1974-79 FUEL SYSTEMS
Bosch AFC Fuel Injection – Japanese

Datsun: 1975-79 280Z, 280ZX, 810
Toyota: 1979 Supra

DESCRIPTION

The Bosch Air Flow Controlled (AFC) electronic fuel injection system uses sensors to detect engine conditions. System consists of airflow meter, various sensors and switches, air cleaner assembly, Electronic Control Unit (ECU), throttle chamber, air and pressure regulators, injectors and connecting wires and hoses. The ECU receives sensor signals to determine amount of fuel and length of time that fuel is to be injected into engine.

An airflow meter, mounted between the throttle chamber and air cleaner, measures amount of intake air. Fuel injector on time is based on amount of intake air required for one rotation of engine. System maintains a constant fuel pressure and accurately balances air/fuel mixture under all operating conditions.

An automatic altitude feature is used on all models. The intake air sensor transmits air flow information to the ECU while the distributor supplies engine RPM data. Toyota Supra models incorporate an oxygen sensor into the Bosch AFC fuel injection system. The system consists of an oxygen sensor mounted in the exhaust manifold, a modulating or frequency valve, a 3-way catalytic converter and a modified electronic control unit.

OPERATION

Fuel under pressure from electric fuel pump, flows through a pulsation damper and fuel filter and is injected into intake manifold branch to mix with incoming air. Surplus fuel returns through a fuel pressure regulator to the fuel tank.

A pressure regulator controls fuel pressure so that a constant difference of 35 psi (2.55 kg/cm²) exists between fuel pressure and intake manifold vacuum. To aid in cold engine starting, a cold start valve is activated by a thermo-time switch to increase quantity of fuel to be injected.

Each engine cylinder is supplied fuel by an injector. Ignition signal from ignition coil determines frequency of injections while the ECU determines length of each injection.

Air is drawn in through air cleaner and is measured by the airflow meter. Air then travels through throttle chamber and into intake manifold. A throttle valve in the chamber controls air flow while driving.

At idle, throttle valve is almost closed and air is drawn through a bypass port in throttle chamber. Idle speed adjusting screw controls quantity of air intake at idle. During warm-up operation, extra air is bypassed through air regulator to increase engine RPM.

The oxygen sensor detects the amount of oxygen in the exhaust gases. If the sensor senses too much or too little oxygen in the exhaust gases, a change in voltage is produced in the sensor and is transmitted to the ECU. The ECU then changes the amount of fuel injected by using the modulating valve to vary the length of time injectors are on. This varying injection time leans or richens the air/fuel ratio, keeping the air/fuel ratio very close to the stoichiometric value of 14.5 to 1.

AIRFLOW METER & POTENTIOMETER

The throttle valve housing provides a method for air to enter engine under controlled conditions. The throttle valve sliding switch is a potentiometer which functions as a sensor for informing Electronic Control Unit (ECU) of throttle valve position.

During starting, fuel pump receives power from starter solenoid through fuel pump relay. Once engine starts, fuel pump relay receives power contact in potentiometer section of airflow meter. Fuel pump contacts turn on only after flap in airflow meter opens. Contact turn off when airflow meter returns to closed position.

INTAKE AIR SENSOR

The intake air sensor provides the control unit with voltage signals. The intensity of these signals, depends upon intake air volume and air temperature. The incoming air moves the stator flap against the force of the return spring.

As more air is drawn in, stator flap opens even more. This rotary motion of the stator flap actuates a potentiometer and thus varies the strength of the signal sent to the Electronic Control Unit (ECU).

Connected to the stator flap is a dampening flap which prevents rapid oscillations of the stator flap. *See Fig. 1.* One of the contacts on the potentiometer operates the fuel pump as the stator flap is opened by air flow. This sensor is an integral part of the potentiometer and its operation modifies signal sent to the ECU.

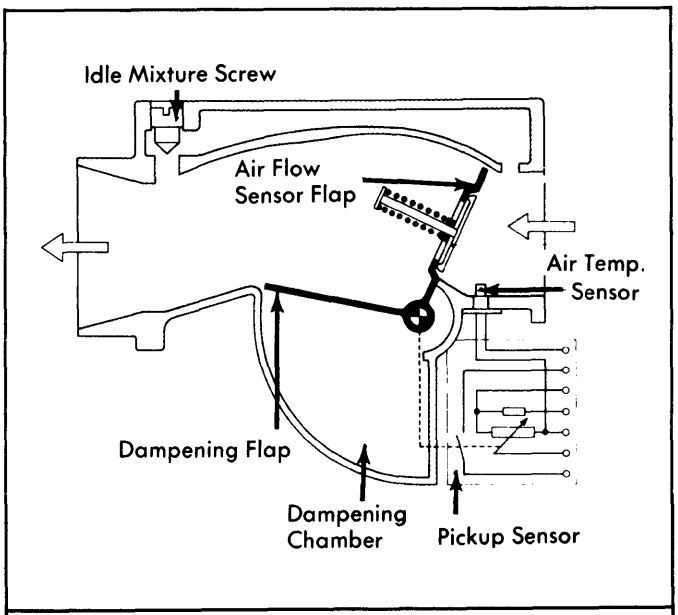

Fig. 1: Airflow Meter & Intake Air Sensor

ENGINE COOLANT SENSOR

This sensor provides the ECU with engine temperature information relating to cold starting and warm-up enrichment operation. The temperature sensing unit uses a thermister which is sensitive in the lower temperature ranges. Electrical resistance of the thermister decreases as coolant temperature rises.

THROTTLE VALVE SWITCH

Throttle valve switch is attached to throttle chamber. Accelerator pedal movement activates the switch which has 2 sets of contact points. One monitors idle position and the other monitors full throttle position. Idle contacts close when throttle valve is positioned at idle and open when it is at any other position. *See Fig. 2.*

Full throttle contacts close only when throttle valve is positioned at full throttle (at more than 34 degree opening of valve). Throttle valve switch compensates for enrichment at idle and after idle, and at full throttle positions. Idle circuit of switch also is responsible for sending out the fuel cut-off signal.

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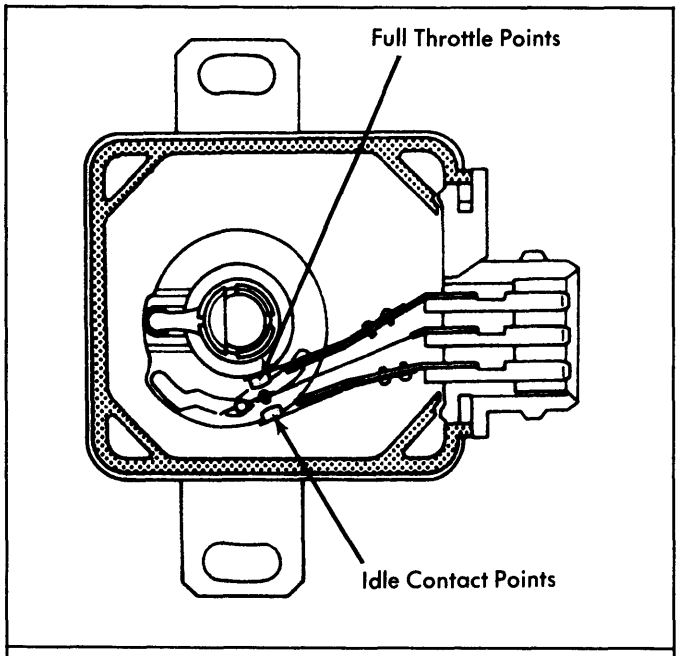

Fig. 2: Throttle Valve Switch (Datsun Shown)

ELECTRONIC CONTROL UNIT

The Electronic Control Unit (ECU) is a pre-programmed computer. Its function is to process the incoming signal from each sensor to determine air volume (by airflow sensor), engine speed, engine temperature, air temperature and throttle position. From this information, ECU determines correct injection time and quantity.

PRESSURE REGULATOR

The non-adjustable pressure regulator controls fuel pressure, maintaining a constant 35 psi (2.55 kg/cm²) difference between fuel pressure and intake manifold vacuum. Fuel exerts pressure against spring-loaded diaphragm, which deflects uncovering return line to fuel tank. Engine vacuum also works with fuel pressure against diaphragm when high vacuum is present. Diaphragm then deflects at about 28 psi (2.0 kg/cm²) instead of 35 psi (2.55 kg/cm²).

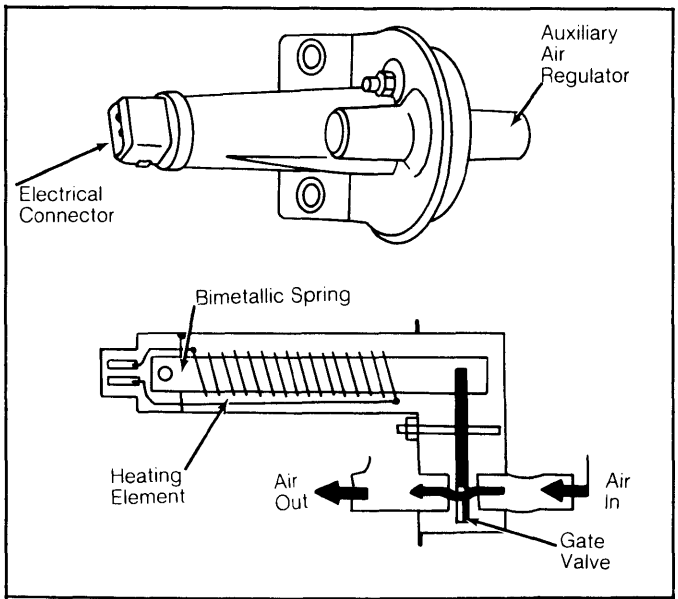

Fig. 3: Auxiliary Air Regulator (Datsun Shown)

AUXILIARY AIR REGULATOR

During cold starting and engine warm up, more air and fuel are required. The auxiliary air regulator opens when engine is cold and provides the additional air required. The additional fuel is provided by the cold start valve. As engine warms up, the auxiliary air regulator slowly closes, cutting off additional air. Valve closes by an electrically heated bimetallic spring on Datsun, by coolant temperature on Toyota. *See Fig. 3.*

THERMO-TIME SWITCH

The thermo-time switch controls the time the cold start valve is switched on. This time limit is usually between 5-20 seconds depending upon engine. The switch has a bimetallic contact, surrounded by a heating coil. The heating coil receives current during cranking. The bimetallic contact breaks the ground circuit of the cold start valve whenever the heating coil is about 95°F (35°C) or when the delay time is up. Delay time is shortened as temperature raises.

PRE-RESISTORS

The purpose of the pre-resistors, if used, is mainly to reduce the response time of the injectors. The pre-resistors are connected in series between the injectors and the dual relay.

DUAL RELAY

The dual relay is composed of 2 relays which control current supply for entire electronic fuel injection system and which disengages system (electrically) from battery when ignition is turned to off position. When ignition switch is on, the main relay points close, providing voltage to the ECU and pre-resistors (if used) of the electronic fuel injection system. The other relay within the dual relay, controls current to the electric fuel pump. These points close during cranking and when points of air flow valve are closed. This design is to cut off current to fuel pump in the event that engine stops (airflow meter closed).

ADJUSTMENTS

OXYGEN SENSOR WARNING LIGHT

Toyota – 1) The oxygen sensor maintenance interval light is located on instrument panel. Light will come on after 30,000 miles, indicating need for oxygen sensor replacement.
2) After oxygen sensor replacement, reset the oxygen sensor warning light switch. Switch is located beneath switch cover on pedal assembly, below instrument panel.

THROTTLE VALVE SWITCH

1977-78 Datsun – 1) Disconnect negative battery cable. Disconnect throttle valve switch connector. Connect ohmmeter leads between terminals No. 2 and 18 of throttle valve switch.
2) Continuity should exist when throttle valve is in idle position. No continuity should exist when valve is opened to about 4 degrees. Now connect ohmmeter leads between terminals No. 3 and 18.
3) Gradually open throttle valve from fully closed position. Ohmmeter reading should be at its lowest point at about 34 degrees of throttle valve rotation. If ohmmeter reading is greater at all other valve positions, throttle valve switch is okay.
1979 Datsun – 1) With engine running at idle, disconnect throttle valve switch connector. Connect ohmmeter leads between terminals No. 29 and 30 of throttle valve switch. DO NOT connect ohmmeter to throttle valve switch wire connector or damage to ohmmeter may result.
2) With engine at idle, ohmmeter should indicate zero ohms. Increase engine speed to 1400 RPM (900 RPM on Federal 810 models). Ohmmeter reading should go from zero ohms to infinity reading. If ohmmeter readings are correct, go to step **5)**. If incorrect, go to next step.
3) Turn engine off and disconnect negative battery cable. Place specified size feeler gauge between throttle valve stopper screw and throttle valve shaft lever. See THROTTLE VALVE SWITCH ADJUSTMENT table.

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4) With correct thickness feeler gauge inserted, turn stopper screw counterclockwise until zero ohms is indicated on ohmmeter. Then, turn screw clockwise until ohmmeter reading goes to infinity. Reconnect negative battery cable, start engine and repeat step **2)**.
5) Turn ignition off and disconnect negative battery cable. Connect ohmmeter leads to throttle valve switch terminals No. 24 and 30. With throttle valve closed, ohmmeter should indicate infinity. With throttle valve fully open, ohmmeter should indicate zero ohms. If not, replace throttle valve switch.

THROTTLE VALVE SWITCH ADJUSTMENT

Application	Feeler Gauge Thickness
810	
Federal	.020" (.5 mm)
Calif.	.047" (1.2 mm)
280ZX	.051" (1.3 mm).

1979 Toyota – 1) Fabricate angle gauge to dimensions shown. *See Fig. 4*. Insert gauge in throttle valve to obtain either a 55 degree or 65 degree throttle angle. Check continuity between IDL-TL, IDL-PSW, and PSW-TL switch terminals.
2) At 55 degree throttle opening, there should be no continuity between any terminals. At 65 degree throttle opening, there should be continuity between PSW-TL switch terminals. If incorrect, go to next step.
3) Loosen adjustment screws and insert a .020" (.52 mm) feeler gauge between throttle stop screw and lever. Connect ohmmeter between IDL-TL switch terminals. Ohmmeter should show continuity. Gradually turn switch assembly counterclockwise until ohmmeter deflects and tighten screws. Remove feeler gauge.
4) To recheck, insert a .017" (.44 mm) feeler gauge between throttle stop and lever. Ohmmeter should show continuity. Now, replace this feeler gauge with one that is .026" (.66 mm) and check continuity. There should be no continuity.

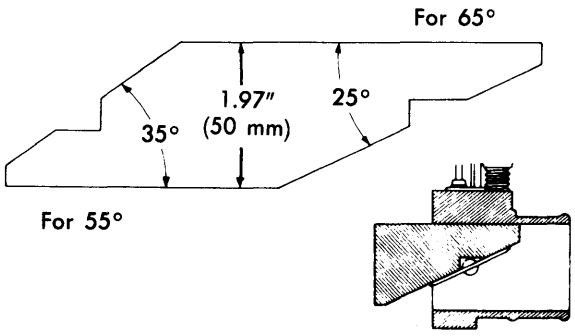

Fig. 4: Throttle Valve Angle Gauge (Toyota)

TESTING

NOTE: The fuel injection system maintains constant fuel pressure in fuel lines and components parts at all times. Be sure to relieve pressure before attempting to open system at any point for testing.

FUEL PRESSURE

1975-78 Datsun – 1) Disconnect cold start valve connector. Release fuel line pressure by connecting terminals of cold start valve to battery terminals for 2-3 seconds, using jumper wires. *See Fig. 5*.
2) Connect fuel pressure in cold start valve fuel line. Start engine and check fuel pressure. If pressure is not as specified, check for leaking fuel lines and/or replace fuel pump.
1979 Datsun – 1) Disconnect ground cable from battery and release pressure in fuel system. Connect fuel pressure gauge between fuel tube and hose to fuel filter. Disconnect lead wire from "S" terminal of starter.
2) Connect ground cable to battery and turn ignition on to operate fuel pump. If pressure is not as specified, replace fuel pressure regulator and repeat test. If pressures are still below specifications, fuel pump is defective.
1979 Toyota – 1) Warm engine to normal operating temperature and turn it off. Disconnect negative battery cable. Release pressure from main fuel line at cold start valve and connect pressure gauge to hose. Disconnect and plug vacuum hose from pressure regulator.
2) Reconnect negative battery cable and start engine. Gauge should read approximately 35 psi (2.5 kg/cm²) or at least 33-38 psi (2.35-2.65 kg/cm²). If within specifications, repeat test with vacuum hose connected.
3) Gauge should read approximately 28 psi (2.0 kg/cm²) or at least 26-30 psi (1.85-2.15 kg/cm²). If pressure is too high or too low in either test, replace pressure regulator.
4) Correct pressure is most important at idle. However, if engine lacks power, check for large pressure drop at full throttle. If so, look for a restricted fuel line, clogged filter, dirt in tank, or defective fuel pump.

FUEL PRESSURE SPECIFICATIONS

Application	Pressure
Datsun	36-37 psi (2.53-2.60 kg/cm²)
Toyota	33-38 psi (2.35-2.65 kg/cm²)

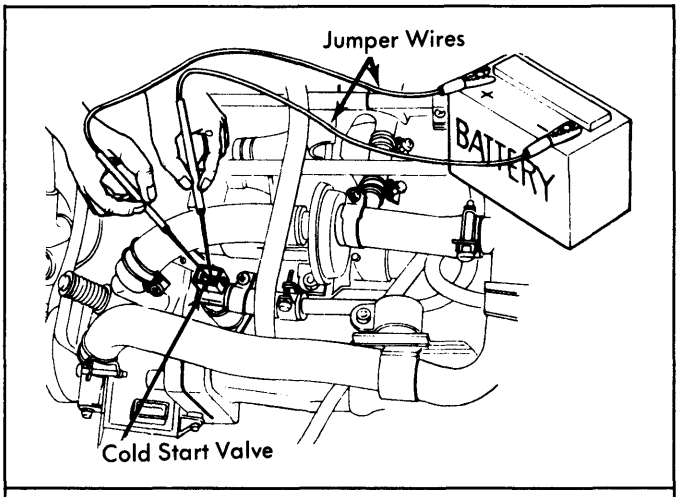

Fig. 5: Releasing Fuel Pressure At Cold Start Valve (Datsun)

INTAKE AIR SENSOR

Datsun – Disconnect battery negative cable and airflow meter. Record outside air temperature. Connect ohmmeter leads between terminals No. 27 and 6 (terminals No. 25 and 34 on 1979 models) on temperature sensor. Readings should be as specified in DATSUN INTAKE AIR SENSOR SPECIFICATIONS table. If not, replace intake air sensor and airflow meter as an assembly.

DATSUN INTAKE AIR SENSOR SPECIFICATIONS

Temperature °F (°C)	Resistance (Ohms)
-22 (-30)	20,300-33,000
14 (-10)	7600-10,800
50 (10)	3250-4150
68 (20)	2250-2750
122 (50)	740-940
176 (80)	290-360

Toyota – Disconnect airflow meter multi-pin connector and record ambient air temperature. Connect ohmmeter leads to terminals E_2 and THA on potentiometer connector. Ohmmeter readings should be as specified in, TOYOTA INTAKE AIR SENSOR SPECIFICATIONS table. If not, replace intake air sensor and airflow meter as an assembly.

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TOYOTA INTAKE AIR SENSOR SPECIFICATIONS

Temperature °F (°C)	Resistance (Ohms)
-4 (-20)	10,000-20,000
32 (0)	4000-7000
68 (20)	2000-3000
104 (40)	900-1300

ENGINE COOLANT SENSOR

Disconnect engine coolant sensor. Connect an ohmmeter between engine coolant sensor and ground. As temperature increases, resistance will decrease. Resistance readings should be as specified in ENGINE COOLANT SENSOR SPECIFICATIONS table.

ENGINE COOLANT SENSOR SPECIFICATIONS

Coolant Temperature °F (°C)	Resistance (Ohms)
-22 (-30)	20,300-33,000
14 (-10)	7600-10,800
50 (10)	3250-4150
68 (20)	2250-2750
122 (50)	740-940
176 (80)	290-360

AUXILIARY AIR REGULATOR

1975-76 Datsun – 1) Remove auxiliary air regulator. Connect ohmmeter to regulator terminals. Ohmmeter reading should be about 30-33 ohms. Blow through regulator with compressed air. Passage must be open when engine is cold.

2) Connect battery voltage to both terminals. As temperature increases, opening in regulator should become smaller. If ohmmeter reading is incorrect or if regulator fails to close with voltage applied, replace auxiliary air regulator.

1977-79 Datsun – 1) Pinch hose between throttle chamber and air regulator with fingers. Engine speed should drop. If not, unhook hoses at each end of regulator. Visually check opening in valve.

2) Valve should be open when cold, and close as temperature increases. Check continuity of air regulator at electrical connector. If continuity does not exist, air regulator is defective and should be replaced.

3) Check smoothness of operation by carefully prying air regulator valve open with a flat bladed screwdriver and then close valve again. Replace valve if operation is not smooth.

THERMO-TIME SWITCH

1975-78 Datsun – 1) Disconnect battery negative cable and switch connector. Connect ohmmeter leads between switch terminals on thermo-time switch. *See Fig. 6.*

2) If engine temperature is below 57°F (14°C), ohmmeter reading should be zero ohms. If engine temperature is above 72°F (22°C), ohmmeter should indicate infinity. If not, replace thermo-time switch. Measure resistance between switch body and terminal No. 45 on thermo-time switch. Reading should be 70-86 ohms.

1979 Datsun – 1) Disconnect battery negative cable and switch connector. Connect ohmmeter leads to switch body and terminal No. 46 on thermo-time switch.

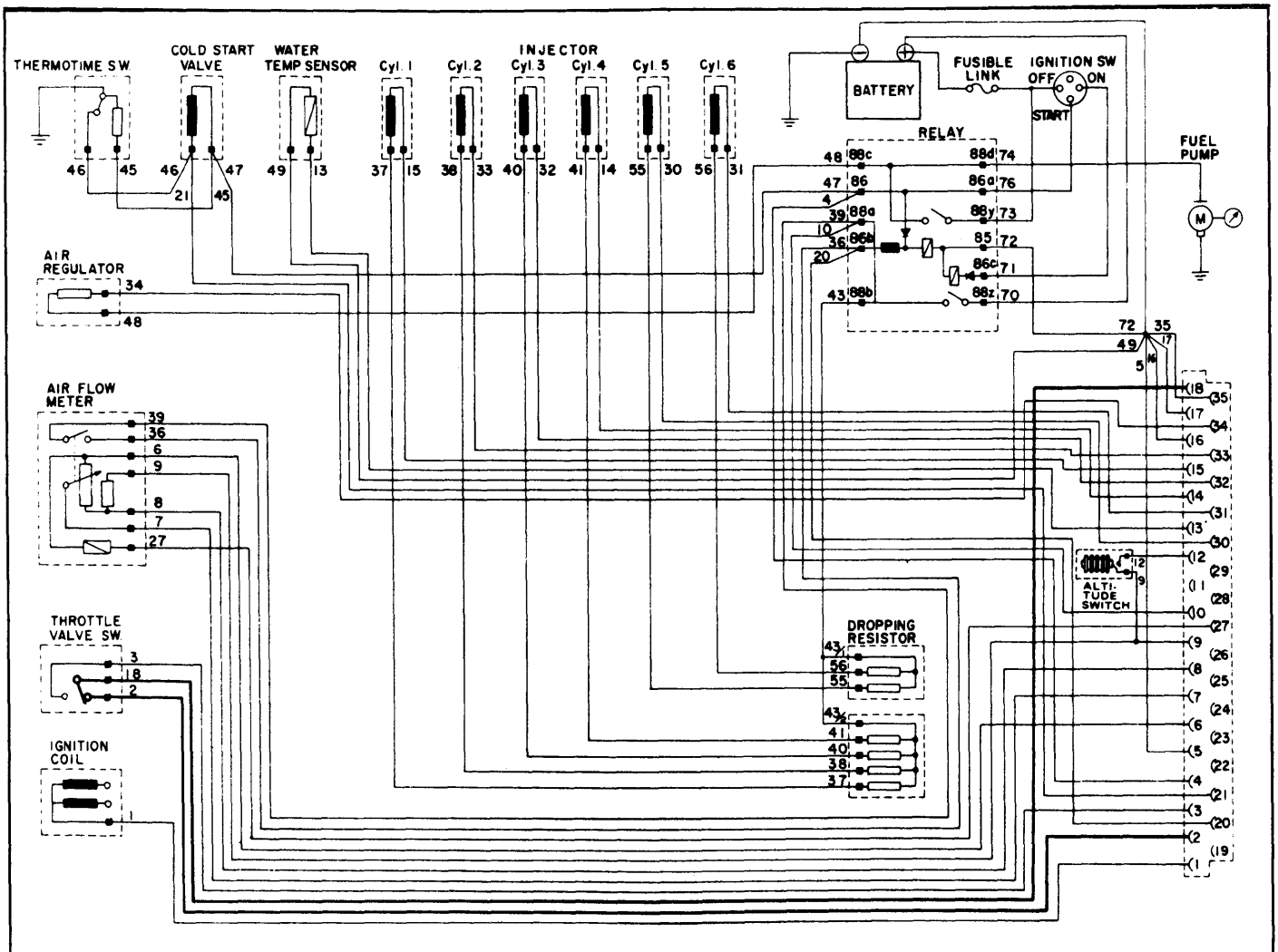

Fig. 6: 1976-78 Bosch AFC Fuel Injection System Wiring Schematic (280Z)

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Bosch AFC Fuel Injection – Japanese (Cont.)

2) If engine temperature is below 57°F (14°C), ohmmeter reading should be zero ohms. If engine temperature is above 72°F (22°C), ohmmeter should indicate infinity. If not, replace thermo-time switch.
1979 Toyota – 1) Disconnect thermo-time switch connector. Connect ohmmeter between terminal STA and STJ on thermo-time switch. Also measure resistance between terminal STA and ground.
2) Resistance between terminal STA and ground should be 20-80 ohms. Resistance between terminal STA and STJ should be 20-40 ohms with coolant temperature below 95°F (35°C), 40-60 ohms with coolant temperature above 95°F (35°C).

COLD START VALVE

1975-76 Datsun – Connect pressure gauge to injector supply line. Operate starter to build-up fuel pressure. Disconnect cold start valve. Connect wires from negative coil terminal to cold start valve. Observe fuel pressure reading, it should slowly decrease. If pressure does not drop, replace cold start valve.
1977-78 Datsun – 1) Disconnect negative battery cable. Disconnect cold start valve connector. Release fuel line pressure by connecting terminals of cold start valve to battery terminals for 2-3 seconds, using jumper wires. *See Fig. 5.*
2) Remove 2 screws and cold start valve from intake manifold. Remove clip and disengage fuel hose from valve. Place cold start valve into glass container with over 20 cc capacity. Cover opening at top of container to prevent spillage.
3) Connect battery ground cable. Turn ignition switch to START position. Cold start valve should NOT inject fuel. Turn ignition off. Connect jumper wire between cold start valve and battery terminals. Cold start valve should now inject fuel. If not, replace cold start valve.
1979 Datsun – 1) Disconnect negative battery cable. Disconnect oil pressure switch connector or "L" terminal of alternator. *See Fig. 7.* Remove screws holding cold start valve to intake manifold.
2) Remove clip and disengage fuel hose from valve. Place cold start valve into glass container with over 20 cc capacity. Cover opening at top of container to prevent spillage.
3) Connect battery ground cable. Turn ignition switch to START position. Cold start valve should NOT inject fuel. Turn ignition off. Connect jumper wire between cold start valve and battery terminals. Cold start valve should now inject fuel. If not, replace cold start valve.

REMOVAL & INSTALLATION

NOTE: The fuel injection system maintains constant fuel pressure in fuel lines and component parts at all times. Be sure to relieve pressure before attempting to open system at any point for testing.

AIRFLOW METER & AIR CLEANER

Removal & Installation (Datsun) – Disconnect battery ground cable. Disconnect rubber hose from both sides of airflow meter. Disconnect airflow meter ground cable and remove 3 bolts securing airflow meter to bracket. Move airflow meter upward, disconnect electrical connector and remove airflow meter. To install, reverse removal procedure.

Removal & Installation (Toyota) – Remove air cleaner inlet pipe, cover and filter element. Remove 4 nuts attaching air cleaner to airflow meter. Remove bracket bolt, hose clamp, and hose from end of meter. Disconnect electrical connector and remove airflow meter. To install, reverse removal procedure.

THROTTLE VALVE HOUSING

Removal & Installation (Datsun) – 1) Disconnect battery ground cable. Remove rubber hoses from throttle chamber. Remove throttle valve switch and disconnect BCDD device (if equipped). Disconnect rod from auxiliary throttle shaft.
2) Remove 4 screws securing throttle chamber to intake manifold. Throttle chamber can now be removed together with dashpot and BCDD device (if equipped). To install, reverse removal procedure.
Removal & Installation (Toyota) – Drain coolant from radiator. Remove air intake connector, throttle link, water and vacuum hoses. Remove electrical connectors from throttle body. Remove 4 throttle

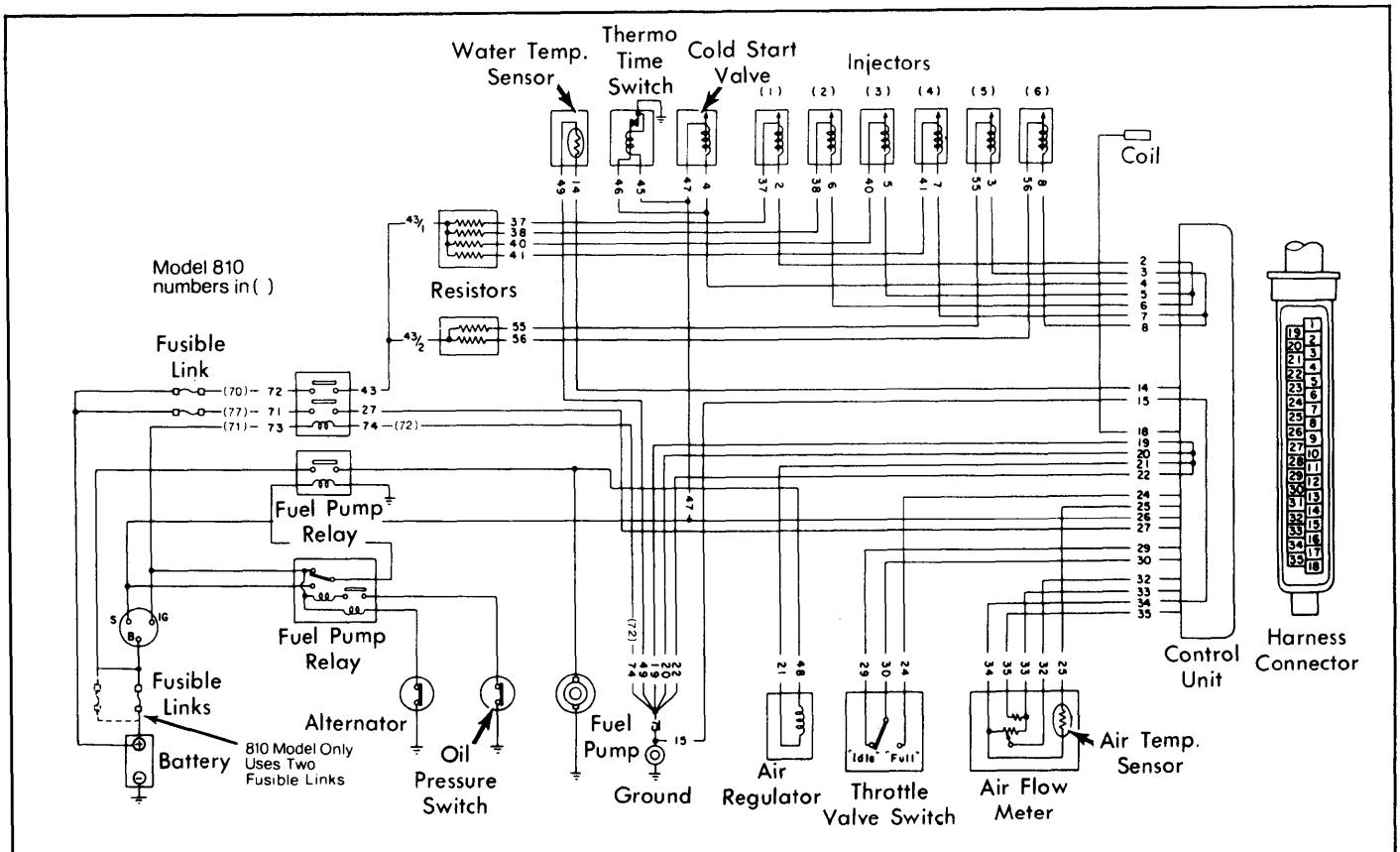

Fig. 7: 1979 Bosch AFC Fuel Injection System Wiring Schematic (Datsun 280ZX & 810)

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body attaching bolts and throttle body from air intake chamber. To install, reverse removal procedure.

ELECTRONIC CONTROL UNIT (ECU)

Removal & Installation (All Models) – Turn ignition off. Disconnect negative battery cable. Remove left kick panel. Remove cover and 3 bolts securing electronic control unit to side panel bracket. Carefully disconnect connector and remove electronic control unit. To install, reverse removal procedure.

COLD START VALVE

1975-78 Removal & Installation (Datsun) – Disconnect negative battery cable. Disconnect Black ground wire from fuel pump and wire from starter "S" terminal. Remove 2 screws and cold start valve from intake manifold. To install, reverse removal procedure.

1979 Removal & Installation (All Models) – Disconnect negative battery cable. Disconnect cold start valve connector. Release fuel line pressure by connecting terminals of cold start valve to battery terminals for 2-3 seconds, using jumper wires. *See Fig. 5.* Remove 2 screws and cold start valve from intake manifold. To install, reverse removal procedure.

AUXILIARY AIR REGULATOR

Removal & Installation (Datsun) – Disconnect battery ground cable. Disconnect electrical connector from regulator and remove hose clamp. Remove screws and auxiliary air regulator. To install, reverse removal procedure.

Removal & Installation (Toyota) – Drain coolant from radiator. Remove air hoses, water hoses and electrical connector from auxiliary air regulator. Remove auxiliary air regulator. To install, reverse removal procedure.

ENGINE COOLANT SENSOR

Removal & Installation (All Models) – Disconnect negative battery cable and sensor connector. Drain radiator coolant. Loosen and remove engine coolant temperature sensor. To install, reverse removal procedure. Apply sealer to threaded portion of sensor. On Datsun, be sure to install copper washers beneath sensor.

THERMO-TIME SWITCH

Removal & Installation (All Models) – Remove radiator cap and drain radiator coolant to level below thermostat housing. Disconnect negative battery cable and thermo-time switch. Loosen and remove thermo-time switch. To install, reverse removal procedure.

FUEL PRESSURE REGULATOR

1975-78 Removal & Installation (Datsun) – Disconnect negative battery cable. Disconnect Black ground wire from fuel pump and wire from starter "S" terminal. Remove 2 screws and cold start valve. Remove vacuum hose connecting pressure regulator to intake manifold. Remove pressure regulator. To install, reverse removal procedure.

1979 Removal & Installation (Datsun) – Disconnect negative battery cable. Disconnect cold start valve connector. Release fuel line pressure by connecting terminals of cold start valve to battery terminals for 2-3 seconds, using jumper wires. *See Fig. 5.* Remove vacuum hose connecting pressure regulator to intake manifold. Remove pressure regulator. To install, reverse removal procedure.

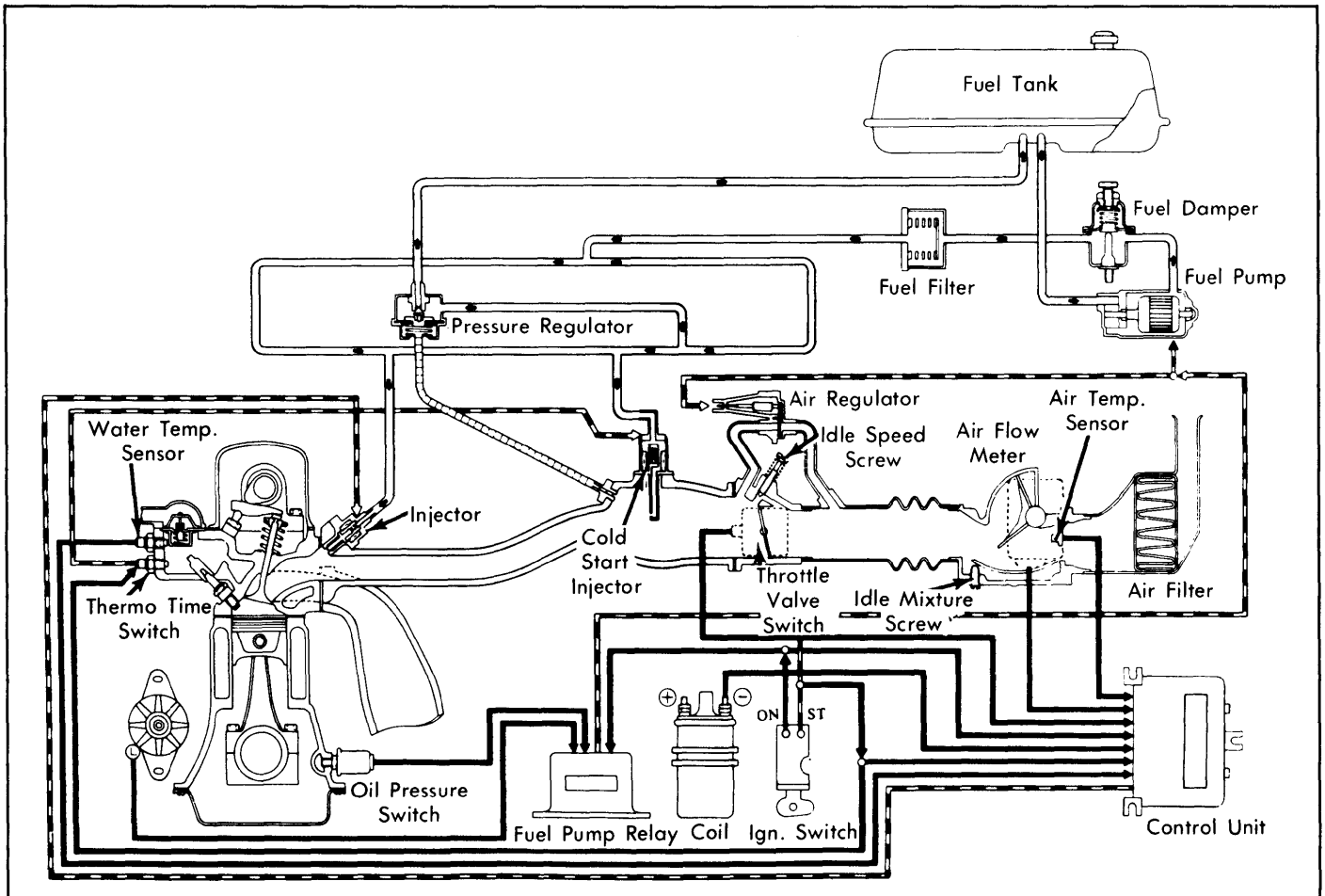

Fig. 8: 1979 Bosch AFC Fuel Injection System Diagram (280ZX & 810)

1979 Removal & Installation (Toyota) – Disconnect negative battery cable and relieve pressure in fuel system. Remove throttle body and 2 screws securing pressure regulator bracket. Disconnect fuel and vacuum hoses. Remove nut and washer attaching regulator to bracket, and remove regulator. To install, reverse removal procedure.

INJECTORS

1975-78 Removal & Installation (Datsun) – **1)** Disconnect negative battery cable. Disconnect Black ground wire from fuel pump and wire from starter "S" terminal. Remove 2 screws and cold start valve.
2) Disconnect electrical connectors from injectors. Remove fuel feed line and remove screws securing front feed line to injectors. To remove rear injectors, remove bolts securing fuel feed line to intake manifold. To install, reverse removal procedure.
1979 Removal & Installation (Datsun) – **1)** Disconnect negative battery cable. Disconnect cold start valve connector. Relieve fuel pressure by connecting terminals of cold start valve to battery terminals for 2-3 seconds, using jumper wires. *See Fig. 5.*
2) Disconnect electrical connectors from injectors. Disengage harness from fuel pipe wire clamp. Remove blow-by hose at rocker cover side. Remove air regulator pipe.
3) Place rag around pipe and unfasten hose clamps on feed and return hoses. Remove fuel pipe bolts and cold start valve mounting bolts and all screws securing fuel injectors. To install, reverse removal procedure.
1979 Removal & Installation (Toyota) – **1)** Disconnect native battery cable and drain engine coolant. Disconnect and mark all vacuum, fuel, and water hoses connected to intake air chamber. Remove cold start injector, EGR pipe, and throttle link from air chamber. Remove intake air chamber.
2) Unplug electrical connectors from injectors and remove 2 injector harness clamps from fuel delivery pipe. Remove 4 fuel delivery pipe bolts and remove fuel delivery pipe with injectors attached. To install, reverse removal procedure.