Spitronics ECU - Throttle Position Sensor - Guide

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The Throttle Position Sensor (TPS) measures throttle position and provides the ECU with an indication of driver demand.

TPS information can be used by many ECU functions, including:

- Acceleration enrichment.
- Idle control.
- Fuel cut-off.
- Load calculation.
- Cam control.
- Launch and other motorsport functions.
- Transmission-related signals.
- Electronic Throttle Controller (ETC) where applicable.

An engine can operate without a TPS on some tuning strategies, but drivability and available functions may be reduced.

Where a suitable TPS is fitted, it should normally be connected and calibrated.

TPS Operation

A conventional TPS is normally a rotary position sensor connected to the throttle shaft.

Many traditional TPS sensors operate as a potentiometer.

They normally have:

- Sensor supply.
- Sensor Ground.
- TPS signal.

As the throttle moves, the signal voltage changes progressively.

The ECU converts this signal into a calibrated throttle-position percentage.

TPS Percentage

After calibration, the software displays throttle position as a percentage.

Typical interpretation is:

- Closed throttle = 0%.
- Fully open throttle = 100%.

Some software generations display whole percentages.

More advanced systems such as ETC may display:

- 0.0% to 100.0%.

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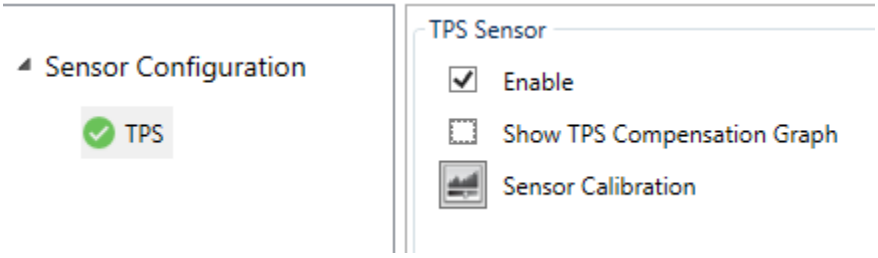
Enabling the TPS

Enable the TPS Input when a throttle-position signal is available and required.



If no TPS is used:

- Disable the TPS Input.
- Insulate any unused TPS wires.
- Ensure unused wires cannot short to power or Ground.

Functions that depend on TPS may be hidden or unavailable when the Input is disabled.

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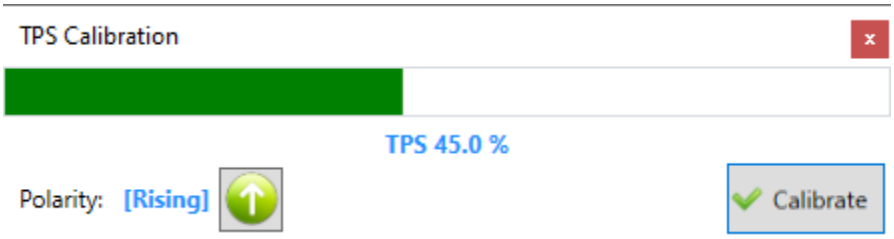
TPS Calibration

TPS calibration establishes the electrical signal corresponding to:

- Closed throttle.
- Fully open throttle.

Calibration is required whenever:

- A new TPS is fitted.
- Throttle linkage has been changed.
- The sensor position has been adjusted.
- Throttle body has been changed.
- ECU configuration has been changed in a way that affects TPS input.



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Safety During Calibration

Some ECU functions may react to throttle movement while the ignition is on.

Depending on the firmware and installation, moving the throttle during calibration may activate fuel-related functions such as Prime or acceleration enrichment.

Where there is any possibility of fuel being injected during calibration, isolate the applicable outputs or disconnect the output harness before repeatedly operating the throttle.

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Calibration Procedure

A typical calibration procedure is:

1. Switch the ignition on without starting the engine.
2. Open the TPS Calibration screen.
3. Fully close the throttle.
4. Fully open the throttle.
5. Return the throttle to the closed position.
6. Allow the software to record the minimum and maximum positions.
7. Save the calibration.
8. Move the throttle through its complete range.
9. Verify that the displayed TPS follows the actual throttle movement.

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Verify the Calibration

After calibration:

- Closed throttle should indicate approximately 0%.
- Fully open throttle should indicate approximately 100%.
- Movement should be smooth through the complete range.
- The value should not jump or drop out.
- The value should increase as the throttle opens.

For ETC systems, the display may show:

- 0.0% at closed position.
- 100.0% at full position.

Minor movement in the final decimal digit may be normal depending on sensor and A/D resolution.

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TPS Direction and Polarity

The displayed TPS value must increase as the throttle opens.

If the value moves in the opposite direction, use the applicable TPS direction or polarity setting.

The exact terminology may vary between software generations.

Typical descriptions may include:

- Rising.
- Falling.
- Positive.

- Negative.

The operating principle is simply that the calibrated percentage must increase from closed throttle toward full throttle.

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Sensor Preload

Many rotary TPS sensors have a small mechanical dead area near the end of their movement.

The sensor should therefore be installed with a small amount of preload so the wiper operates inside its usable electrical range throughout normal throttle movement.

Do not position the sensor directly against its mechanical stop.

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Checking a Conventional TPS with a Multimeter

A conventional three-wire potentiometer TPS can often be identified using a multimeter.

Resistance Test

With the TPS disconnected:

1. Measure resistance between the available terminals.
2. Identify the two fixed ends of the potentiometer.
3. Identify the wiper terminal by moving the throttle and observing which resistance changes progressively.

Do not rely only on wire colours because OEM colours vary between manufacturers.

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Four-Wire TPS Sensors

Some throttle-position sensors have four terminals.

The additional terminal may be used for:

- Idle switch.
- Wide-open-throttle switch.
- Other OEM functions.

A conventional aftermarket ECU may only require:

- Supply.
- Ground.
- TPS signal.

Do not assume the fourth wire is unused without checking the sensor or vehicle documentation.

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Sharing an Existing OEM TPS Signal

Where the original ECU remains fitted, another Device may sometimes read the existing TPS signal.

In this case, the additional Device should normally connect only to the signal line.

Do not connect a second sensor supply to the OEM TPS circuit.

Do not connect an unnecessary second Ground to the sensor circuit.

Both control systems must have compatible electrical references.

This principle can apply to combinations such as:

- ECU + OEM ECU.
- ECU + TCU.
- ECU + other compatible Device.

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Shared Signal Ground Reference

When two Devices share an analogue TPS signal, the signal is only meaningful if both Devices have a compatible Ground reference.

Poor Grounding can create a voltage difference between the Devices and cause different TPS readings.

Where shared analogue signals are used:

- Verify the Grounding system.
- Compare TPS readings between Devices.
- Check during cranking and electrical load.
- Do not create unnecessary parallel sensor-Ground paths.

Detailed Grounding principles are covered in the Power and Grounding documentation.

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Realtime TPS Display

The Realtime TPS display is one of the easiest ways to confirm correct operation.

Move the throttle slowly from closed to fully open.

The displayed value should:

- Start near 0%.
- Increase progressively.
- Reach approximately 100%.
- Return smoothly to 0%.

There should be no sudden jumps or missing areas.

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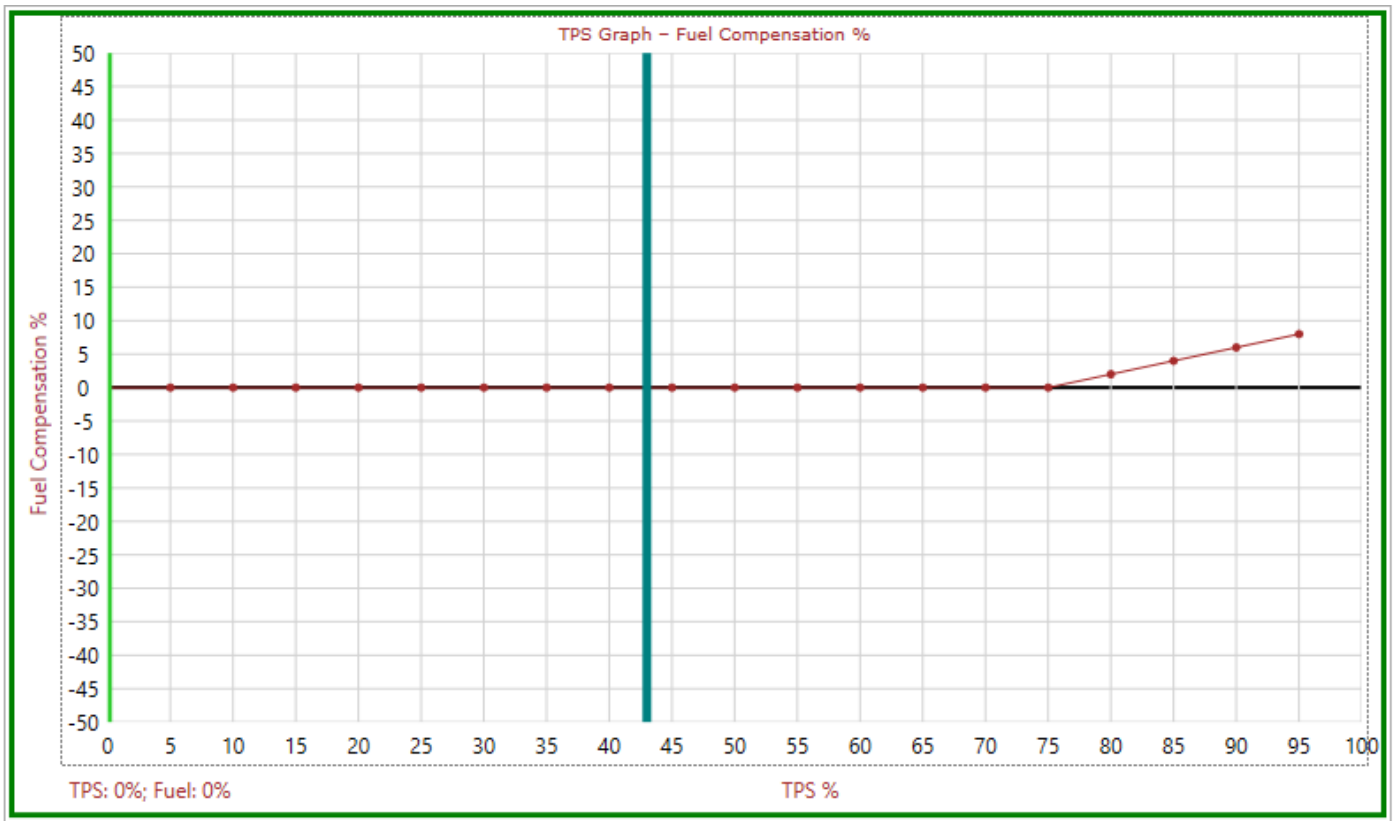
TPS Compensation Graph

Where supported, a TPS Compensation Graph can apply an additional fuel correction according to throttle position.



This can be useful where TPS provides additional information that is not fully represented by the main load signal.

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TPS Fuel Compensation

TPS Compensation should normally be regarded as a correction to the main fuel Tune rather than the primary fuel calculation.

It may be useful for:

- Additional high-throttle fuel correction.
- Fine adjustment under load.
- Applications where MAP behaviour does not perfectly represent engine airflow.

The correct use depends on the selected tuning strategy.

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TPS as an Engine Load Input

TPS can also be used as part of the primary engine-load calculation.

This can be useful on engines with:

- Individual throttle bodies.
- Large camshaft overlap.
- Poor manifold vacuum.
- Highly unstable MAP signals.

Depending on firmware, TPS may be used:

- On its own.
- Together with RPM.
- Together with MAP.
- As part of a blended load strategy.

This is different from the TPS Compensation Graph.

Primary load-calculation strategy is covered in the Fuel Tuning documentation.

TPS and Idle Control

TPS is commonly used to determine whether the driver has closed the throttle.

Idle Control may only become active when TPS is below the configured Idle Active TPS threshold.

For this reason, TPS calibration must leave sufficient margin for:

- Sensor tolerance.
- Throttle-stop movement.
- Cable movement.
- Temperature changes.
- Mechanical wear.

A TPS that never returns close to its calibrated closed position can prevent Idle Control from activating correctly.

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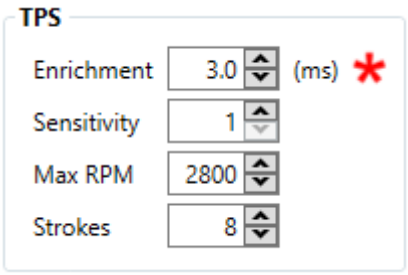
TPS and Acceleration Enrichment

Throttle movement can be used to detect rapid driver demand.

A rapid increase in TPS can trigger additional transient fuel enrichment.



This is commonly referred to as:

- Accelerator Pump.
- Acceleration Enrichment.
- Transient Fuel.

TPS therefore needs to be:

- Smooth.
- Responsive.
- Correctly calibrated.

A noisy TPS can cause unwanted transient-fuel operation.

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Electronic Throttle Controller (ETC) TPS

Electronic Throttle Controller (ETC) systems normally use multiple position sensors for safety.

These may include:

- Pedal TPS 1.
- Pedal TPS 2.
- Throttle TPS 1.
- Throttle TPS 2.

The same basic principle applies:

The sensor is calibrated into a meaningful position percentage.

The ETC software may display position with **0.1% resolution**, for example:

43.7%

ETC-specific calibration, plausibility checking and safety functions are covered in the Electronic Throttle Controller manual.

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Testing the TPS Signal

If TPS operation appears incorrect, check:

Supply

Verify the correct sensor supply.

Ground

Verify the sensor Ground reference.

Signal

Measure the TPS signal while slowly moving the throttle.

The signal should change smoothly.

Realtime Value

Compare the electrical signal with the software TPS percentage.

Mechanical Movement

Verify that:

- Throttle reaches the mechanical closed position.
- Throttle reaches full opening.
- TPS is not reaching its own mechanical stop.
- Linkage is not loose.

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Troubleshooting

Symptom	Possible Cause	Action
TPS does not reach 0%	Incorrect calibration or mechanical preload	Recalibrate and inspect sensor position
TPS does not reach 100%	Incorrect calibration or limited throttle travel	Check throttle and recalibrate
TPS moves backwards	Incorrect polarity/direction	Change TPS direction setting
TPS jumps while moving	Worn sensor or wiring fault	Test signal with meter
TPS remains fixed	Missing supply, Ground or signal	Check wiring

Symptom	Possible Cause	Action
Idle Control does not activate	TPS not returning below Idle Active threshold	Check calibration and mechanical stop
Acceleration enrichment occurs randomly	Noisy TPS signal	Check sensor, wiring and Ground
Shared OEM TPS reads differently between Devices	Ground reference difference	Check common reference and wiring

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Setup Check

Before relying on TPS information, verify:

[ ] TPS Input is enabled where required.

[ ] Sensor wiring is correct.

[ ] Sensor has suitable preload.

[ ] TPS calibration has been completed.

[ ] TPS increases as the throttle opens.

[ ] Closed throttle reads approximately 0%.

[ ] Fully open throttle reads approximately 100%.

[ ] Realtime TPS movement is smooth.

[ ] Shared TPS signals use a compatible Ground reference.

[ ] TPS-dependent functions operate correctly.

[ ] Calibration has been saved.

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