

Turbo-Charged DeLorean Digital Ignition Timing Control Unit (DITCU)

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I have recently had a BAE Turbo Kit installed on my DeLorean. The performance of the machine was dramatically improved. My only complaints which are shared by most after market turbo owners is that when under boost with a load placed on the car, such as what occurs when accelerating up an incline, the engine would begin to ping. Ping sounds like a rapid rattling inside the engine. Additionally the low end performance seemed a bit sluggish. I attributed this incorrectly to turbo lag.

Ping occurs when the air fuel mixture burns too rapidly releasing its energy while the piston is still in the process of compressing the air fuel mixture. The entire force of the explosion is applied

directly to the piston which is unable to move downward. This is similar in effect to beating the piston with a hammer. The force rocks the piston which will eventually damage the piston rings and cylinder wall destroying the engine. This sort of repair is extremely costly. Incidentally, it doesn't take a whole lot of pinging to destroy an engine!

Maximum horse power and fuel economy are achieved when the ignition timing is advanced to a point just before ping occurs. This allows the ignited fuel/air mixture to burn completely producing maximum combustion pressure as the piston starts its downward stroke, delivering the maximum amount of energy. The "dumb" system designed into cars in the early eighties provided only vacuum and centrifugal advance as a means of adjust-

ing the ignition timing for peak engine performance. This system was adequate for the stock power plant but is wholly inadequate for a turbo-charged vehicle.

Realizing the dynamics of the combustion process it was evident that something needed to be done. The solution until now has been either to avoid using the turbo, use water injection, install an expensive intercooler, or to retard the timing.

After becoming accustomed to the advantages (power) offered by the turbo, eliminating it was out of the question. I ruled out water injection because I had heard horror stories of using this technique in a vehicle with an aluminum alloy engine. The cost and complexity of installing an intercooler was out of the question. (I understand that DeLorean Motor Center will soon offer a kit for adding an Intercooler to a car equipped with the BAE turbo.)

The last option, retarding the timing,

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seemed to be the most desirable. I re-adjusted the distributor from the 13 degree factory specification to 10 degrees BTDC. This was unacceptable as it not only eliminated the dreaded ping but significantly reduced the POWER I had become accustomed to. Well, back to the drawing board.

At last I found a solution which would prevent ping without sacrificing performance under normal driving conditions. The answer was to retard the timing, as required, only after the first signs of pre-ignition. This was accomplished by sensing preignition while still at an inaudible and harmless level. The piezoelectric element I chose to do this was, in fact, the BOSCH part used on the new turbo-charged VOLVO's.

DeLorean Timing Specifications

The following section describes the ignition timing specified for a "stock" DeLorean.

Engine RPM	Degrees of Resultant Timing	
	Advance	(degrees)
775	0	13 BTDC
1000	0	13 BTDC
2000	10	13 BTDC
3000	14	27 BTDC
4000	20	33 BTDC
6500 (red line)	20	33 BTDC

The specification for vacuum advance is:

Vacuum (in hg.)	Vacuum (PSI)	Ignition advance (degrees)
5	2.46	3
10	4.91	12
15	7.367	20

During normal driving conditions (not accelerating) the vacuum system advances the timing. As an example, at 2000 RPM the combination of preset and centrifugal advance is 27 degrees, the vacuum would cause a further 20 degree advance. The total advance is therefore 47 degrees.

With Don Stegers' help I determined that my distributor had been recurved. (The centrifugal advance mechanism had been altered.) As it turned out the BAE turbo kit installation had involved limiting the total mechanical advance through a modification to the distributor. The modified centrifugal advance mechanism resulted in the following values: (vacuum advance disabled)

Engine RPM	Degrees of Resultant Timing	
	Advance	(degrees)
775	0	13 BTDC
1000	0	13 BTDC
2000	3	16 BTDC
3000	12	25 BTDC
4000	12	25 BTDC
6500 (red line)	12	25 BTDC

The total advance at 2000 RPM for my distributor would therefore be 16, 20 or 36 degrees. Significantly retarded from the 47 degrees in the unmodified engine. This probably explains sluggishness had noticed before the turbo boost kicks in. With the recurved distributor retarding the timing by a mere 3 degrees, by turning the distributor, had eliminated the ping under all but the most severe conditions.

EICU Modification Procedure

The first step is to modify the DeLorean Electronic Ignition Control Unit (EICU). This is a \$300.00 gray electronic module located directly behind the driver's seat under the rear deck. Don't mess with it unless you know what you are doing or have a lot of spare cash! The module must be removed from the vehicle. This can be accomplished by removing two bolts which hold the sheet metal bracket supporting the oxygen sensor control unit, idle speed regulator, power antenna control relay and on the underside, the EICU. Remove the four screws supporting the EICU to the bracket. The connector can be disengaged by pulling it firmly or if too tight by lifting both sides of the spring latch then pulling the connector off. The gray cover of the module can be removed by releasing the plastic from the base, start at the end opposite the connector.

Digital Ignition Timing Control Unit Installation

Now that the circuitry is accessible the Ignition Timing Retard Module can be connected. To maintain a regulated voltage within the EICU regardless of the load placed on the electrical system by the cooling fans and other accessories I would recommend that R2 be either changed to a 100 ohm 1 watt 5% resistor or the existing 220 ohm part be paralleled with a 180 ohm 1/2 watt 5% resistor. Unsolder the end of R16 which is closest to T4 from the post. R16 is the Large Power Resistor mounted to the aluminum base plate at

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end opposite the connector. The four wires from the retard unit labeled A-D should be connected (soldered) as follows:

WIRE #	CONNECT TO:
A	The cathode end of D1 (large Black Diode)
B	Connector contact labeled 31
C	To the post to which R16 had been connected
D	To the free end of R16 (secure the resistor lead to prevent damage should the wire get tugged on accidentally the resistor lead should not be allowed to come in contact with any circuitry or the aluminum case)

The wires going to the DITCU module must be routed to prevent them from being abraded against metal parts. The gray plastic cover should be replaced and the EICU reinstalled. This completes the installation of the DITCU module. The Knock Sensor is bolted to the Engine and its cable routed through the fire wall at the rubber grommet located behind the rear panel.

Theory of Operation

Due to the higher pressures and temperatures encountered in the engine when

the turbo is operating the timing must be retarded (delayed) to prevent premature ignition of the mixture. Premature ignition causes engine PING which, if left uncorrected, will rapidly destroy the engine. The heart of the DITCU module is a phase locked loop integrated circuit. This synchronizes the digital circuitry to the incoming distributor timing pulses. The circuitry is actually phase locked on two consecutive timing pulses. The odd fire nature of the DeLorean's engine means that one spark plug fires followed by a 100 degree gap before the next plug is activated. There is a 140 degree gap to the next plug firing. This 100/140 pattern is repeated 3 times per engine revolution. To the best of my knowledge the DITCU is the only ignition timing retard module capable of operation on the DeLorean. Only upon detecting a ping is the timing altered. The first delay period would be 2 degrees of revolution at the camshaft. If subsequent pings were detected the next delay would be applied. The maximum delay will be 30 degrees which will be far more than is necessary as this would counteract the effect of both the centrifugal and vacuum advance.

The timing retard unit has the added benefit of inhibiting current flow through the ignition coil when the engine is not

running. The unmodified EICU allows 4 amps to flow through the coil when the ignition switch is in the run position, and the engine is not running.

The timing control unit is enabled by placing the switch in the delay position. The more the timing is retarded the more power is lost. However, it is better to lose a bit under boost than to rebuild an engine. This modification, like the turbo itself may affect the exhaust emissions and therefore cannot legally be installed or operated in California. This device will be inoperative during the smog test as it is performed without load on the engine, and therefore will not affect the emissions as they are presently measured in California.

If you would like to know more about this modification, please feel free to give me a call at (714) 551-9171, after 6 P.M. Pacific time. By the time this article is published there may be several service locations where you may purchase a kit and/or have this device installed. I would be happy to recommend one in your area. If your distributor has been modified, a skilled mechanic should return it to the "stock" setting. One last word of caution, with all the extra power your turbo will provide, remember what happens when the DeLorean hits 88 MPH. 