

Turbo2Link

Turbo Charger System Control (Dual Coil)

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1. System Outline

The dual channel TurboLink consists of three main functional blocks within one unit:

1. **Auxiliary fueling** - Add one or more extra injectors to increase fuel flow on a fully zone-mapped structure.
2. **Retard ignition timing** on two separate channels, also fully zone-mapped, to control detonation under high boost conditions.
3. **Boost control** with sixteen fully adjustable zones allows the boost 'curve' to be tailored to suit individual requirements. Additional controls modify the response characteristics for either gentle or aggressive behaviour.

The system is adjusted with the standard Link Tuning Remote (optional extra) and comes complete with wiring loom and mounting hardware.

2. I/O Descriptions

Input Pin Descriptions

+12V (red) 12 Volt power supply ignition switch. Current drain is in the order of 0.2 amps.

SIG GND (black 1.25mm) Signal ground for the internal processing. This wire must be connected to the engine block and run as a independent wire from the PWR GND.

PWR GND (black 2.00mm) High current ground for internal power drivers. Use the engine block for a good earth point. This wire must be run separately from the signal ground. NEVER connect the two grounds together and run as a single wire.

TRIGA (green) Input signal FROM factory ECU to be retarded.

TRIGB (white/blue) Second input signal FROM factory ECU to be retarded.

Output Pin Descriptions

Fuel (orange) High current Earth sourcing drive for the auxiliary injector(s). Capable of driving up to six high resistance injectors or four low resistance injectors with appropriate ballast resistors. Maximum continuous current equal to eight Amps.

Wastegate (brown/white) Earth Sourcing drive intended to operate a wastegate solenoid control valve thus allowing programmable turbo boost control. (See later section regarding valve types and installation).

OUTA (blue) Output signal TO factory igniter. 'Retarded' version of TRIGA signal.

OUTB (green/yellow) Output signal TO factory igniter. 'Retarded' version of TRIGB signal.

3. Installation

Each function (auxiliary fuel, boost control, rpm switching etc.) may be used independently or all together as required. In all cases, the primary inputs of +12V, grounds and trigger must be connected as shown in the accompanying diagrams. The output wiring will depend on which options are used.

Injector Ballasting

If injector(s) have coil resistance greater than 6 ohms, then no ballast resistance is required. If less than 6 ohms, use a 4.7 ohm, 15 watt resistor PER injector.

MAP Sensor

The pressure port of the on-board MAP sensor must be connected to a source of vacuum / pressure via a 4 mm vacuum line. This should be taken from the inlet manifold plenum chamber or from a “mini-manifold” joining together individual runners of a multi-butterfly engine. (Never connect the vacuum line to a single manifold runner. This may damage the MAP sensor).

4. Tuning Remote Functions

Ensure that computer power (key) is OFF before connecting any Link Tuning device or improper operation will result.

TEST All functions in this mode are "read only" and have no effect on the operation of the system. There are 3 functions selected by pressing and holding the appropriate push switch;

RPM (default) displays engine RPM. Erratic or incorrect readings indicate a triggering fault or interference.

MAP (ADJ DOWN) displays Manifold Air Pressure in units of kPa. Engine stationary, value = 102 +/- 5 at sea level, typical idle = 30..40, boost pressure = >102, e.g. 200 = 15 PSI boost.

SOFTWARE ID (EDIT UP) displays the software code and programming date.

CYLINDERS Informs the computer as to the number of engine cylinders and should be set accordingly.

Note: This system is primarily intended for 4 cylinder engines using 2 dual coils. Other combinations may work, but consult your local dealer for further information.

ONSET Sets the value (manifold air pressure) at which the auxiliary injection commences. The value is expressed in kPa and may be cross referenced as follows.

<u>kPa</u>	<u>Non turbo Vacuum ("Hg)</u>
0	29"
20	23"
40	17"
80	6"
100	0"

<u>kPa</u>	<u>Turbo Boost (psi)</u>
100	0
120	3
140	6
160	9
180	12
200	15
220	18
240	21

When the MAP (shown in parentheses (xxx)) exceeds the ONSET value, fuel will start to flow from the auxiliary injectors. As the MAP or RPM increases, fuel flow will increase proportionally.

MASTER Controls overall fuel injection scheduling and is effective throughout the entire operating range from idle to full power. The scale ranges from 5..30, the higher the value, the greater the overall fuel.

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 Used during initial setup to transfer a default table into the computer zoning system. 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 computer memory and should only be used during initial setup or if you wish to restart the tuning procedure again from scratch.

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 retard 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 retard table instead. The adjustment value is shown as degrees of retard. NOTE:The retard is limited to 40°. Larger numbers than 40° may be entered but will be limited to 40°.

INJ / MAP 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 MAP displays shows the current manifold air pressure (MAP) value.

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.

Storing Values

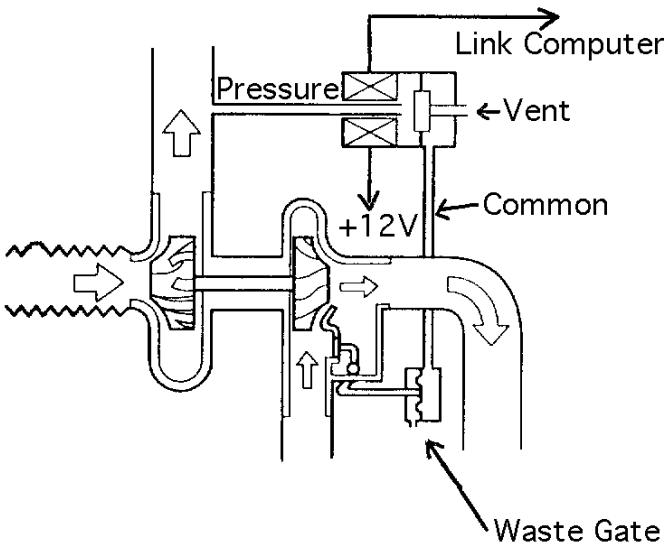
To Store select STORE. Pressing both ADJUST buttons together until display shows "*****" and then release.

5. Closed Loop Boost Control

Operation

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

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



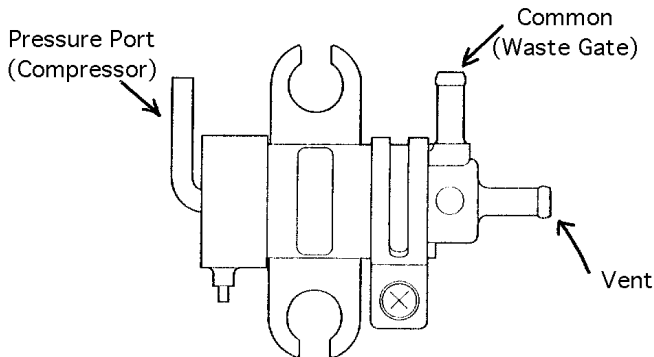
When the solenoid is de-energised the common and pressure ports are connected and compressor pressure is allowed to fill the actuator and open the waste gate. The actual boost pressure that results is entirely dependent on the waste gate construction and therefore determines the minimum boost for the system.

When the solenoid is energised the the common and vent ports are connected and the air pressure in the actuator is bled off to atmosphere causing the waste gate to close and boost pressure to rise. By varying the ON / OFF ratio of the solenoid (duty cycle) any

level off boost may be achieved and since the manifold air pressure (MAP) is being measured by the Link computer the boost may be precisely programmed and controlled.

Solenoid Types

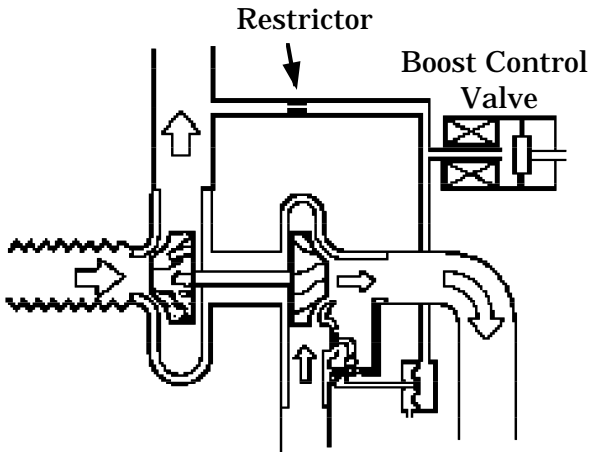
The correct type of solenoid valve must be used and devices intended for this purpose should be used wherever possible. Some types of plastic bodied units may work satisfactorily but may not withstand the constant cycling imposed upon it and subsequently fail after several hours of service. In either 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.



Three port example

Two Port Control Valves

Some OEM boost control systems use a simple two port solenoid rather than the three port type previously described (especially Nissan and Mitsubishi). These basically work as “variable bleeds” and require some form of restrictor between the compressor (pressure source) and the boost control 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 will fill and therefore move the actuator arm. If the restrictor is too large the the TurboLink 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.

Boost

Boost target values: An extra ROW of sixteen zones has been added to the zoning system to hold the target boost value for each 500 rpm interval between 500 and 8,000 rpm. This allows the boost “curve” to be tailored to suit the application. This flexibility may be used to hold the boost 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 at any time or using the “Boost = xx” mode for making changes while actually operating in that zone. Note that any changes are temporary until STORED.

Waste Gate Controls

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

i) WG BASE

This value is used for calculating a base line duty cycle which the software uses to initially guess the final value. This base line is used mainly during the turbo spool up time when the system is unable to control the boost and holds the waste gate setting close to the final (settled) value.

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

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

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

ii) WG SENS

Sensitivity Control: All closed loop (feed back) systems require an optimum sensitivity level which is a compromise between fast response time and overall stability. High sensitivity values produce fast response at the expense of instability (hunting or oscillation around the target value) and low sensitivity may result in slow settling times.

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

iii) WG RPM

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

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

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 and will only have affect when TPS is wired and the switch (SW2) is set accordingly.

6. Auxiliary Fuel Setup

1. Decide on the point at which auxiliary injection is required and set this point using the ONSET menu. EG a turbo engine may require extra fuel from 7 psi of boost and upwards. Set the ONSET to about 150 kPa. See the conversion tables to assist selection.
2. Select MASTER FUEL and operate the engine at about 75% maximum power (above the onset point). Adjust the MASTER to obtain the required fuel flow at this point. Note: MASTER fuel has a limited range of 5..30 with fairly coarse steps. It is primarily used to get the system approximately correct then use the ZONE Fuel for fine tuning.

Select INJ / MAP menu to observe the injector flow versus manifold air pressure. If injector % exceeds about 95% then larger or extra injectors may be required.

3. Select ZONEFUEL and use this control to make changes in any zones as required. ZONEFUEL has 96 zones at 500 rpm intervals arranged as a three dimensional array to allow the fuel “curve” to be tailored as required. Remember that the base fuel line has already been established using ONSET and MASTER so use ZONEFUEL only if you wish to deviate from the baseline. ie. it is not necessary to have rising values across the zones to establish proportional fuel flow.

The default values (after RELOAD) for all fuel zones = 50. Note that this does not mean that fuel flow will = 50% but rather that ZONEFUEL trim factor is at its centre value (0 = very low flow, 100 = very high flow).

7. Ignition Retard (Intercept)

This sub-system allows the ignition timing to be modified in order to control the detonation (knock) especially on turbo charged engines. The system works by applying a precision programmable delay on the signal between the factory ECU and the factory igniter. This applies to distributor based ignitions only. due to the single channel nature of the controller.

Wiring details for Intercept mode

Important: Take care to identify the correct wire between the ECU and the igniter. Refer to the factory (OEM) wiring diagram for further details.

Setup and Adjustment

1. Ensure CYLINDERS is correctly set.
2. On dispatch the ZONE IGNITION table is filled with zeros at all locations. Therefore the ignition timing remains unchanged. Programme values into the appropriate zones either by using “Zone IGN” while the engine is running or “EDIT Zi” at any time. The numbers entered represent degrees of retard over factory values.
3. The maximum retard value is 40° irrespective of any higher values programmed into the ZONE IGNITION table. Note also that no retard action occurs until 2,000 rpm. This ensures that the engine will start, idle and run at low speed without any intervention from the TurboLink (failsafe mode).
4. A small amount of ADVANCE may be added by moving the distributor or crank angle sensor to achieve (typically) an extra 5° of base timing then writing an extra 5° of retard to all (96) zones. If any zone is now set less than 5° retard then this will advance the ignition slightly.

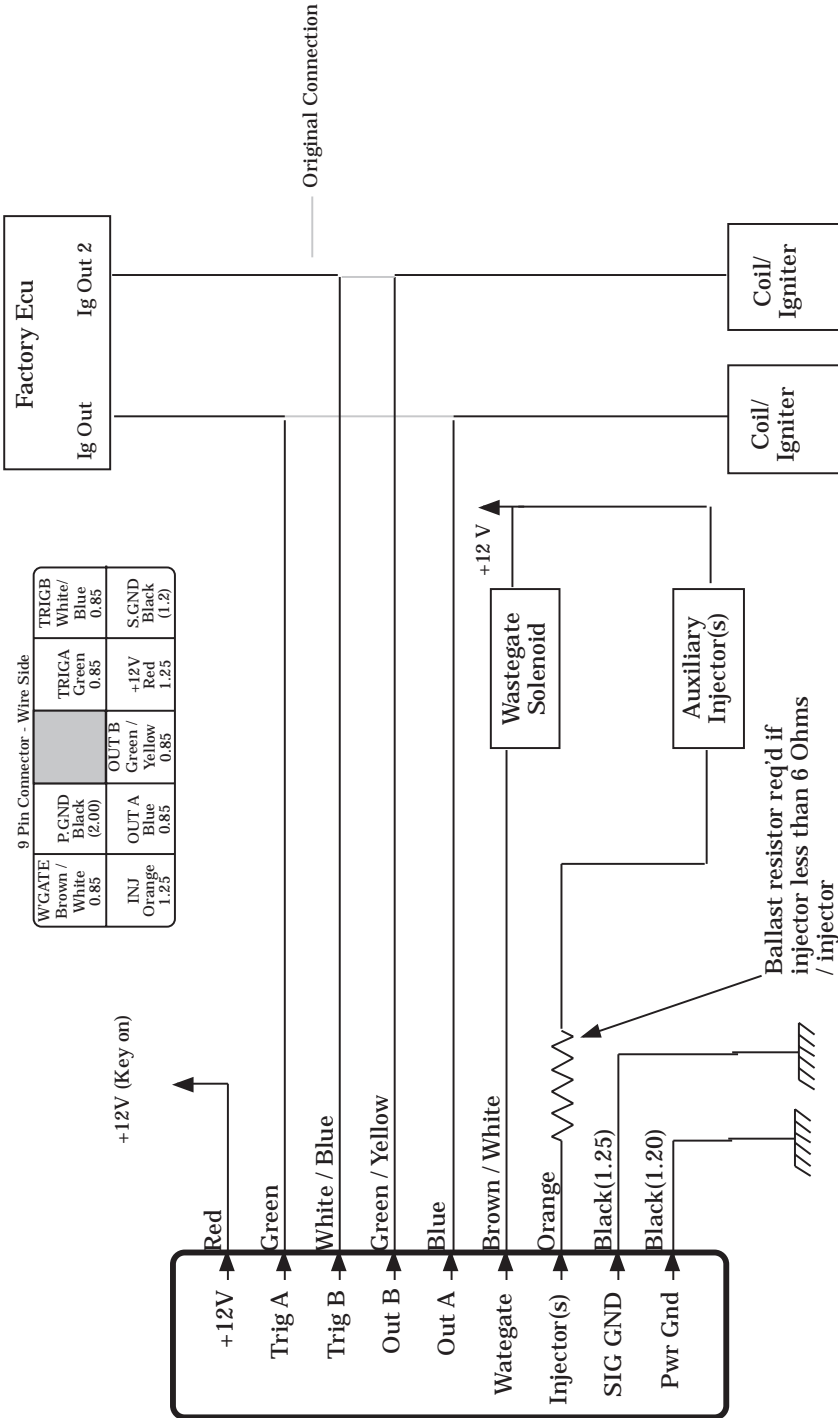
e.g. -5° (at distributor) + 5° (zone retard) = 0° (no difference)

-5° (at distributor) + 2° (zone retard) = -3° (3° advance)

Note: The system is primarily intended for retarding purposes so apply the above with caution.

9 Pin Connector - Wire Side

WGATE Brown / White 0.85	P.GND Black Black (2.00)	TRIGA Green 0.85	TRIGB White/ Blue 0.85
INJ Orange 1.25	OUT A Blue 0.85	OUT B Green / Yellow 0.85	+12V Red 1.25
			S.GND Black Black (1.2)



Ballast resistor req'd if
injector less than 6 Ohms
/ injector

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ONSET	MAST				CYL	WGRPM	WGBAS E	WGSEN		Mode	Rpm Lim				
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Acceleration

0 - 2	2 - 4	4 - 6	6 +	Decay											
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

Zone Fuel

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

Zone Ignition

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