EVOLink

Plug-in, fully programmable Engine Management System
for the Mitsubishi Evo 1, 2, & 3.

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Effective April 5,1992 5 p.m.

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By Link ElectroSystems Ltd.

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1. System Installation

1. Installation.

The factory ECU is located on the passenger's side, left kick panel area. Remove the two 6mm (10mm socket) bolts, noting that several earth/ground connections use these mounting points. It is ESSENTIAL that these earth/ground terminals are properly earthed at all times.

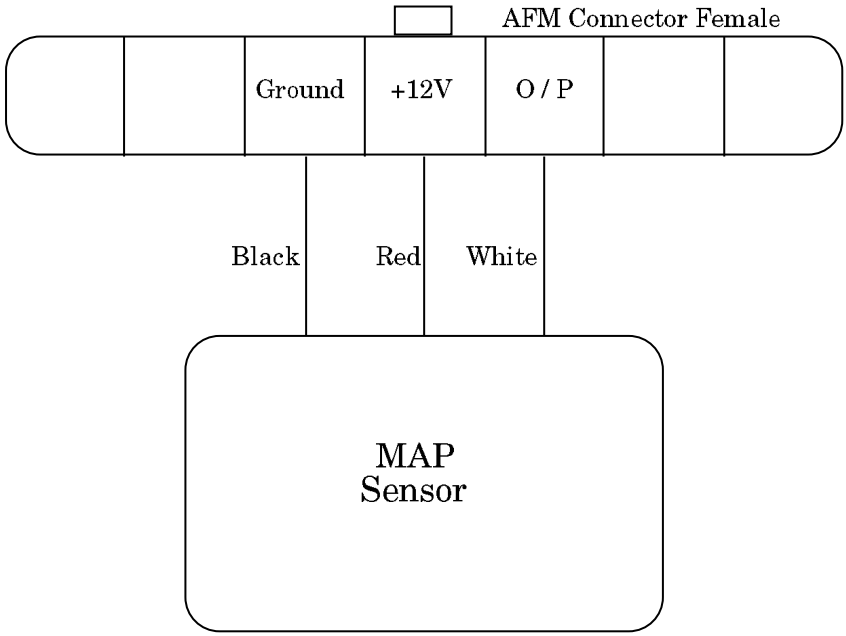
Remove the factory ECU from vehicle and remove the lid. The printed circuit board is retained with 4 screws. Substitute the original for the retro but leave cover off computer for tuning purposes. Refit ECU back into the vehicle.

MAP sensor - A manifold air pressure sensor (MAP) is supplied and must be connected both electrically and pneumatically. Since the airflow meter is no longer used, the MAP power supply and signal output use this wiring loom. The MAP sensor wiring has been terminated with small male pins for insertion into the AFM female sockets and must be correctly located for normal operation although incorrect wiring will not damage the MAP sensor in the short term.

2. Connect the pressure port of the MAP sensor to a source of vacuum/boost via a suitable length of 3 mm (1/8") vacuum tubing. This will normally be in the plenum chamber region. Beware that some "vacuum" lines in the engine bay have conditional vacuum/boost controlled by solenoids etc. After installation check operation by selecting TEST MAP (TEST menu with ADJUST DOWN switch held down) to show the TEST MAP message. This should read 102 kPa +/- 5 kPa at sea level. If this is not the case, rectify the wiring etc as required. When engine is running, MAP should read about 33..40 kPa at idle. If not, check vacuum hose for correct connection.

EVOLink uses 5° Initial Timing

(See page 14)



2. Tuning Module Functions

+ Ignition switch (key) must be OFF before installing any device. When the key is switched on, the EVOLink 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.

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. By using OFFSET to set idle and MASTER to set high power the 2 most important points of the base fuel curve can be set. After that, use ROW FUEL and ZONE FUEL to make localised corrections 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. The RPM limit has a soft limit at 200 RPM below the set value, and hard limiting (fuel and ignition cut) at the preset 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.

eg. 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 limiter only and does not invoke any actual ignition or fuel cuts.

TPS SPAN. (Throttle Position Sensor span)

Select TPS SPAN on the remote and with throttle fully closed set to "10" using the adjust keys. Open throttle fully and set the value to "100" using the same ADJUST keys. Close the throttle and reset the "10" value 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. These values must always be set unless otherwise specified.

KNOCK LIMIT.

Select KNOCK LIMIT ON/OFF and set as required by pushing either ADJUST key. The display will change to KNOCK (xxx) ON when active. The xxx value in () is a knock event counter which will count the total number of "knocks" since key on. When the system detects knock the ignition timing in the current ZONE IGNITION (one of ninety six

zones) will be reduced up to a maximum of -6 degrees per zone. Note that these corrections will not be permanent unless a STORE is carried out before key-off.

KNOCK SENS Adjusts the sensitivity of the above knock control system. Every engine has an unique noise profile from which the knock control system must extract genuine knock signals from the enormous amount of background noise. Use the ADJUST keys to set the knock target value as required. The higher the number the lower the sensitivity. If the value is set too low then the timing will be unnecessarily removed due to the rising background noise. If too high then actual knock events will be ignored. Default value = 190, max value = 255 (minimum sensitivity). The value in brackets (xxx) is the actual knock signal for monitoring and diagnostic purposes. Watch the knock counter and listen for detonation as a guide for setting.

IGNITION TIMING Experience with these engines has shown that they DO NOT tolerate much ignition advance (compared with similar engines). The default advance curve is therefore fairly conservative and based on 5º BTDC base timing. This base timing must be set as follows.

i) Start the engine and allow it to idle

ii) Select ADVANCE LIMIT and set it to ZERO.

iii) Fit a timing light to #1 cylinder HT lead and check timing.

iv) If necessary, adjust the timing by rotating the Crank Angle Sensor (CAS), located on the end of the camshaft, as required.

v) Remember to re-tighten the CAS clamp bolts after adjustment.

Drive Fuel (automatic transmission only) allows extra fuel to be added when the vehicle is in “drive”, “reverse”, etc This helps stabilise idle quality in some cases. Use just sufficient amount of this trim to cure any surge.

AIRCN FUEL similar to DRIVE FUEL above but is active when air-conditioning compressor clutch is engaged. Use just sufficient trim to cure any idle surge.

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

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 (EVOLink) 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.

CRANK ENRICH (EDIT only, zone #21). Sets the amount of extra fuel added to a cold engine during crank and for about 10 seconds post-start. Note that SMALLER numbers = MORE fuel. Default value = 60, useable range = 40..80.

COLD fuel (main menu control, or EDIT zone #16). Primarily intended as a warm-up enrich but also effective during crank. This value decays with rising engine temp, until 70 degrees where it will equal 0. If this value is decreased (say) to improve warm-up running, then it may be necessary to

increase Crank Enrich to restore cold start fueling etc. (All cold fuel enrich devices interact to some degree so some juggling of numbers may be required for ideal results.) Default value = 10%.

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, 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.

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”.

BOOST Boost target values: An extra Row of sixteen zones has been added to the zoning system to hold a 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 through the Rpm mid

range to suppress detonation and then allowed to rise at higher Rpm where detonation is less likely. These target values may be changed by using either the EDIT function to adjust each zone individually (zones 700 . . . 775), or using this "BOOST=" menu to adjust ALL targets up or down simultaneously in a manner similar to ROWFUEL.

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

+ The standard Mitsubishi boost control solenoid is generally inadequate for substantial boost increases in it's current configuration and will require modification to either the line restrictors or replacement of the modulating valve with a 3 port type.

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.

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 (>1.0 Bar).

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 sufficiently 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 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 3,500 and 4,000 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.

IDLE RPM See Chapter 5 "Idle Speed Control"

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.

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

TEST FUEL PUMP allows the fuel pump to be flow tested without the engine running. Pressing and holding the EDIT down button (in the “TEST” menu”) cause the pump to run at full power for return - line flow testing.

EVOLink uses 5º Initial Timing

Experience with these engines has shown that they do not tolerate much ignition advance (compared to simular engines). The default advance curve is therefore fairly conservative, and based on a 5º BTDC base timing. This base timing must be set as follows.

a. Start the engine and allow to idle
b. Select ADVANCE LIMIT and set to zero
c. Fit a timing light to #1 cylinder HT lead and check the timing.
d. If necessary, adjust the timing by rotating the Crank Angle Sensor (CAS) located on the end of the camshaft as required.
e. Remember to re-tighten the CAS clamp bolts after adjustment.

Storing Values

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

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)
CLAMP (38)	35	
MASTER FUEL	35%	
RPM LIMIT	7300	
MAP LIMIT	210 kPa	
ADV LIMIT	27	
KNOCK ( )	ON	
KNOCK SENS	200	
ACCEL Z = 1	10%	
COLD (88)	0%	
VOLTS V = 13.8	15	
STORE		(Both Adjust together)
RELOAD		(Both Adjust together)
DRIVE FUEL	0	
AIRCN 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*	(* shows throttle closed)
BOOST	200 kPa	
WGATE SENS	5	
WG BASE	43	
WG RPM	3500	
EDIT Z 0	35	(Editor @ zone 0 “CLAMP”)

Do not adjust the EVOLink 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 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 5º 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 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 EVOLink will automatically remove up to 6º advance from any zone if the "KNOCK" system is turned on.

14. 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.

15. Select IDLE SPEED CONTROL. Select the required idle speed by using the IDLE function to set the RPM in steps of 50 rpm.

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.

4. Additional Tuning Tips

1. Large steps between zones are permitted since the EVOLink System interpolates (ie. 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 EVOLink System can produce millions of possible combinations so keep track.

5. Idle Speed Control

This engine utilises a stepper motor for idle speed control purposes. This motor has approx. 150 steps from fully closed to fully open, but does not supply any feedback as to what it's actual position is at any given time. To this end, the software assumes that at key-on the ISC actuator is already positioned at it's normal "hot idle" position, and assigns a position value of "50" to this current position. If the engine temperature is less than 70 C, the system will add extra steps to provide a faster cold idle at start up. Once the engine is running, the software will add or subtract steps as required to meet the target RPM.

THE DEFAULT POSITION NUMBERS QUOTED HERE ARE FOR A TYPICAL VEHICLE WITH THE THROTTLE STOP SCREW SET TO THE "FACTORY" POSITION. IT MAY BE NECESSARY TO RESET THE STOP SCREW TO BRING THE ISC INTO IT'S PROPER WORKING RANGE.

Do this (if necessary) by doing several start cycles on a hot engine and allow the engine to stabilise it's idle each time. Whenever the engine achieves a stable idle ("=" sign for at least 2 seconds), AND the engine temp. is greater than 80C, AND the aircon/fans are both OFF, then the software will force the step value to "50" in order to remove any accumulative counting errors that may occur from time to time.

NOTE: The "50" step value may or may not actually be 50 steps off closed. This number is simply a reference point for the system to work with.

There are three adjustments that may be made to the system:

1. IDLE = (normal menu item on remote, Zone #8)

   Sets the required idle speed in increments of 50 RPM. A value of about 800 RPM is typical. The number in parentheses (xxx) shows the actual ISC position on a scale of 0 = fully closed, and 130 = fully open. Also, one of 5 different symbols will appear in the right-most position to show the status of the system to aid adjustment.

T = throttle not fully closed. System will set and hold the ISC position until the throttle closes. Ensure that the TPS SPAN is set to "10" at closed throttle and "100" at full throttle. The actual position that the ISC is forced to depends on a number of factors including engine temperature, air-con on/ off, and "base" setting described later in this document.

V = over-run vacuum condition. (vacuum (kPa) is less than pre-set over-run target described below). System will "default" as described above.

= the actual idle speed = the target idle speed. The step number (xxx) will be steady at this time.

+ the idle speed is less than the target value. The step number (xxx) will be increasing to compensate.

- the idle speed is above the target value. Step number (xxx) will be decreasing.

2. OVER-RUN VACUUM (EDIT only, zone #18).
Sets the vacuum value BELOW which the idle speed system will pre-set the ISC to a default (constant) positon. This will occur while the vehicle is coasting on closed throttle, and normal ISC operation will resume when vacuum rises upward toward normal idle values. Default value = 26 (kPa). If this value is set too low, then the idle system may try to make corrections while the vehicle is coasting to a stop, usually resulting in the engine stalling. If set too high, the ISC will maintain a constant position resulting in high, fixed idle speed.

3. "BASE" value (EDIT only, zone #19)
Sets the base step position from which corrections due to engine temp, air-con etc are made. Default value = 60. The ideal value results in the RPM dropping quickly to about 1000 RPM, then slowly decaying to about 800 RPM over a period of about 2 seconds. If the BASE is set too high, the RPM will drop rapidly to about 1400 RPM, and then take a relatively long time to finally stabilise at the target value. If set too low, the RPM will quickly fall to a low value and may

even cause the engine to stall. (This feature is similar to the "IDHOT" and "IDCOLD" values of the earlier, linear ISC motors)

4. AIRCON step-up (EDIT only, zone #20)
   Sets the number of "open" steps applied BEFORE the air-con clutch is engaged to prevent engine stalling with the increased load. Default value = 32.

5. FAN step-up (EDIT only, zone #17).
   Number of "open" steps applied as the radiator fans switch on. Default value = 10.

6. 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, 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. Connect the heater wires to earth and an ignition switched +12 volt supply. Typical current draw is 1 to 2 amps.

All sensors have M18 x 1.5 metric threads, and a boss will need to be welded into the exhaust manifold for mounting purposes. Handle the probe CAREFULLY since the internal ceramic material is easily cracked if sharp blows are applied. For prolonged operation on leaded fuels, a lead tolerant sensor must be used. These have a extra shroud with small gas sampling hole around the sensing tip to prevent lead deposits from fouling the sensitive material. Failure to use this type will result in inaccurate readings after several hours of running with subsequent incorrect operation.

2. The computer must have closed loop software installed for operation. Early models may be upgraded for a nominal charge.

3. A Link Tuning Module will be required for setting up all aspects of operation including both manual and automatic tuning modes.

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. Closed loop operation will only occur if the following conditions are met:

- Engine temperature above 50 C
- Engine been running for 90 seconds after start
- Manifold vacuum above 22 kPa (ie not in over-run vacuum)
- No acceleration (transient) 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)

3. The following Link Tuning Module functions will change when the LAMBDA control is switched on:

   a. MASTER:Master works in exactly the same manner as in open loop mode except the corrections are automatic and result in the MASTER value being acted upon. The ADJUST buttons have no effect, and the display shows the current MASTER value which will change as the system makes corrections.

      NOTE:Auto MASTER tuning will only occur while the engine RPM is greater than 2000 RPM, and all other closed loop conditions are met.

   b. ROW FUEL:Operation as per open loop mode except fully automatic. ROWFUEL adjusts ALL zones in the current ROW irrespective of the current RPM value. ADJUST switches have no effect, and display shows value of the current fuel zone. Operating conditions apply as per MASTER. (RPM > 2000 etc.)

   c. ZONE FUEL:Fully automatic zone fuel tuning. Operation identical to ROWFUEL except corrections effect ONE zone only, rather than the entire row. There are no RPM restrictions, but normal closed loop criteria apply

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 "target" system

The actual required fuel/air ratio is dependent on the operating conditions prevailing at the time, and is generally "load" sensitive. During operation at idle and light throttle cruise, the A/F ratio should be fairly lean in the interests of fuel economy and low exhaust emissions. At high power however, the A/F ratio needs to be richer to produce satisfactory horsepower, reduce cylinder head temperature, and control detonation. The manifold air pressure (MAP) is a good indication of engine load and is usedto select one of eight Lambda "target" values for the system to use as a reference. Each target covers an MAP span of 40 kPa which corresponds to each ROW of zones. A separate block of zones (26 .. 31) are used to store the target values, and may only be changed in the EDIT mode.

The default values loaded on dispatch were determined after much testing and should be correct for the majority of applications. The target values are displayed as a voltage which the software compares to the actual probe voltage and makes the necessary correction. e.g. 60 = 0.6 volts. Default values are shown below:

ZONE	kPa	TARGET	COMMENTS
26	0.. 40	75	high vacuum
27	40.. 80	78	idle/cruise vacuum
28	80..120	80	WOT (n/a engines)
29	120..160	84	low boost (turbo engines)
30	160..200	87	med boost (turbo engines)
31	200+	89	high boost (turbo engines)

The relationship between Lambda probe voltage and the A/F ratio is not very linear since the Lambda probe shows a steep voltage step at stoichiometric mixtures. This transition voltage indicates that no excess oxygen or fuel is present i.e chemically perfect combustion, and is the desired voltage for minimum exhaust emissions. At low to medium power, the system should be "rocking" back and forth over this transition line so that the catalytic

converter can do its job. The actual voltage at which this occurs lies between 0.4 to 0.6 volts. Tests have shown that if the target is set much below 60 (.6 volts) that undesirable idle surging will result in some engines. Some experimentation may be necessary. Above the stoichiometric point the curve flattens out as the A/F ratio becomes richer. The maximum voltage produced is normally about 0.92 volts which equates to VERY rich A/F ratios. The targets should never be set above 90 (.9 V) for this reason. As a rough guide.

VOLTAGE	%CO	A/F RATIO (approx)
< 0.6	< 1.0	> 15:1
0.72	1.0	14:1
0.76	2.0	
0.80	3.0	
0.84	5.0	13:1
0.86	6.0	12:1
0.88	8.0 +	11:1

Note that the enrichment becomes fairly compressed at higher voltages i.e. small voltage changes = large ratio changes
LAMBDA has a series of indicators to show the system's status. Note that closed-loop tuning is only available in ZONEFUEL, TEST XXX, and INJ/OXY display modes. (MASTER and ROW auto-tune

have been removed.) The sampling (and correction) rate is now indexed to the injector fuel flow so that the rate is quite slow at idle (1 correction. every 2 seconds), and faster at medium/high power (4 correction. per second).

T Timer. The system waits for 1 minute after starting before becoming active.

E Engine temp. below 70 C. System = standby

A Acceleration fuel is present. System = standby

V Vacuum is abnormally high (over-run condition). System = standby

X maX allowable correction. System is limited to a maximum of +/- 8% to prevent gross errors due to failed probe etc. This may be cleared by carrying out a STORE function which will give another 8% of trim. Be suspicious of large corrections. There may be a fault somewhere in the system. (max. trim = 3% if remote is not connected)

= Exhaust oxygen = target value. This should flash up fairly regularly.

+ System is increasing the fuel.

- System is decreasing the fuel.

NOTE: The "cruise" target (zone 27) MUST be smaller than or equal to the "power" target (zone 28). The simple interpolator used on the lambda targets will not handle negative (reverse) trends.

7. Typical tuning procedure.

1. Tune engine manually until reasonable results are achieved.
2. Turn on closed loop system (LAMBDA = ON).
3. Select ZONE FUEL and continue the process. Zone Fuel makes localised corrections throughout the entire operating range so be prepared to spend some time exploring the range, especially at low speed, light throttle where the majority of driving will occur for a street car. Remember to STORE all the corrections BEFORE turning off the engine!
4. Once tuning is complete, select the TEST function, INJ/OXY, or disconnect the Link Tuning Module. This will enable the "continuous" closed loop function to make the necessary day to day corrections on a limited range basis.

   The limited tuning range of this mode is sufficient to compensate for normal variations in temperature, fuel types, engine aging etc., but limited to prevent gross mis-fueling should the oxygen sensor or associated wiring develop a fault.

   Periodic "tune- ups" may be done by connecting the Link Tuning Module and driving the vehicle while TEST or INJ/OXY is selected, and then initiating a STORE function. The temporary corrections made during the calibration drive will then be stored, and the Link Tuning Module may then be removed.

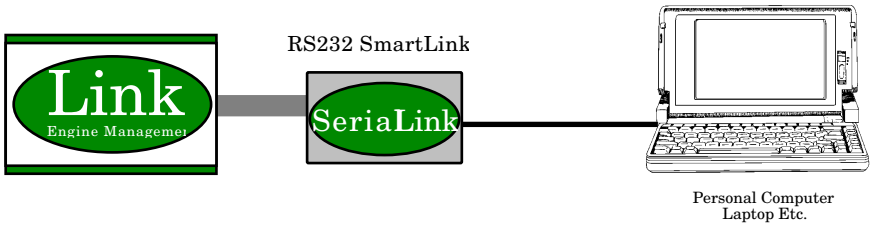
8. Tuning Port

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 Tuning Module

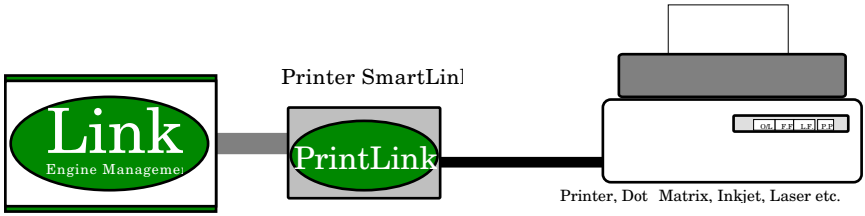
The Link Tuning module allows all aspects of fuel, ignition, boost and utility functions to be adjusted, edited and stored. A security code prevents unauthorised tampering on all adjustments except diagnostic (read only) functions. Detailed instructions are included elsewhere in this manual.

SerialLink



The SerialLink allows communication between the EVOLink and a personal computer via the PC's RS232 serial port for data-logging and downloading of the EVOLink 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.

EVOLink

Miscellaneous

Offset	Mast	R Lim	M Lim	A Lim	Mode		Volt
0	1	2	3	4	5	6	7

Idle	Fan
8	9

TPS

Low	High
10	11

Wastegate

Sens	Knock	Base	RPM
12	13	14	15

Cold	Fans	OVac	IDBase	AirS	Crank
16	17	18	19	20	21

Accel.

22	23	24	25

0 2 4 6

RPM x 1,000

Lambda Targets

Idle	Cruise	Row 3	Row 4	Row 5	Row 6
26	27	28	29	30	31

0 40 80 120 160 200

MAP (kPa)

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