

# TECH PROCEDURE

## How to troubleshoot the Bosch L-Jetronic system using a Volt-Ohm meter

by Paul Mitchell  
PHOTOS BY THE AUTHOR



Previously, when one's Bosch fuel injection was suspected of acting up, there was one course of action—take the car to the dealer or an independent garage to have it diagnosed and repaired. The dealer usually was the only place that had the tool, known as a Bosch Analog Tester, to analyze the injection system. The Tester was available only to licensed service centers, and so was unavailable to the public and even many independent garages. That meant that if you or this unfortunate garage wanted to perform the diagnosis and repair yourselves, the only method available to you was to replace each suspected part with one that was known to be functioning properly. This requires having access to functioning test parts, and usually entails test fitting almost every component until finding the faulty part.

Though the Bosch L-Jet was one of the most reliable injection systems available at the time, when it did act up many were frustrated that this entailed a trip to the dealer, and there was no guarantee that the service technicians at the dealership even knew how to operate the Analog Tester or that their tester was functioning properly. Some attempted to perform their own diagnosis using a VOM (Volt-Ohm Meter), which is essentially what the Bosch Analog tester is, though instead of giving a numeric value to its reading as a VOM would, a "good" or "bad" indication is given. These early attempts at troubleshooting with a VOM were often more trouble in themselves, and often resulted in the car ending up at the dealer hooked up to the Bosch Analog Tester. Eventually, someone would get the numeric values for the proper functioning range of each component of the complete fuel injection system, allowing system diagnosis with a common VOM.

The following test procedures are the

complete injection system test. All that is required is a car with a suspected injection fault, a VOM, and a set of basic hand tools. Our car being tested here is our project GTV-6, as it is a prime example of 1980's Bosch injection technology, all the components are accessible, and the car was just sitting there.

A brief description of the L-jet system begins with the air-flow meter, which is equipped with a small spring-loaded door placed in the airstream. This door is wired for varying resistance based on position. As airflow past the door increases, the door is forced open, and the signal to the Electronic Control Unit (ECU) reflects the amount of relative airflow. This signal is corrected for air temperature by the air-flow meter before being passed on to the ECU. The air-flow meter also controls the current to the fuel pump: When the door is closed the fuel pump is off, and conversely, when the door is open the pump is switched on. The air-flow meter is also equipped with an idle rpm CO regulator.

The intake air, having passed through the air-flow meter, now is drawn up the intake hose to the throttle body. This is a single throttle plate, and the assembly is

BOSCH L-JETRONIC SYSTEM  
E.C.U. Plug Terminal Designations

### L-JETRONIC

Place over wiring harness plug.

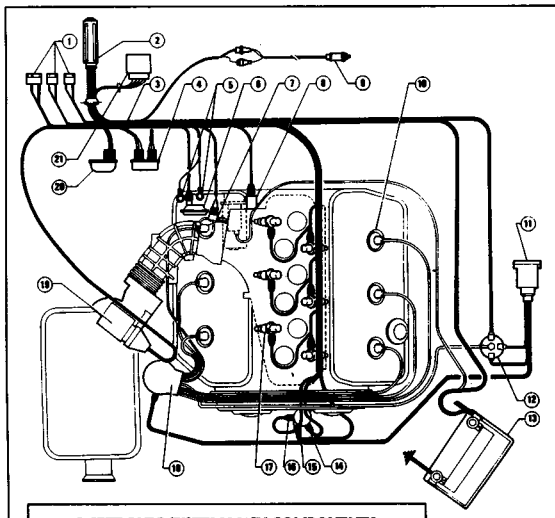
|    |     |
|----|-----|
| 19 | —1  |
| 20 | —2  |
| 21 | —3  |
| 22 | —4  |
| 23 | —5  |
| 24 | —6  |
| 25 | —7  |
| 26 | —8  |
| 27 | —9  |
| 28 | —10 |
| 29 | —11 |
| 30 | —12 |
| 31 | —13 |
| 32 | —14 |
| 33 | —15 |
| 34 | —16 |
| 35 | —17 |
|    | —18 |

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bolted directly to the intake plenum. At the throttle body is the throttle position switch, which provides throttle position information to the ECU. In early systems this is a two-position switch and so gives a less detailed account to the ECU than the switches of later systems, which are three-position switches. To tell if yours is a two- or three-position switch, manually rotate the throttle with the engine off; you should be able to hear and feel each segment of the switch click.

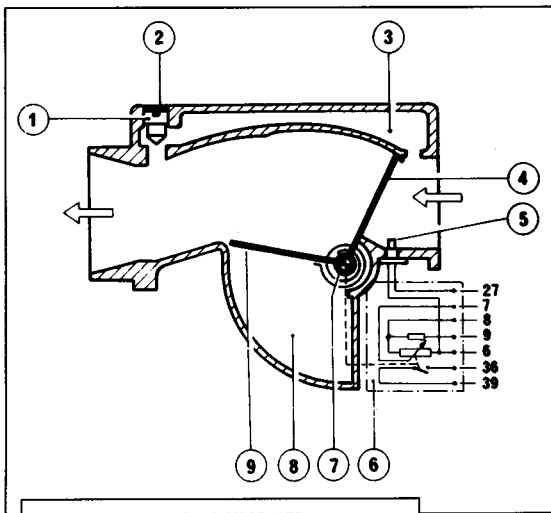
The plenum is connected to the head by separate intake runners or a manifold, and it is here that the injectors will be found—one for each cylinder. They are located in the optimum position, just upstream of the intake valves. The injectors are supplied fuel by a fuel rail, and the operating pressure is controlled by a pressure regulator. The injectors are controlled electronically for timing and duration. The duration determines the amount of fuel injected, and when it is injected is a function of timing.

The Electronic Control Unit is a small computer contained within a black box approximately eight inches by six inches by two and a half inches. It is usually



**L-JETRONIC SYSTEM MAIN COMPONENTS AND WIRING**

- |                                |   |
|--------------------------------|---|
| 1. Vehicle wiring connectors   | 12. Ignition coil                                     |
| 2. Electronic control unit     | 13. Battery   |
| 3. L-Jetronic wiring           | 14. Engine coolant temperature sensor                 |
| 4. Relay set                   | 15. Thermal contact for ignition advance control unit |
| 5. Ground terminals (common)   | 16. Thermo-time switch                                |
| 6. Auxiliary air device        | 17. Injector  |
| 7. Accelerator throttle switch | 18. Ignition distributor                              |
| 8. Cold starting               | 19. Air-flow sensor                                   |
| 9. Lambda sensor               | 20. Altitude compensation device                      |
| 10. Spark plug                 |   |
| 11. Electronic power module    |   |



**AIR FLOW SENSOR (AFS)**

- |                            |                    |
|----------------------------|--------------------|
| 1. CO adjusting tool       | 2. Sealing plug    |
| 3. By-pass                 | 4. Floating flap   |
| 5. Air temperature sensor  | 6. Potentiometer   |
| 7. Return spring           | 8. Damping chamber |
| 9. Compensating flap valve |                    |

*This diagram of the Air flow sensor shows the connector terminal order, along with the principle components.*

located within the cabin of the car to protect it from excessive abuse. Not only does it process information from the air-flow meter and throttle position switch but the following parameters as well: engine rpm, water temperature, exhaust oxygen content (via the lambda sensor), intake air pressure in relation to the altitude, and battery voltage. The information gathered

from all of these sources is used to determine the fuel needs of the engine and to maintain the correct stoichiometric ratio. All of this is done within the realm of what is called a map. The map provides the framework for the computer to base its fuel delivery curve in all operating conditions.

Also contained within the system are the following components: a cold start injector, a dashpot to eliminate pulsing caused by pressure peaks, an auxiliary air device to supply air when the engine is cold, an adjustment for idle rpm, an rpm sensor and an altitude compensation device.

One shouldn't be intimidated by the number of components or the complexity of the system. Consider that most of the sensors work by simple resistance, and that the system has few moving parts, and it all seems much easier to diagnose any potential problems. It's that the system has so few moving parts and relies on simple resistance sensors that contributes to the L-Jetronic system's reliability.

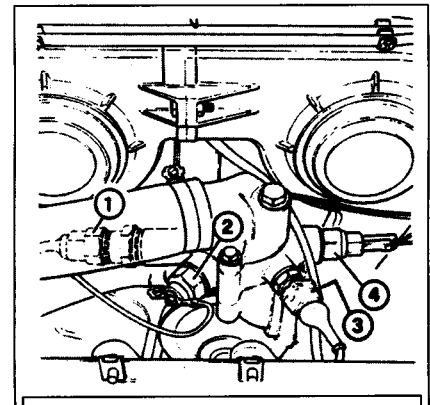
Using the harness connector at the ECU will also test the wiring harness and connectors associated with each component. **The ignition must be OFF when disconnecting the ECU or system damage will occur.**

Special thanks to Tom Tompkins of the Alfa Romeo Library of California, who provided reference material and invaluable advice in the writing of this article. The library and its services are an asset beyond value to those who are interested in Alfa Romeo and its history and any enthusiast of European automobiles.

**Tech Procedures**

**Warning: The ignition must be OFF when disconnecting the ECU or system damage will occur.**

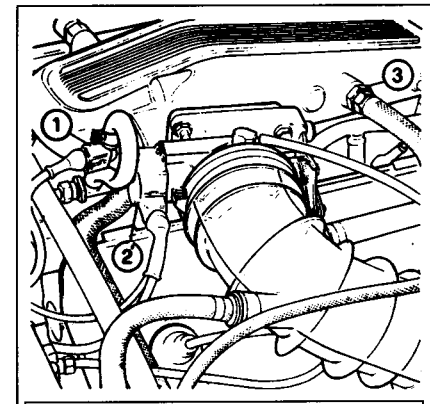
Use the L-Jetronic template provided to determine the terminal number. Cut out the template and place over the harness connector at the ECU. The template will



**THROTTLE POSITION SWITCH-DECELERATION FUEL CUT-OFF**

- |   |  |
|---|--|
| 1. Thermo-time switch                   | 2. Ignition coolant temperature sensor           |
| 3. Injection coolant temperature sensor | 4. Coolant temperature indicating device on dash |

*These are the sensors located at the thermostat housing.*



**BY-PASS FOR IDLE SPEED ADJUSTMENT**

- |   |                    |
|---|--------------------|
| 1. Cold start injector                      | 2. Throttle switch |
| 3. Nut for idle-speed adjustment on by-pass |                    |

**only align one way; if the numbers and lines do not correspond with the terminals, the template is installed inverted.**

**Electronic Control Unit**

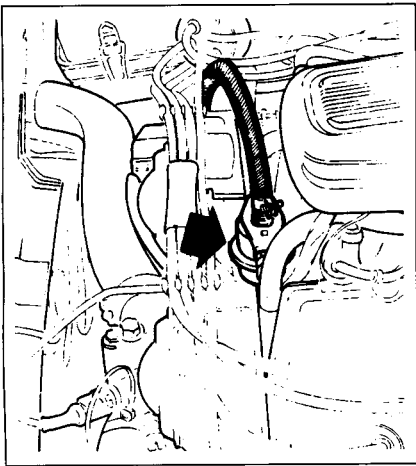
It is impossible to field test the ECU by any means other than substitution. If all other related components have been eliminated as possible defects, substitute a known good unit to make a positive diagnosis.

**Air Flow Meter, Fuel Pump Contacts**

Disconnect the plug at the air flow meter. Measure the resistance between terminals 36 and 39. At rest (flap closed) there should be infinite resistance; depressing the flap should cause a transition to 0 Ω. If different, replace the air flow meter. With the air flow meter reconnected and the switch in the "on" position, depressing the flap should activate the fuel pump. If this does not occur, check the power supply and relay set. If

## L-JETRONIC FUEL INJECTION

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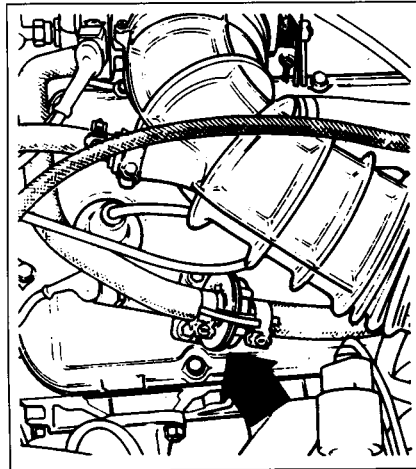


The fuel pressure regulator, seen here, is located in front and beneath the plenum.

they are in working order, the contacts for pump activation are faulty, requiring replacement of the air flow meter.

### Voltage Supply & Relay Set

With the ignition switch **off**, disconnect the ECU plug. Turn the ignition switch to the "on" position and test for battery voltage (11 - 12.5 v) between terminal 10 (system +) and terminal 17 (ground). If supply is less than 11v, check

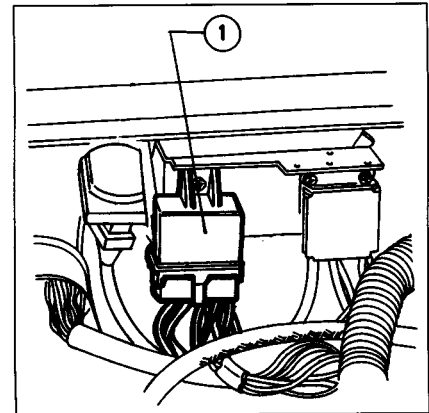


Here's the auxiliary air device, located on the left side of the engine, under the intake hose.

for excessive resistance in wire 10, wire 17 or at the relay connector. If supply is 0v, check for an open from the relay to the ECU. Also check for voltage at terminals 86a and 88y of the relay. Replace relay as necessary.

### Main Relay

With ignition on, terminals 88a, 88c, and 88z should all have battery voltage (11 - 12.5v) with respect to ground termi-

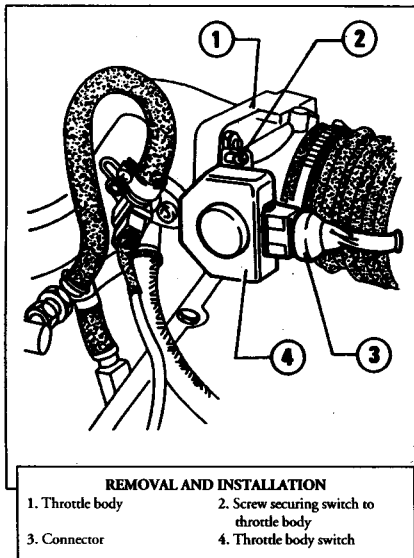


The arrow indicates the relay set located against the rear firewall. to the left is the altitude compensation device.

nal 85. If no system voltage is present, the main relay is defective.

### Fuel Pump Relay

Turn the ignition on and check resistance between ECU terminals 20 and 17. Specifications are 52-78  $\Omega$ . Should the results be outside these values, test for continuity from ECU terminal 20 to relay terminal 86b, and continuity from relay terminal 85 to ground. If continuity exists, relay is defective.



### Starter Connection—Start Signal

Crank the engine and measure the voltage from ECU terminal 4 to ground terminal 17. If the starter operates but no voltage is present at terminal 4, check continuity between relay terminal 86 and ECU terminal 4 and continuity between starter terminal 50 and relay terminal 86a.

### Coolant Temperature Sensor

Resistance measurements taken between terminals 13 and 17 should be as follows: engine coolant temperature in degrees F 68F - 2-3K  $\Omega$ ; 176F - 250-400  $\Omega$ ; 14F - 7-12k  $\Omega$ .

If readings deviate, test resistance at the sensor or remove the temperature sensor and bench test with properly measured and heated water.

### Thermo-Time Switch

A series of tests will determine the switching accuracy of this device. The main objective is to note the change with engine temperature. If the engine is cold, the thermo-time switch can also be tested for duration of operation (max. 9-13 sec.)

Resistance should be as listed:

Terminal G to ground: engine temperature below 86F = 25-40 ohms; engine temperature above 104F = 50-80 ohms.

Terminal W to ground: engine temperature below 86F = 0 ohms; engine temperature above 104F = 100-160 ohms

Terminal G to W: engine temperature below 86F = 25-40 ohms; engine temperature above 104F = 50-80 ohms

### Cold Start Injector

If the thermo-time switch is function-

ing, the cold start injector should fire for a brief period when a cold engine is cranked.

### Auxiliary Air Valve

In addition to response to engine temperature, the bi-metallic element in the auxiliary air valve is heated electrically by means of a heating coil. Should the duration of the fast idle be excessive during warm-up, test the heating coil for continuity.

### Throttle Position Switch

Fitted to the throttle housing is a microswitch that signals the ECU when mixture enrichment is required for fast acceleration. Test between ECU terminals 18 and 3 for the transition from infinite to 0 ohms when the switch is activated.

### Injector Valves

The windings of each injector valve should have a resistance of 2-3 ohms. Defects usually appear as open or shorted windings. ❌

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