.e. The signal will always rise with increasing power at a PROGRESSIVE rate if there is no detonation. The amplitude of the Knock Signal will depend on knock sensor position and the engines type/modification state.

     For example a Knock Count of 5 (xxx = 5) indicates the knock level processed from the engine, has exceeded the Knock target 5 times.

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

2. Knock Base Target

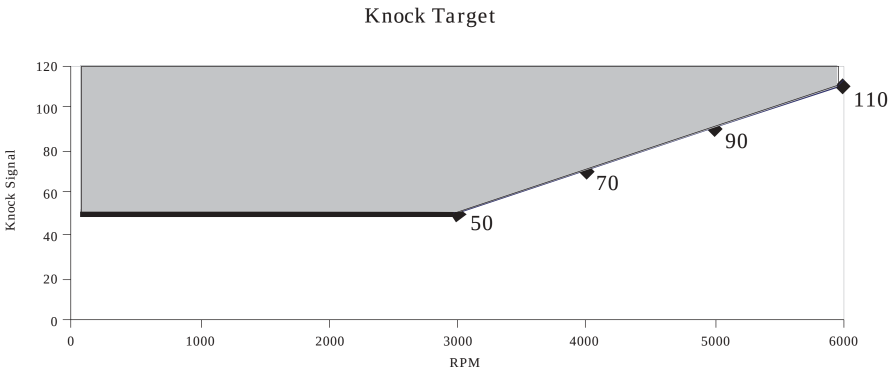
   This allows the knock base target to be set. This is the amplitude of the Knock signal when the engine starts to generate noise. From this point, engine noise will normally rise as the RPM and load increases. To match the Knock target to the engines noise profile the target requires RPM correction.

3. Knock RPM Correction

The microprocessor uses the base target and RPM correction to produce a knock target that is proportional to RPM i.e. at higher engine RPM more "noise" is generated, hence the knock threshold needs to be increased. For every 1000 RPM the RPM correction value will be added to the Base Target. Intermediate values will also be calculated.

Example 9: Base Target of 50 below 3000 RPM.

RPM Correction = 20



RPM	Knock Target
3,000 & less	50
4,000	70
5,000	90
6,000	110

The example illustrates the knock target as it varies with RPM. If the Knock signal enters the gray region a knock event will be generated and timing will be removed. Note: Below 3000 RPM the knock target is the "base target", with no RPM compensation.

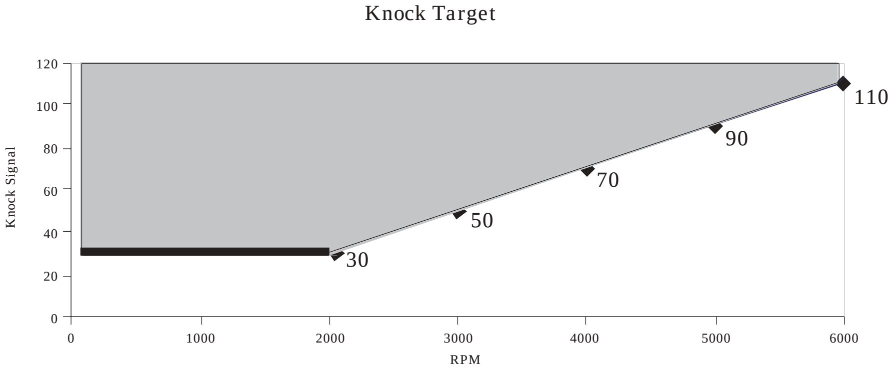
4. Knock RPM Start.

The last adjustable factor that will vary from engine to engine, is the RPM point where the engine begins to generate noise. It can range from 1000 through to 4000. See Example 9.1.

Example 9.1: Base Target of 30

RPM Correction = 20

RPM Start = 2000



RPM	Knock Target
2,000	30
3,000	50
4,000	70
5,000	90
6,000	110

If the knock level enters the "grey" region, ignition will be removed from the engines current ignition zone. Note below 2000 RPM the "base target" is used, having no RPM correction.

The default values for the GTSLink are:

Knock Base	=	20
Knock RPM Corr.	=	25
Knock RPM Start	=	4000

10. LAMBDA

Closed loop 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.

System Requirements.

Hardware for closed loop operation is essentially the same as for open loop with the following exception.
An exhaust gas oxygen sensor (Lambda probe) must be mounted in the exhaust manifold as close as possible to the engine (rather than down the tail-pipe). The factory sensor in its original mounting position is adequate provided it is in working condition. For cars utilising the factory setup no wiring will be required as the signal should already reach the GTSLink via the factory wiring.

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 70º
d. Idle vacuum normal (not over-run vacuum)
e. No “acceleration” fuel pending

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)

Operation and setup.

1. The system should first be tuned in open loop mode (LAMBDA = OFF) until a reasonable state of tune is achieved.
2. The closed loop mode is enabled by selecting LAMBDA from the *LAMBDA* menu on the Link Tuning Module and switching to "ON".

NOTE: All corrections made by the closed loop lambda system are temporary unless a STORE is carried out.

3. The dither 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 considerably.

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.

11. BOOST CONTROL

If required, the GTSLink can offer Closed Loop Boost Control for turbo charged engines. This Section provides hardware configurations, wiring information and the setup procedure to achieve this.

Internal Wastegates

Wiring of Boost Control Solenoid

Some models of the GTS engine do not have any electronic boost control as original equipment. These require a solenoid to be fitted if ECU controlled boost is required. Using Figure 11.1 follow the wiring diagram 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.

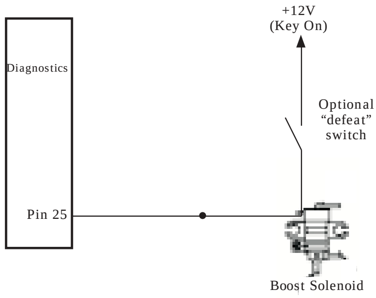


Figure 11.1 Boost Control Wiring

Operation

Boost control is achieved by modifying the pressure signal between the waste gate actuator and the compressor outlet using a solenoid assembly. A three port solenoid (recommended) is arranged as follows and illustrated in Figure 11.2:

- 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)

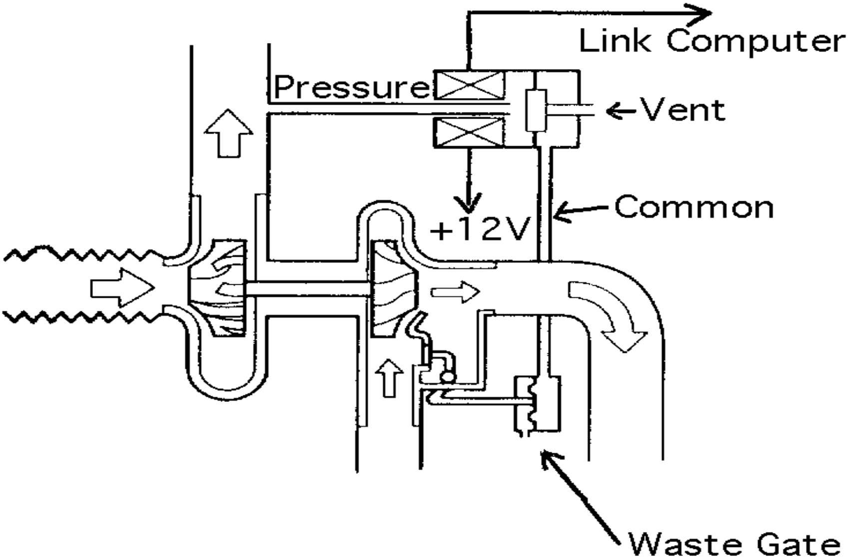


Figure 11.2 Solenoid Plumbing for 3-port Solenoid

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 common and vent ports are connected and the air pressure left in the actuator is bled to atmosphere. This causes the waste gate to close and boost to rise. By varying the ON/OFF ratio of the solenoid (duty cycle) any level of boost may be achieved within the physical constraints of the turbo itself. Since the GTSLink is measuring the manifold air pressure (MAP) the boost level may be precisely programmed and controlled.

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. Figure 11.3 shows the recommended three port solenoid which can be supplied with the GTSLink.

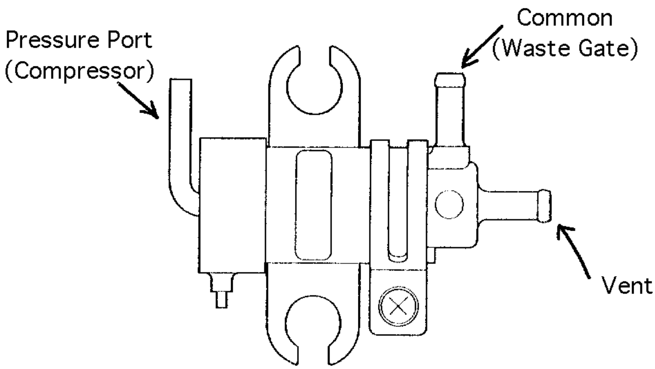


Figure 11.3 Three Port Boost Control Solenoid

Two Port Control Valves

Some boost control systems use a simple two port solenoid rather than the three port type previously described. These basically work as "variable bleeds" and require some form of restrictor between the compressor (pressure source) and the boost control solenoid.

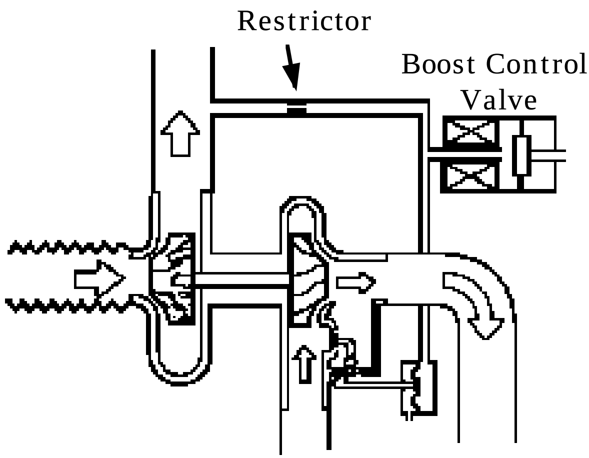


Figure 11.4 Solenoid plumbing for 2-port solenoid

Typical size for the restrictor is 1.00 to 1.50 mm. The actual size varies somewhat depending on the wastegate construction, length of tubing between the pressure source and the solenoid, diameter of tubing etc.

If the restrictor is too small then boost will tend to overshoot since it limits the rate at which the wastegate actuator will fill and therefore move the actuator arm. If the restrictor is too large the GTSLink will be unable to achieve high boost operation. The solenoid is unable to bypass sufficient pressure so the wastegate opens prematurely.

It is recommended that two port type solenoids be used for small to moderate increases in boost over the normal wastegate operating pressure and the three port types for high boost applications requiring higher precision and better control.

External Wastegate

The Boost Control software in Link Engine Management systems is configured for either integral waste gates or external wastegates.

It is important for stable operation that the top and bottom of the wastegate are fed by separate pressure lines. Plumb the lines according to the diagram below. The bottom of the diaphragm receives a pressure supply from the turbocharger to equalise the wastegate.

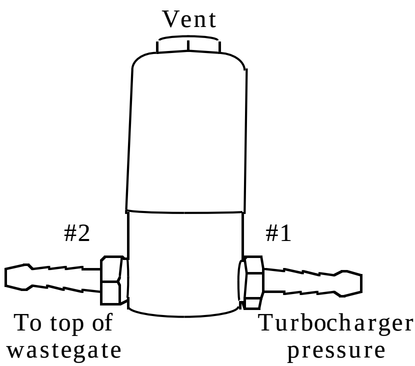


Figure 11.5 External Wastegate - Parker Solenoid

Install the pictured solenoid (Fig. 11.5) on the supply line to the top of the wastegate. Port #1 is plumbed to the turbocharger and is blocked when the solenoid is de-energised. Port #2 is plumbed to the top of the wasted gate and is vented to atmosphere (top of solenoid) when the solenoid is deactivated (you should be able to blow through it). This allows the diaphragm in the waste gate to move freely once the boost target is achieved. The Nippon Denso three port solenoid (Fig 11.3) is not suitable as the turbo pressure will force it open thereby pressurising the top of the wastegate. This results in unlimited boost pressure.

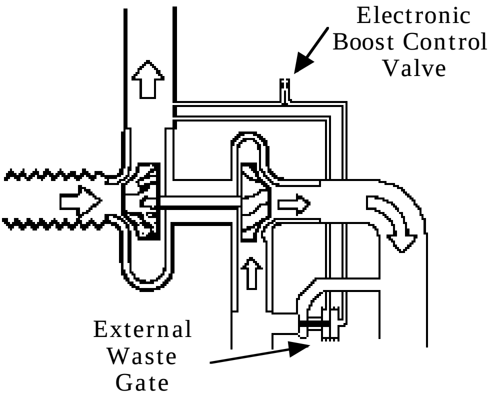


Figure 11.6 External Wastegate Solenoid Plumbing

Wiring & Mounting of Boost Control Solenoid

The solenoid should be mounted in the engine compartment as close to the Waste Gate as possible. This will keep the pressure line to the solenoid as short as possible and minimise any signal delay.

Electronic Boost Control

The computer 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.

Functions

BOOST Boost target values: Twenty zones are used to hold a target boost value for each 500 Rpm interval between 500 and 10,000 Rpm. This allows the boost curve to be tailored for the application e.g. the boost may be held at lower levels through the Rpm mid range to suppress detonation and then allowed to rise at higher Rpm where detonation is less likely. The target values may be changed as follows:

1. From the *BOOST CTRL* heading, select "BOOST =" on the remote and use ADJUST keys to set as required. Note that this will affect all 20 zones in a manner similar to row fuel e.g. if 5 kPa is added to BOOST, 5 kPa will be added to all 20 zones.

2. EDIT mode; select each zone individually and ADJUST to the required value. EDIT mode affects one zone only. (See Section 17.)

   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 Max for supplied MAP Sensor

WGATE SENS Sensitivity Control: All closed-loop (feedback) 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 (hunting or oscillation around the target value), and low sensitivity may result in slow settling times.

Experience has shown a "WGATE SENS xx" value of about 5 to 10 to be fairly close. (Never set the value to 0). Generally a "soft" waste gate requires higher numbers, especially when operating at high boost levels (>200 kPa absolute).

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 (e.g. 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.

If WGBASE is set too high, then the boost will initially overshoot the target value, then decay slowly to the settled value. If set too low, then boost will initially rise short of target, then slowly increase toward the final value.

WG RPM Sets the engine RPM at which the system will start controlling the boost. At low RPM (about 3,000 rpm) there may not be sufficient gas flow to 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 duty-cycle without effect, and when the boost does arrive would grossly over-shoot since the waste gate is fully shut down. Typical rpm lock out values depend somewhat on the turbo size and matching, but a typical value usually falls between 3,300 and 3,800 rpm. If boost overshoots at low RPM when driving in higher gears (4th / 5th etc.) try raising the rpm point.

Note: A throttle position lockout also exists which inhibits the control system when the throttle is less than 60% open. This feature is not adjustable.

12. IDLE SPEED

12.1 Function

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. This menu also contains an annunciator used to display the system status.

Annunciators

T	Throttle open
V	Engine in over-run vacuum
A	Acceleration fuel pending
=	Idle speed equals target value
+	System is increasing idle speed
-	System is decreasing idle speed

The default mode is when the annunciator shows T, V, A. In this state the system is using the IDHOT/IDCOLD default duty cycles. No idle speed correction will be performed in this mode.

IDLE DUTY CYCLE DEFAULTS There are 2 default values labelled "Idle Hot" and "Idle Cold". These are used by the software to preset the ISC duty cycle to about the correct value during gear shifts, over run vacuum, returning to idle etc.

IDLE HOT When the engine is above 50°C, the "Idle hot" value is the default duty cycle forced into the solenoid. This should provide an idle RPM close to the required value. To change use the ADJUST buttons.

IDLE COLD When the engine is below 20^{o}C the "Idle Cold" value is the default duty cycle. Between this temperature and 50 the software will interpolate to create an intermediate duty cycle. To change use the ADJUST buttons.

12.2 Idle Speed Setup

The Idle speed control system has three main adjustments for correct operation.

1. "IDLE (xx%) yyyz" sets the required idle speed in steps of 50 rpm. The (xx%) value shows the actual duty cycle to assist settings and monitoring. Use the ADJUST buttons to select the idle RPM.

2. Two default values for cold and hot engines.

   Hot Engine
   Select "IDLE (xx%) yyy z" on the remote and set the required idle speed. Once the idle rpm has stabilised note the duty cycle value shown in parentheses (xx%) and record the value. Select the "Idle Hot xx%" menu and enter the recorded value + 2%.

   e.g. Duty Cycle = 43% (stable hot idle) then enter a value of 45%

   Cold Engine

   Use the same procedure as above except note the duty cycle shortly after a cold start. Enter this value using the menu " Idle Cold xx%" under the "IDLE SPEED" heading. The engines idle will always be higher when it is cold implying the IDLE COLD value will be larger than IDLE HOT.

   Store the new value by moving to a STORE menu and holding both ADJUST buttons until the display shows "********" and then release.

   Note that the software also generates an intermediate (warm) value, which is the average of the cold and hot settings but is not independently adjustable. If the target rpm is changed at a later date, the HOT and COLD default values may require adjustment.

3. To aid in the control of the Idle Speed solenoid the software uses TPS to determine throttle position. Always ensure the TPS "low" value is 20. This is the value used to determine closed throttle and MUST be set to ensure the correct operation of the Idle Speed system. See the * UTILITIES * Section for TPS setup information.

4. The Idle speed system will perform idle correction under the following conditions
   - TPS < 23 (Throttle Closed)
   - Engine MAP > Overrun Vacuum Target

   All other conditions will cause the idle system to enter hold mode, where "Idle Hot" and "Idle Cold" are used to determine duty cycle.

13. CONFIGURATION

13.1 Functions

ROW STEPS This control allows the zone table row selection to be setup in one of two modes. These are MAP or MAP+TPS. To scroll through these modes used the ADJUST buttons.

MAP This function allows the selection of one of two MAP sensors. The supplied 2.5 Bar MAP sensor reads to a maximum boost pressure of 250 kPa absolute (23psi). If a higher boost pressure is required, a 3 Bar (300 kPa) map sensor is available from link and may be selected in this menu.

TRANS Allows selection of either manual or automatic transmissions using the adjust buttons.

LAUNCH CTRL (Manual Trans only) This will activate the launch control function. To switch ON press the ADJUST UP button. The required launch RPM can be adjusted from the * UTILITIES * heading. See section 8.3 for setup information.

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.

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

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.

13.2 Scheduling

Scheduling refers to the way in which the zone table ROWS are selected. There are two options available, each one specific to an engine configuration. The default mode is MAP meaning ROW selection is based ONLY on the engines Manifold Air Pressure.

MAP Mode

This allows Manifold Air Pressure to select the current zone table ROW. This will give 10 tuning rows. See Appendix A for the zone sheet. To effectively use this mode the engine should have good idle vacuum, operating in ROW 1 or 2. This will maximise the number of rows available for tuning. If the engine exhibits poor vacuum use the following mode.

MAP + TPS Mode (Mixed Mode)

> ☞ The actual injector pulse width is still a function of MAP at all times, so mixed mode scheduling will ONLY effect the zone table ROW selection.

Engines using high lift, long duration cams create problems for EFI systems due to irregular, low manifold vacuum at low RPM. This results in the engine being "over fuelled" since the MAP sensor interprets the poor vacuum as the throttle being mostly open, when in fact, the throttle is closed on the idle stop. Although the over-fuelling can be tuned out using the ZONE FUEL table, the actual zone selected by the software is incorrect since the zone in use is also a function of the "incorrect" MAP signal.

To overcome the zoning problem, a Throttle Position Sensor (TPS) is used to select the current operating zone. This results in stable zone selection to allow the necessary corrections to be made in the problem areas, particularly at low RPM "idle" settings. The actual injector pulse width is still a function of MAP at all times.

Setup

With engine stationary, key on, select ROW STEPS on the Link Tuning Module and press ADJUST UP. The display should now read "ROW STEPS = TPS + MAP".

When Manifold Air Pressure (MAP) exceeds 110 kPa (1.5 PSI boost), the system will revert to MAP zoning above this value. A TPS span of 20/100 should be used so that at the cross-over point (110 kPa) there will be no sudden steps in the selected zone. I.E. The "MAP" selected zone and the "TPS" selected zone should be the same.

At this stage, refer to “typical tuning procedure” (Chp 15) and follow accordingly.

14. DIAGNOSTICS

The section provides basic engine information for diagnostic and monitoring purposes. All information is temporary stored and will be lost when ignition is switched off.

Max RPM

This menu displays the engine maximum RPM. This menu is used to check for trigger glitches, indicated by an unrealistic RPM figure.

Max Map

Displays the maximum manifold air pressure for turbo charged engines.

Max Injector Duty Cycle

Displays the maximum duty cycle of the injector. If this value is between 90 – 95% the fuel system is struggling to supply enough fuel to the engine. A value of 99% means the fuel system cannot deliver the required fuel.

Sync/Cyl Err. xx

The menu displays a counter, which is incremented every time any inconsistency is found between the “expected” Sync/Cyl Ratio and the measured ratio. A value of 1 or 2 may be observed on startup. This is normal as the ECU is just beginning its triggering sequence.

This counter can be useful when trying to fault find engine misfire under load. Simply observe the counter value before and after misfire. If the value has increased a triggering anomaly has occurred.

15. TYPICAL TUNING 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	20	(Throttle closed)
OFFSET (38)	40	
MASTER FUEL	89	
RPM LIMIT	7300	
MAP LIMIT	210 kPa	
ADV LIMIT	27	
KNK ( )	ON	
KNK SENS (0)	150	
ACCEL Z = 1	26	
COLD (88)	0	
VOLTS V = 13.8	15	
STORE		(Both Adjust together)
RELOAD		(Both Adjust together)
ZONEFUEL 105	94	(Row 1, 500 - 1,000 rpm)
ZONE IGN 105	11	
ROWFUEL (1)	94	
INJ=1% OXY=81		(OXY may be varying)
LAMBDA	OFF	
IDLE (38%)	800*	(* shows throttle closed)
CAM RPM	2000	
FAN CONTROL	94º	
BOOST 200 kPa		
WGATE SENS	5	
WG BASE	43	
WG RPM	3500	
EDIT Z 0	35	(Editor @ zone 0 “CLAMP”)

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

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

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. CLAMP 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 both ADJUST buttons 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 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.

10. Select ROWFUEL. Run the engine in each of the ten rows (load rows) and adjust for optimum performance. Refer to the Zone Sheet in Appendix A to see the MAP which each row spans. Adjustments should not be necessary unless significant changes have been made to the engine or fuel system.

11. Select ZONEFUEL. The engine should now be operated throughout the entire power range and the UP/DOWN ADJUST buttons 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.

12. Select Zone Ignition. 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 GTSLink will automatically remove up to 6º advance from any zone if the "KNOCK" system is turned on.

13. Select ACCEL. Run engine at idle and snap open throttle. Adjust for cleanest 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 eg ZONEFUEL value is probably too low. DO NOT use ACCEL to cover up lean ZONEFUEL values.

14. 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:

    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. Enter both these numbers in the Idle Menu

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.

15. Assuming all the above operations are completed successfully, allow the engine to cool down completely (preferably overnight). Select COLD from the *FUEL AUXILIARY* menu and restart engine. Adjust as required for clean operation remembering. "STORE" after setting.

16. ADDITIONAL TUNING TIPS

1. Large steps between zones are permitted since the GTSLink System interpolates (i.e. calculates intermediate values) on all tabled data.
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 GTSLink System can produce millions of possible combinations so keep trace.

17. STORING & EDITING VALUES

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

Only adjust FUEL, IGNITION and BOOST zones in the zone editor. ALL other functions should be changed in their corresponding menu outside of the zone editor.

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 Sheet in Appendix A. 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.

18. TUNING PORT

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

The fourteen pin connector located at the top left-hand corner of the circuit board (Figure 18.1). It 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.

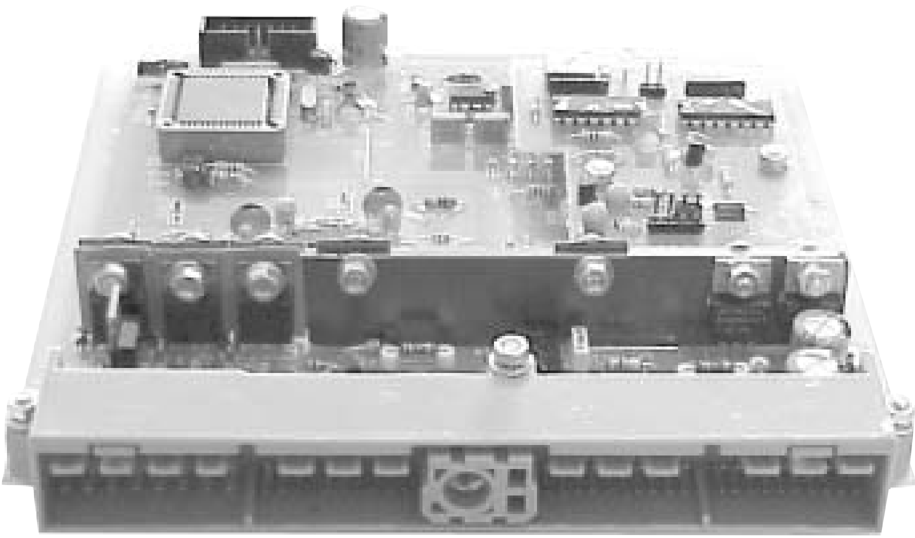
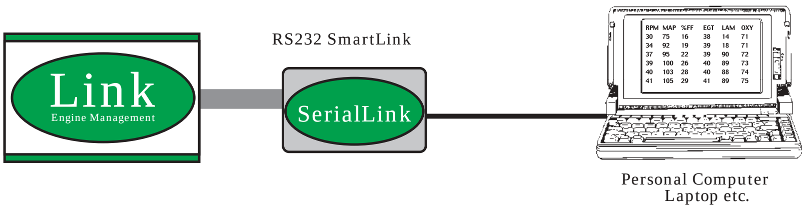


Figure 18.1. GTSLink

Link Tuning Module

The Link Tuning module allows all aspects of fuel, ignition, boost and utility functions to be adjusted, edited and stored. Detailed instructions are included elsewhere in this manual.

SerialLink



The SerialLink allows two way communication between the GTSLink and a personal computer via the PC's RS232 serial port for data-logging and tuning the GTSLink settings. It is required for Comlink and PClink.

ComLink

While the engine is running a data 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. The DOS based software used to view and store this data is called "Comlink" and can be copied from the CD supplied with the GTSLink (Alternatively it can be downloaded from our web site www.link-electro.co.nz). Place the CD in the CD ROM drive and select the directory "PCLink\PCLink Software Installer\Comlink.exe". Copy comlink.exe to the hard drive where the program can be executed. Connect the 14 way flat ribbon cable between the GTSLink and SerialLink. Next connect the standard serial cable between the SerialLink and an available COM Port on the PC. Now start Comlink. There are 2 setup options

- First select the correct COM Port. Use the keyboard buttons Q & A to change the settings. Once configured press the Enter button on the keyboard
- Next select the correct baud rate using the Q and A Keys.

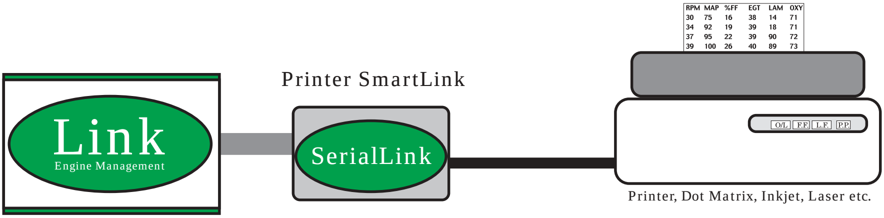
  Select 9600 baud.

  Once configured press the Enter key on the keyboard
- Switch the ignition key ON. The initial data dump will be in the same format as the Zone Table shown in Appendix A. The first 3 rows are configuration and tuning functions. Next is the Fuel table, followed by the ignition table, and lastly the boost table.
- Now start the engine and observe the runtime data. Follow the onscreen help for storing this data.

PCLink

This Windows based software allows the GTSLink and a PC to perform 2-way communication using the SerialLink. Once the PCLink software has been installed from CD the GTSLink can be tuned from laptop or personal computer. See Section 19 for software installation and hardware setup.

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.

19. WINDOWS PC TUNING

The GTSLink offers PC/Laptop tuning using PCLink Software. A copy can be found on the CD supplied with the computer or from our web site: www.link-electro.co.nz. It allows real time 2-way communication between the GTSLink and Laptop computer.

Installing PCLink Software from CD

- Insert PCLink CD into the CD ROM drive.
- The software in located in the "PCLink\PCLink Software Installer\Setup.exe" folder.
- Double click on the "setup.exe" file and follow the installation instructions.

  During the installation process a PCLink icon will be generated and placed on the desktop. To start, simply double click on this icon.
- For detailed information on the operation of the PCLink software, start the program and read the online Instructions.
- A Tutorial is also available and can be copied from the CD in directory, "PCLink\PCLink Tutorial\PCLink_Tute.pdf". This is PDF file, which requires Acrobat reader.

PCLink hardware connection.

This requires one 14-way flat ribbon cable, one SerialLink, one standard serial cable and a PC.

- Connect one end of the ribbon cable to the Link Tuning Port, the other end should connect to the SerialLink.
- Take a standard serial cable and connect one end to the SerialLink. Connect the other end to an available COM Port on the PC.
- Start the PCLink Software by double clicking on the desktop icon or using the START, programs menu.

- Switch the ignition on which will power up the GTSLink

  NOTE: The SerialLink should ALWAYS be connected before the ignition key is switched ON.

- The PCLink offers both mouse and keyboard control. To start the connection between PC and GTSLink using the mouse, move to the "Link Control" menu and select "Connect Link". Alternatively, using the keyboard, press and hold the Ctrl, Alt and L keys. This will bring up an "Options" box. Check the following settings
- Make sure the Link Connection shows "ONLINE"
- Select the correct COM Port
- Click the OK button. Once the PC is communicating with the GTSLink, tuning can begin. Remember to STORE any changes before disconnecting the PCLink software from the GTSLink.

APPENDIX A Zone Sheet Vacuum/Boost

GTSLink – Plug In Engine Management

PCLink / Link Tuning Module

Offset	Master	R Lim	M Lim	A Lim	Mode1		Volt	Idle		TPS Low	TPS High	Boost Control Sens	Boost Control Knock	Boost Control Base	Boost Control RPM	Cold	O'Run	Id Hot	IdCold
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

AirC	Drive	Acceleration 2,000	Acceleration 4,000	Acceleration 6,000	Acceleration 8,000	Dither						KStart	KRate	Crank	WPulse	WWidth			
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39

		Launch L Rpm	Launch L Rise	Launch L Retard															
40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59

Zone Fuel

0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 8,000 9,000 10,000

kPa																				
30	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195
60	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	185	290	295
90	300	305	310	315	320	325	330	335	340	345	350	355	360	365	370	375	380	385	390	395
120	400	405	410	415	420	425	430	435	440	445	450	455	460	465	470	475	480	185	490	495
150	500	505	510	515	520	525	530	535	540	545	550	555	560	565	570	575	580	585	590	595
180	600	605	610	615	620	625	630	635	640	645	650	655	660	665	670	675	680	685	690	695
210	700	705	710	715	720	725	730	735	740	745	750	755	760	765	770	775	780	785	790	795
240	800	805	810	815	820	825	830	835	840	845	850	855	860	865	870	875	880	885	890	895
270	900	905	910	915	920	925	930	935	940	945	950	955	960	965	970	975	980	985	990	995
300	1000	1005	1010	1015	1020	1025	1030	1035	1040	1045	1050	1055	1060	1065	1070	1075	1080	1085	1090	1095

Zone Ignition

0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 8,000 9,000 10,000

kPa																				
30	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195
60	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	185	290	295
90	300	305	310	315	320	325	330	335	340	345	350	355	360	365	370	375	380	385	390	395
120	400	405	410	415	420	425	430	435	440	445	450	455	460	465	470	475	480	185	490	495
150	500	505	510	515	520	525	530	535	540	545	550	555	560	565	570	575	580	585	590	595
180	600	605	610	615	620	625	630	635	640	645	650	655	660	665	670	675	680	685	690	695
210	700	705	710	715	720	725	730	735	740	745	750	755	760	765	770	775	780	785	790	795
240	800	805	810	815	820	825	830	835	840	845	850	855	860	865	870	875	880	885	890	895
270	900	905	910	915	920	925	930	935	940	945	950	955	960	965	970	975	980	985	990	995
300	1000	1005	1010	1015	1020	1025	1030	1035	1040	1045	1050	1055	1060	1065	1070	1075	1080	1085	1090	1095

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Boost Control

0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 8,000 9,000 10,000

100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195

APPENDIX B Pressure Conversion

kPa (Absolute)	InHg
32	20
35	19
39	18
42	17
45	16
49	15
52	14
55	13
59	12
62	11
66	10
69	9
72	8
76	7
79	6
83	5
86	4
89	3
93	2
96	1
100	0

kPa (Absolute)	Pressure (PSI)
100	0.00
105	0.73
110	1.45
115	2.18
120	2.90
125	3.63
130	4.35
135	5.08
140	5.80
145	6.53
150	7.25
155	7.98
160	8.70
165	9.43
170	10.15
175	10.88
180	11.60
185	12.33
190	13.05
195	13.78
200	14.50
205	15.23
210	15.95
215	16.68
220	17.40
225	18.13
230	18.85
235	19.58
240	20.31
245	21.03
250	21.76
255	22.48
260	23.21
265	23.93
270	24.66
275	25.38
280	26.11
285	26.83
290	27.56
295	28.28
300	29.01