

Spitronics ECU - Fuel Supply Systems - Guide

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Overview

The fuel supply system delivers fuel from the tank to the injectors at the required pressure and flow rate.

In most applications, the ECU controls only the electrical operation of the fuel pump. Fuel pressure itself is normally controlled mechanically by a fuel-pressure regulator.

Some systems use electronically controlled fuel-pump speed or fuel-pressure control. Support for these functions depends on the Device and firmware.

A correctly designed fuel system must provide:

- Adequate fuel flow.
- Stable fuel pressure.
- Correct filtration.
- Reliable electrical supply to the pump.
- Safe fuel-line routing.
- Suitable pressure regulation.

Basic Fuel System Layout

A typical fuel system contains:

- Fuel tank.
- Pre-filter or strainer.
- Fuel pump.
- High-pressure fuel filter.
- Fuel rail.
- Injectors.
- Fuel-pressure regulator where used.
- Return line where used.

The exact layout depends on whether the system uses an external pump, an in-tank pump, or a returnless arrangement.

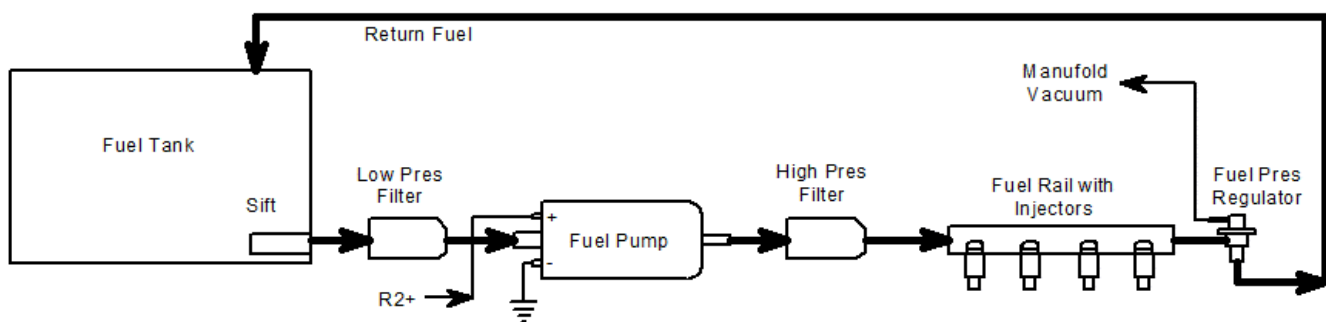
External Fuel Pump

An external fuel pump is mounted outside the fuel tank.

Fuel normally flows from the tank through a pre-filter to the pump inlet.

The pump then supplies pressurised fuel through a high-pressure filter to the fuel rail and injectors.

A mechanical fuel-pressure regulator controls pressure by returning excess fuel to the tank.



A typical arrangement is:

Fuel Tank → Pre-Filter → Fuel Pump → High-Pressure Filter → Fuel Rail → Pressure Regulator → Return to Tank

External pumps should have a reliable fuel supply to the inlet.

Restricted pump inlet flow can cause:

- Fuel starvation.
- Pump noise.
- Cavitation.
- Reduced fuel pressure.
- Pump damage.

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Internal Fuel Pump

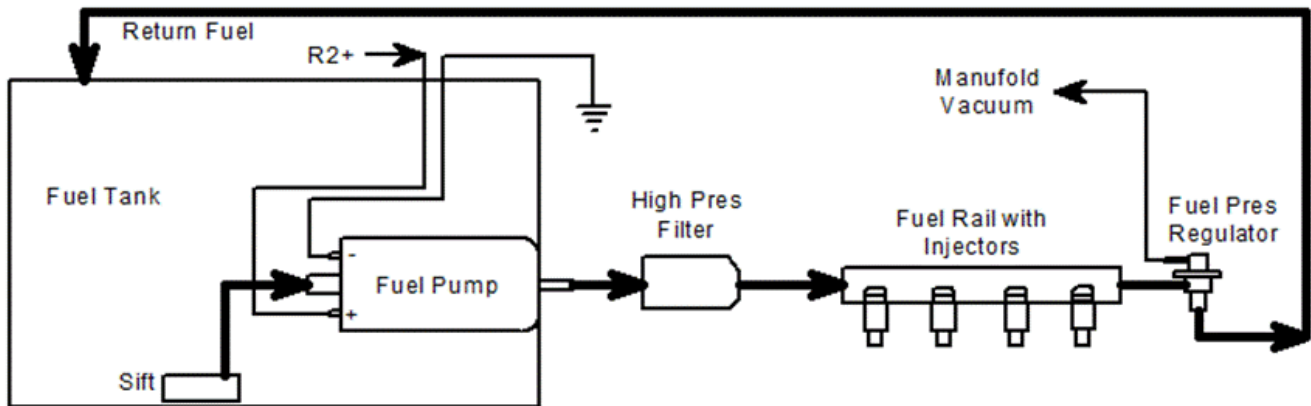
An internal fuel pump is mounted inside the fuel tank.

A strainer or pre-filter is normally fitted directly to the pump inlet.

The pump supplies pressurised fuel through a high-pressure filter to the fuel rail and injectors.

Excess fuel may be returned to the tank through a mechanical pressure regulator.

The fuel surrounding the pump also assists with pump cooling.



A typical return-type system is:

Fuel Tank → In-Tank Pump → High-Pressure Filter → Fuel Rail → Pressure Regulator → Return to Tank

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Return-Type Fuel System

A return-type fuel system uses a pressure regulator and return line.

The pump normally operates continuously at full electrical supply while the engine is running.

Fuel that is not required by the injectors is returned to the tank by the regulator.

This circulation helps maintain stable pressure and can assist with fuel and pump temperature control.

A typical arrangement is:

Tank → Pump → Filter → Rail → Regulator → Return Line → Tank

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Manifold-Referenced Fuel Pressure Regulator

Many fuel-pressure regulators are connected to intake manifold pressure.

The regulator adjusts fuel-rail pressure according to manifold pressure.

This helps maintain a reasonably constant pressure difference across the injector.

For example, when manifold pressure rises under boost, fuel pressure must also rise so that the injector continues to deliver fuel correctly.

The regulator reference hose must therefore:

- Be connected to the correct manifold-pressure source.
- Be free from leaks.
- Not be restricted.
- Not contain fuel.

A damaged regulator diaphragm or reference hose can cause incorrect fuel pressure and poor engine operation.

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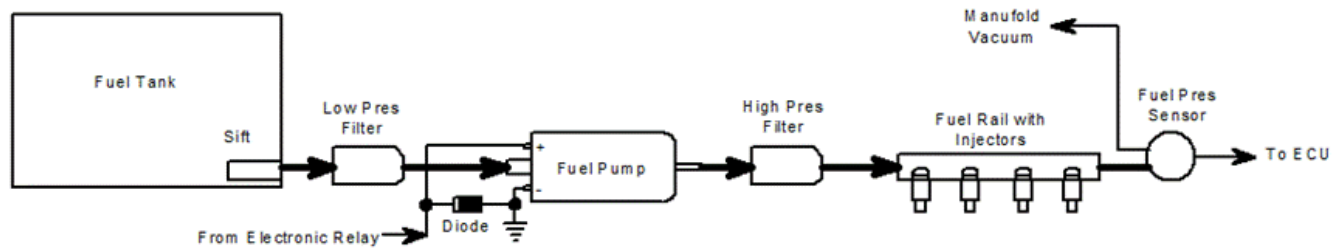
Returnless Fuel System

Some vehicles use a returnless fuel system.

In this arrangement, the pressure regulator may be mounted inside the fuel tank.

Only one fuel line then runs from the tank to the engine fuel rail.

Fuel-pressure regulation and excess-fuel return take place inside or near the tank.



A typical arrangement is:

Fuel Tank → Pump → In-Tank Regulator → Fuel Line → Fuel Rail

There is no external return line from the engine bay back to the tank.

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Electronically Controlled Fuel Pump

Some fuel systems control fuel-pump speed electronically.

A fuel-pressure sensor measures fuel pressure and the ECU or external controller adjusts pump speed using PWM or another control method.

Pump speed can then be increased or decreased according to fuel demand.

A typical arrangement is:

Fuel Pressure Sensor → ECU or Pump Controller → Fuel Pump

This type of system may reduce:

- Pump electrical load.
- Fuel heating.
- Unnecessary fuel circulation.

Support for electronic fuel-pressure control depends on the Device and firmware.

Do not assume that a fuel-pressure sensor automatically means that the ECU controls pump pressure.

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Fuel Pressure Sensor

A fuel-pressure sensor may be used for:

- Monitoring fuel pressure.
- Data logging.
- Safety protection.
- Fuel-pressure control on supported systems.

Some fuel-pressure sensors measure pressure relative to atmosphere.

Other systems may use differential pressure sensing or manifold-pressure compensation.

Always confirm the sensor type and calibration before using the signal for control or protection.

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Fuel Filters

Correct filtration is important for both pump and injector life.

Two types of filtering are commonly used.

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Pre-Filter

The pre-filter is fitted before the fuel pump.

Its purpose is to prevent large contamination from entering the pump.

An in-tank pump commonly uses a strainer attached directly to the pump inlet.

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High-Pressure Filter

The high-pressure filter is fitted after the pump.

Its purpose is to remove fine contamination before fuel reaches the injectors.

The filter must:

- Be suitable for the fuel being used.
- Be rated for the fuel-system pressure.
- Have sufficient flow capacity.
- Be installed in the correct direction where applicable.

A restricted fuel filter can cause fuel pressure to fall under load.

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Fuel Pump Size

The fuel pump must supply sufficient fuel for the maximum expected engine demand.

Pump capacity must allow for:

- Engine power.
- Injector flow.
- Fuel type.
- Boost pressure where applicable.
- Fuel-pressure requirement.
- Electrical supply voltage.
- Pump temperature.
- Pressure losses through filters and lines.

A pump that appears adequate at idle may still be too small at high engine load.

Always confirm fuel pressure under full-load conditions.

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Fuel Line Size

Fuel lines must be large enough to supply the required fuel flow without excessive pressure loss.

Restrictions can occur in:

- Small fuel pipes.
- Blocked filters.
- Poor fittings.
- Sharp bends.
- Damaged hoses.
- Restricted tank outlets.

Fuel pressure should be checked under the highest expected engine load.

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Fuel Pump Electrical Supply

Fuel pumps can draw significant current.

The electrical system should normally include:

- Correctly sized fuse.
- Suitable relay.
- Adequate cable size.
- Reliable power supply.
- Good Ground connection.

The ECU fuel-pump output should normally control a fuel-pump relay or suitable electronic driver.

Do not connect a high-current fuel pump directly to a low-current ECU output unless the applicable product documentation specifically permits it.

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Fuel Pump Relay

A typical arrangement is:

Battery Supply → Fuse → Relay → Fuel Pump

The ECU controls the relay.

This allows the ECU to switch the fuel pump on and off without carrying the full pump current through the ECU output.

Refer to the applicable Fuel Pump and Product wiring documentation for the correct connection.

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Fuel Pump Ground

Poor fuel-pump Ground can cause:

- Reduced pump speed.
- Low fuel pressure.
- Hard starting.
- Lean running under load.
- Pump overheating.
- Intermittent engine cut-out.

The fuel pump should have a clean, low-resistance Ground connection suitable for the pump current.

Check voltage directly across the pump terminals while the pump is operating.

Fuel Pump Cooling

Fuel pumps generate heat during operation.

In-tank pumps are cooled by the surrounding fuel.

External pumps may benefit from continuous fuel circulation in return-type systems.

Running an in-tank fuel pump with very little fuel in the tank can reduce cooling and increase pump temperature.

Fuel Pressure Testing

Fuel pressure should be checked during:

- Initial installation.
- Engine tuning.
- Full-load testing.
- Fuel-system fault finding.

Do not assume fuel pressure is correct because the engine runs normally at idle.

Monitor pressure during increasing engine load.

A fuel system that cannot maintain pressure at high load can cause a dangerous lean condition.

Turbocharged Engines

Turbocharged engines require particular attention to fuel pressure.

Where a manifold-referenced regulator is used, fuel pressure must rise correctly with boost.

If fuel pressure does not follow manifold pressure correctly, injector fuel delivery can become insufficient under boost.

Always verify fuel pressure during boost operation.

Common Fuel Supply Faults

Symptom	Possible Cause	Check
Low fuel pressure	Weak pump	Check pump supply and pressure
Pressure falls under load	Restricted filter or undersized pump	Check flow and filters
Pump noisy	Restricted inlet or low fuel level	Check pre-filter and fuel supply
Engine lean at high load	Fuel pressure falling	Monitor fuel pressure
Fuel pressure too high	Regulator fault or blocked return	Check regulator and return line
Fuel pressure unstable	Air, wiring or regulator fault	Check pump supply and regulator
Hard starting	Fuel pressure bleeding away	Check regulator, pump and injectors
Pump runs slowly	Voltage drop	Check power and Ground
Fuel smell or leak	Damaged hose or fitting	Stop engine and repair immediately

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Installation Safety

Fuel is highly flammable.

Always:

- [] Use fuel hose and fittings suitable for the fuel type and pressure.
- [] Secure all fuel lines correctly.
- [] Keep fuel lines away from exhaust components.
- [] Keep fuel lines away from moving parts.
- [] Use proper fuel-system clamps and fittings.
- [] Check all connections for leaks.
- [] Test the system under pressure before operating the engine.
- [] Repair any fuel leak immediately.

Never continue operating an engine with a known fuel leak.

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Setup Check

Before engine tuning:

- ☐ Fuel tank is clean.
- ☐ Fuel pump is correctly sized.
- ☐ Pre-filter or strainer is installed.
- ☐ High-pressure filter is installed.
- ☐ Fuel lines are correctly sized.
- ☐ Fuel-pressure regulator is connected correctly where used.
- ☐ Regulator manifold reference is correct where applicable.
- ☐ Return line is unrestricted where fitted.
- ☐ Fuel-pump relay is wired correctly.
- ☐ Fuel-pump fuse is correctly rated.
- ☐ Pump power supply is adequate.
- ☐ Pump Ground is reliable.
- ☐ Fuel pressure is correct at idle.
- ☐ Fuel pressure remains correct under load.
- ☐ Fuel pressure follows boost correctly where required.
- ☐ No fuel leaks are present.

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Related Documents

Refer to the applicable current manuals for:

- Fuel Pump.
- Fuel and Timing.
- Fuel Pressure Sensor.
- Power and Grounding.
- Product Pin Layouts.
- Installation Safety and Wiring Precautions.

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