Spitronics ECU - Coolant Temperature Sensor - Guide

Index

The Coolant Temperature Sensor measures engine temperature and allows the ECU to compensate for the way an engine behaves when cold, warming up, at normal operating temperature, and when overheating.

Coolant temperature can influence functions such as:

- Cold starting.
- Warm-up fuel compensation.

- Ignition timing compensation.
- Idle control.
- Acceleration enrichment.
- Prime fuel.
- Start enrichment.
- Engine protection.

If the coolant temperature reading is incorrect, the ECU may apply the wrong correction even when the base Tune is correct.

Software Terminology

Newer software uses the term **Coolant Temperature**.

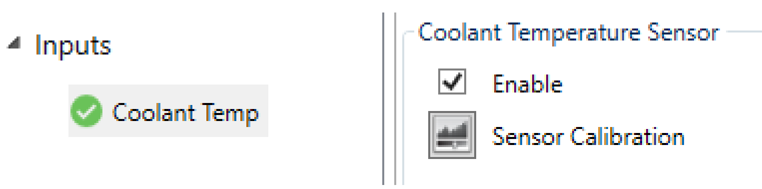
Older software may use **Water Temperature**.

This guide uses **Coolant Temperature** unless an older software label must be identified.

The exact calibration controls may also differ between firmware generations. The operating principles remain the same.

Software Setup

Enable the Coolant Temperature Sensor under the applicable ECU Inputs section before calibration or tuning.



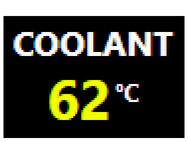
Older Hyperspace software may identify this Input as **Water Temperature** under Active Sensors.

The exact options shown depend on the Device and firmware.

Back to Top

Real-Time Verification

Before adjusting any coolant-related tuning, first confirm that the displayed temperature is believable for the actual engine temperature.



A useful basic check is:

- A completely cold engine should read close to ambient temperature.
- The temperature should rise smoothly as the engine warms.
- The reading should stabilise near the engine's normal operating temperature.
- The reading should not suddenly jump or fall.

If the displayed temperature is incorrect, diagnose the sensor, wiring and calibration before changing fuel or ignition compensation.

Back to Top

Sensor Calibration

Coolant Sensor calibration converts the electrical sensor signal into the correct temperature value.

The calibration method depends on the firmware generation.

Some products may provide:

- A fixed 2 kΩ NTC calibration with an offset adjustment.
- Selectable sensor curves.
- Additional calibration options depending on the Device and firmware.

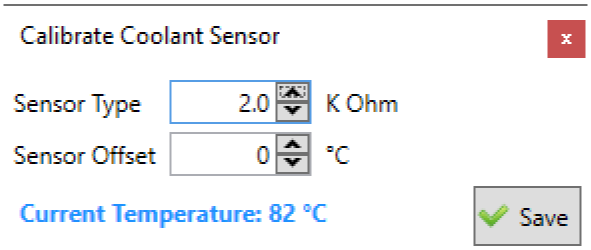
The important principle is that the displayed ECU temperature should agree with the actual engine temperature.

Calibration Procedure

A typical procedure is:

1. Start with the temperature offset at its default value.
2. Select the correct supported sensor curve where this option is available.
3. Bring the engine to normal operating temperature.
4. Measure or independently verify the actual engine temperature.
5. Compare this with the ECU temperature reading.
6. Adjust the calibration offset where required.
7. Save the calibration to the Device.

If a large correction is required, verify that the correct sensor type and calibration curve are being used rather than attempting to correct an incompatible sensor with a large offset.



[Back to Top](#)

Standard Spitronics Coolant Sensor

The standard Spitronics coolant-temperature system is based on a:

2 kΩ NTC sensor at approximately 25°C

A quick resistance test can therefore be used to identify a suitable sensor.

At approximately 25°C, a standard Spitronics 2 kΩ NTC sensor should normally measure approximately:

1.8-2.2 kΩ

This is a quick suitability check rather than a complete calibration test.

[Back to Top](#)

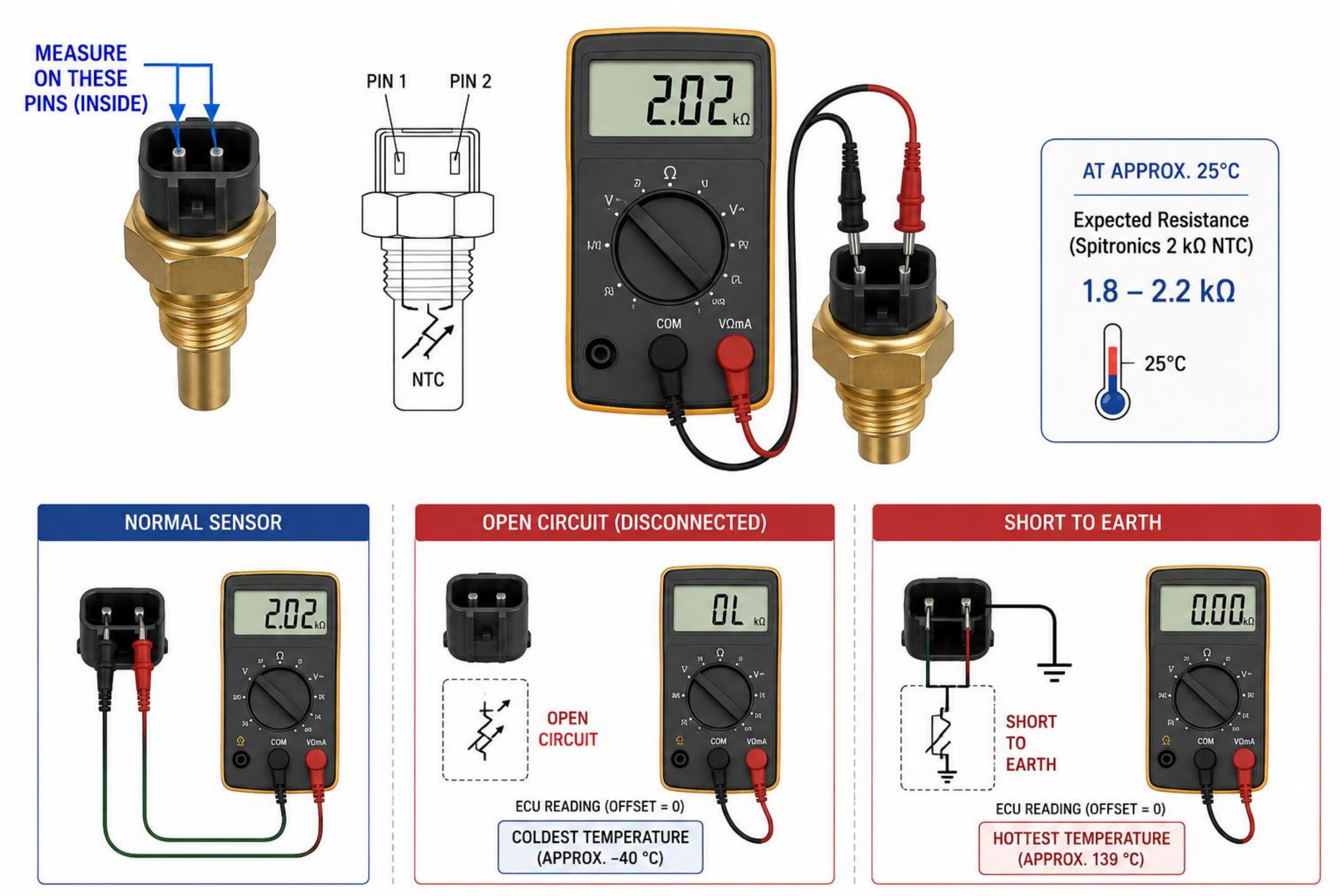
Quick Resistance Test

Disconnect the sensor before measuring resistance.

1. Set the multimeter to a suitable resistance range.
2. Measure across the two sensor terminals.
3. Compare the measurement with the expected temperature.

At approximately 25°C:

Expected resistance: approximately 1.8-2.2 kΩ



If the sensor resistance is very different, verify the sensor type before attempting software calibration.

Open and Short-Circuit Check

The ECU temperature display can also provide a quick wiring and input test.

With the temperature calibration offset at its default value:

Open Circuit

Disconnecting the sensor should cause the ECU to indicate approximately its coldest possible temperature.

The displayed temperature is typically approximately:

-40°C

Short to Ground

Shorting the temperature input to ECU Sensor Ground should cause the ECU to indicate approximately its hottest possible temperature.

The displayed temperature is typically approximately:

139°C

Exact end values may vary slightly depending on the Device and firmware.

The important diagnostic principle is:

Open circuit = cold extreme

Short to Ground = hot extreme

Back to Top

How the Sensor Works

The Coolant Temperature Sensor is normally an NTC resistor.

NTC means:

Negative Temperature Coefficient

Its resistance decreases as temperature increases.

The sensor itself does not generate a voltage.

The ECU creates a measurable voltage using a pull-up resistor.

In the standard Spitronics coolant circuit:

- Sensor nominal resistance = approximately 2 kΩ at 25°C.
- Pull-up resistor = approximately 1 kΩ.
- Pull-up supply = regulated 5 V.
- Cold sensor = higher resistance.
- Hot sensor = lower resistance.

[Insert Diagram - 5 V Pull-Up, NTC Sensor and ECU Input]

Back to Top

Voltage Divider Operation

The ECU pull-up resistor and the NTC sensor form a voltage divider.

As coolant temperature increases:

Sensor resistance decreases → input voltage decreases → ECU temperature reading increases

At low temperature:

- Sensor resistance is high.
- Input voltage is relatively high.
- ECU calculates a low temperature.

At high temperature:

- Sensor resistance is low.
- Input voltage is relatively low.
- ECU calculates a high temperature.

This electrical principle remains the same across supported Devices.

Back to Top

Sensor Installation

Mount the coolant sensor where it accurately represents engine temperature.

The preferred location is normally:

Engine side of the thermostat

This allows the ECU to see engine temperature before the thermostat opens.

A sensor mounted on the radiator side of the thermostat may:

- Read cooler.
- Respond more slowly.
- Delay cold-start and warm-up compensation.

Back to Top

Two-Wire Sensor Requirement

Use an isolated two-wire temperature sensor where the ECU provides the sensor Ground reference.

The sensor should connect between:

- Coolant Temperature Input.
- ECU Sensor Ground.

The standard Spitronics connection uses an isolated 2 kΩ NTC sensor with a 1 kΩ internal pull-up to the regulated sensor supply.

Do not use a single-wire dashboard gauge sender as the ECU coolant sensor.

A single-wire sender normally Grounds through the engine and is not electrically equivalent to the intended two-wire sensor circuit.

[Back to Top]

Multiple Sensor Elements

Some OEM temperature-sensor assemblies contain more than one internal sensor element.

For example:

- One element may supply the OEM ECU.
- Another may supply the dashboard gauge.

Resistance testing can help identify the correct terminals.

Do not assume that every pin in a multi-pin temperature sensor belongs to the same electrical circuit.

[Back to Top]

Standalone Sensor Connection

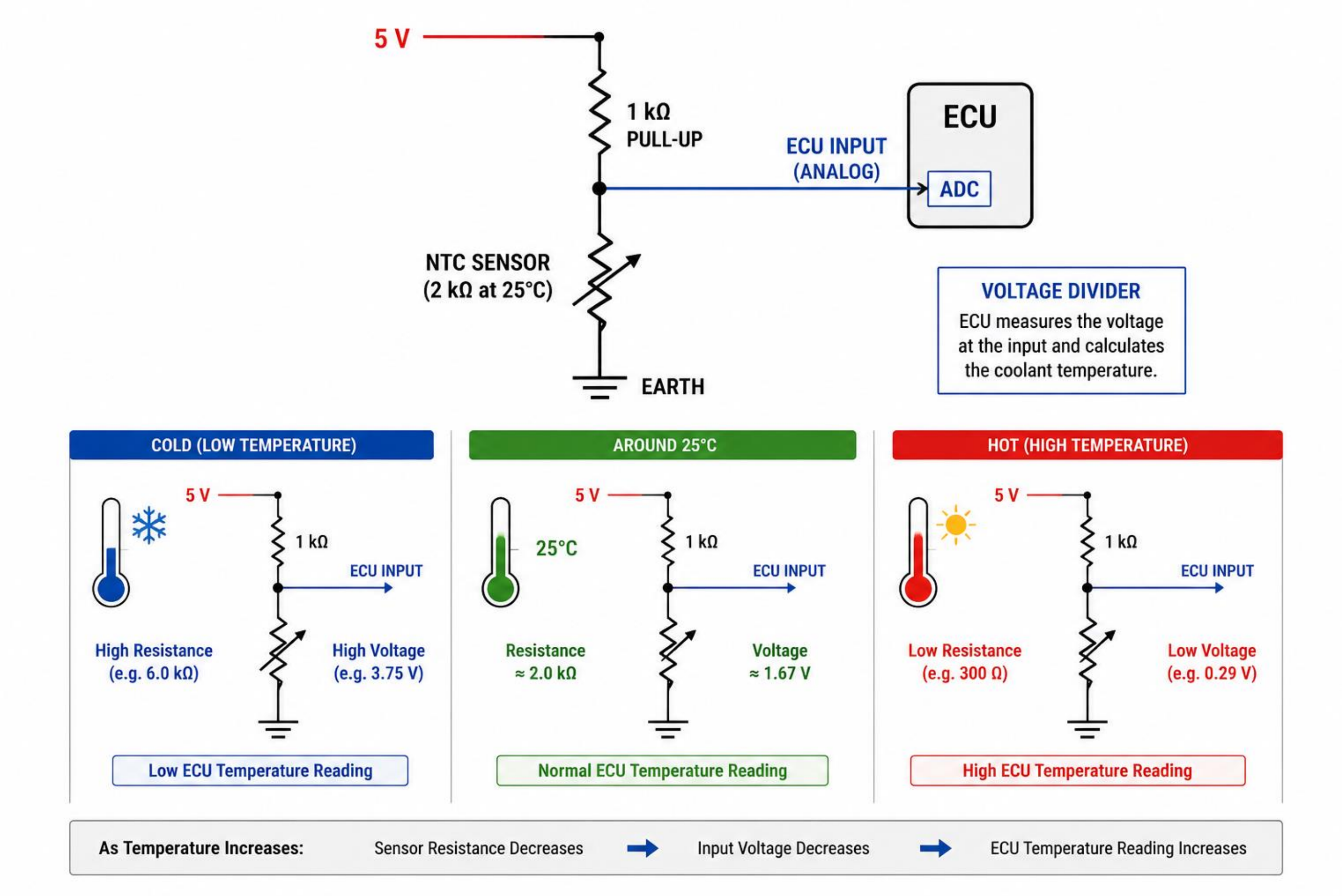
In a normal standalone installation, the Spitronics ECU provides the pull-up resistor required by the NTC sensor.

Typical arrangement:

ECU regulated 5 V → Internal Pull-Up → Coolant Input → NTC Sensor → ECU Sensor Ground

Only the signal path and Sensor Ground appear externally.

The NTC sensor and internal pull-up together generate the voltage measured by the ECU.



Product-specific connector pins are shown under the applicable Product information.

[Back to Top]

Sharing an Existing Coolant Sensor

Some installations require two Devices to read the same coolant-temperature sensor.

Examples may include:

- Spitronics ECU + OEM ECU.
- Spitronics ECU + standalone ETC.
- Other compatible combinations.

This can only be done correctly if the electrical circuits are compatible.

The main issue is the pull-up resistor.

Why Two Pull-Ups Cause a Problem

An NTC sensor does not produce its own voltage.

The controller pull-up resistor creates the voltage used for temperature measurement.

If two controllers both connect their own pull-up resistors to the same sensor, the pull-ups operate in parallel.

This changes the effective resistance of the circuit.

The result is that:

- Sensor voltage changes.
- Both controllers can calculate the wrong temperature.
- Calibration may appear incorrect.
- Temperature may change when the second Device is connected.

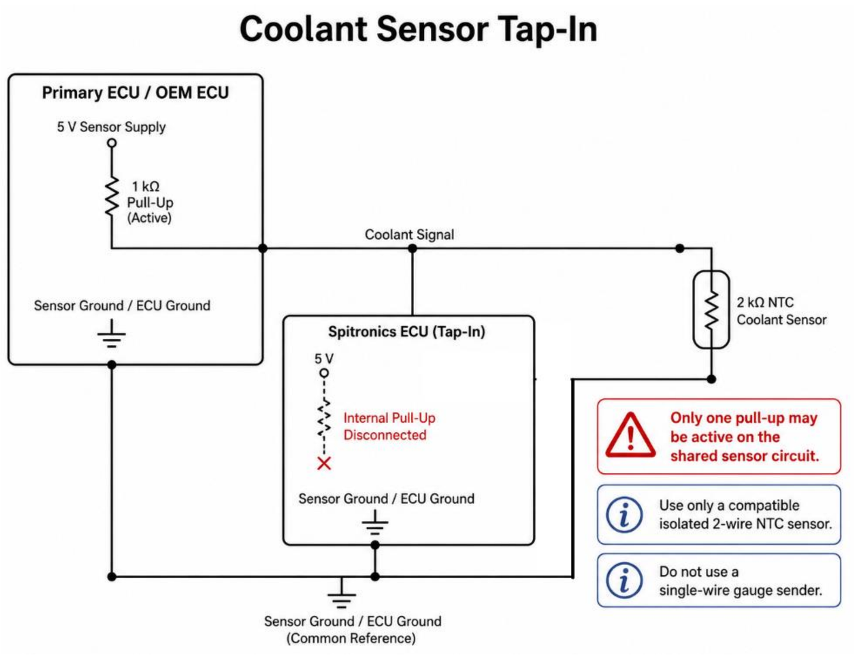
This is why only one compatible pull-up should normally control a shared NTC sensor circuit.

Tap-In Connection

Some newer Spitronics products provide a Tap-In option.

In Tap-In mode:

- The existing ECU or controller provides the sensor pull-up.
- The Spitronics Device reads the existing sensor voltage.
- The Spitronics internal pull-up is disconnected.
- Input filtering and protection remain active.



The method used to disable the pull-up depends on the hardware.

Refer to the applicable Product information for jumper locations.

[Back to Top](#)

Tap-In Requirements

Use Tap-In only when all of the following are true:

[ ] The shared sensor is a compatible isolated two-wire NTC sensor.

[ ] The existing sensor circuit uses a compatible pull-up relationship.

[ ] Only one effective pull-up is active.

[ ] The shared signal remains within the acceptable ECU input voltage range.

[ ] The two control systems have compatible Ground references.

[ ] The sensor Ground returns correctly through the ECU Ground system.

[ ] The signal has been verified before normal operation.

The shared signal must remain within the acceptable ECU input range and must not exceed 5 V.

If these requirements are not met, install a separate compatible coolant sensor.

Back to Top

Important - Do Not Tap Into a Gauge Sender

Do not connect the ECU coolant input to a normal single-wire dashboard temperature sender.

These senders normally use the engine as their electrical Ground and may have a completely different resistance curve.

Possible results include:

- Incorrect temperature reading.
- Ground-current problems.
- Unwanted current paths.
- Damage to sensitive ECU input circuitry.

Use an isolated two-wire sensor instead.

Back to Top

Alternative Surface-Mounted Sensor

Where installing an immersed coolant sensor is difficult, a 2 kΩ NTC element can be mounted to a suitable engine surface.

One practical method is to install the sensor element into a heavy-duty ring terminal and secure it under a thermostat-housing or cylinder-head bolt.

The element must be electrically insulated and mechanically protected.

A surface-mounted sensor measures metal temperature rather than coolant temperature directly, so:

- It may respond more slowly.
- It may require a small calibration offset.
- Sensor position becomes important.

This method can be useful where fitting an immersed sensor is impractical.

[Back to Top](#)

Air-Cooled Engines

For an air-cooled engine, cylinder-head temperature is normally more useful for cold-start compensation than oil temperature.

Oil temperature generally changes too slowly to represent the immediate thermal state of the engine during starting and warm-up.

A suitable NTC sensor can be mounted to the cylinder head where an immersed coolant sensor is not available.

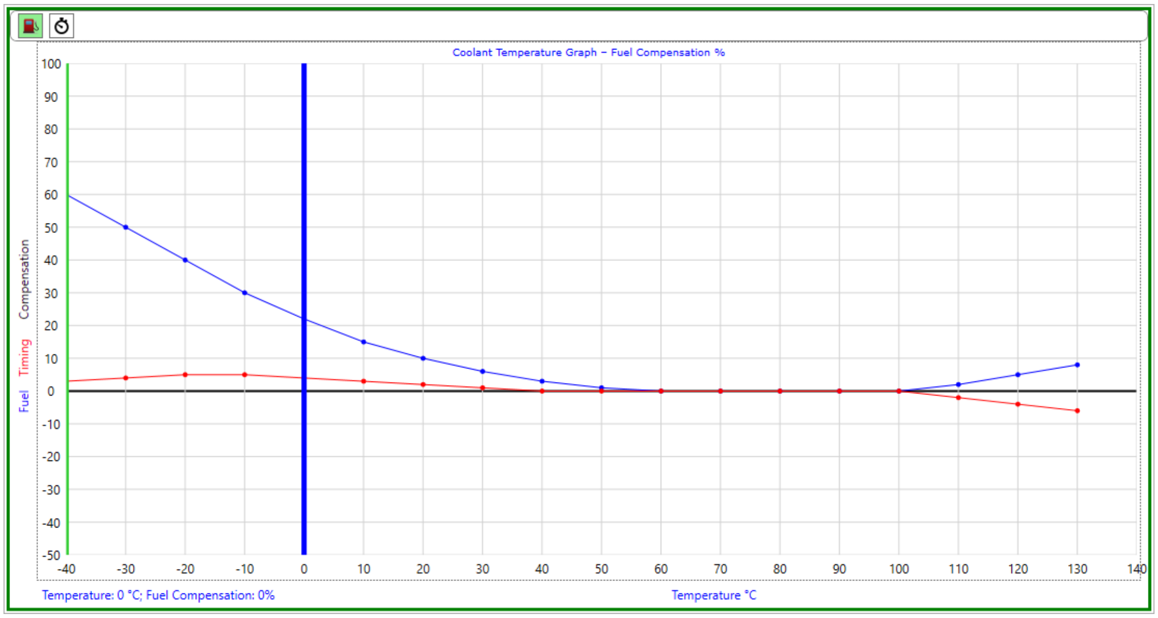
[Back to Top](#)

Coolant Temperature Compensation

Coolant Temperature Compensation adjusts fuel and ignition timing while the engine temperature is outside its normal operating range.

The purpose is to:

- Improve cold starting.
- Improve cold drivability.
- Stabilise the engine during warm-up.
- Return to normal calibration once warmed.
- Assist protection when the engine becomes excessively hot.



[Back to Top](#)

Tuning Principle

A correctly tuned engine at normal operating temperature should require no coolant-temperature compensation.

The base fuel and ignition Tune must therefore be established with the engine fully warmed.

Once the engine reaches its normal operating range:

- Fuel compensation should return to 0%.
- Timing compensation should return to 0°.

Coolant compensation should not be used to hide a poor base Tune.

[Back to Top](#)

Fuel Compensation

When the engine is cold:

- Fuel vaporisation is poor.
- More fuel can condense on the intake manifold and ports.
- Less of the injected fuel reaches the combustion chamber in vapour form.

Additional fuel is therefore required.

As the engine warms, this enrichment should be reduced progressively.

[Back to Top](#)

Normal Operating Temperature

For a typical petrol engine, approximately:

60-100°C

as the normal operating region for a typical petrol engine.

Within this area:

- Fuel vaporisation is stable.
- Combustion is efficient.
- Coolant fuel compensation should normally be approximately 0%.

This is a starting guideline.

Different engines may have different normal operating temperatures.

[Back to Top]

Over-Temperature Fuel Compensation

At excessive coolant temperature, a small amount of additional fuel can be used as part of an engine-protection strategy.

As a starting guideline, some protection strategies may begin adding fuel above approximately:

110°C

A slightly richer mixture may reduce combustion temperature.

This must not be used as a substitute for correcting an overheating problem.

[Back to Top]

Ignition Timing Compensation

Coolant Temperature can also apply ignition timing correction.

Timing compensation should generally be more conservative than fuel compensation.

Cold Timing Compensation

A small amount of additional ignition advance while warming up may:

- Improve combustion stability.
- Improve idle quality.
- Reduce the tendency to stall.

As the engine warms, this compensation should gradually return to 0°.

Over-Temperature Timing Compensation

When coolant temperature becomes excessive, ignition timing may be gradually retarded.

Retarding timing can:

- Reduce cylinder pressure.
- Reduce combustion temperature.
- Assist other engine-protection functions.

This is a protection aid, not a solution to an overheating engine.

Back to Top

Coolant Compensation Tuning Procedure

Always establish the warm-engine Tune first.

1. Tune the normal fuel and ignition calibration with the engine fully warmed.
2. Allow the engine to cool completely.
3. Start the engine.
4. Observe starting quality.
5. Observe idle stability.
6. Monitor AFR during warm-up.
7. Adjust only the coolant-temperature area requiring correction.
8. Keep transitions smooth.
9. Repeat cold starts until behaviour is consistent.

Back to Top

Cold-Start Tuning

Cold-start behaviour is controlled by more than the Coolant Compensation Graph.

Depending on firmware, the following may all influence starting and warm-up:

- Prime Pulse.
- Start Enrichment.
- Coolant Temperature Compensation.
- Idle Control.
- Accelerator Enrichment.

For this reason, diagnose the stage at which the engine has difficulty before changing settings.

Back to Top

Engine Cranks but Does Not Start

If the engine cranks normally but does not start, the mixture may be too lean.

During extended cranking, the initial prime fuel is gradually drawn through the engine.

A practical test is to add an additional Prime where the firmware permits it.

If the engine then begins to fire or starts more easily, additional starting fuel is probably required.

Possible adjustments include:

- Prime Pulse.
- Temperature-dependent Prime Fuel.
- Cold-temperature fuel compensation.

Make small changes and observe the result.

Back to Top

Prime Pulse

Prime Pulse provides fuel before or during the initial starting process, depending on firmware implementation.

A practical starting point is approximately:

10 ms

as a practical warm starting point and notes that some applications may require values approaching:

20 ms

These values are application-dependent and should be treated as tuning guidance rather than fixed requirements.

Back to Top

Engine Starts but Immediately Dies

If the engine starts but dies immediately afterwards, the problem may be insufficient Start Enrichment.

At normal operating temperature, Start Enrichment may begin near 0 ms and be increased as required. Approximately 1.5 ms can be a practical upper tuning region for firmware using this control.

Tune according to the available software control and engine response.

Back to Top

Engine Starts but Hesitates When Pulling Away

If the engine:

- Starts correctly.
- Idles reasonably.
- But hesitates or dies when pulling away while cold,

the cold fuel calibration may still be too lean.

Increase the applicable cold-temperature fuel compensation slightly and retest.

Also verify Idle Control and acceleration enrichment.

Back to Top

Correct Cold-Start Behaviour

A correctly calibrated engine should:

1. Start without excessive cranking.
2. Continue running after starting.
3. Maintain a stable cold idle.
4. Accept throttle cleanly.
5. Pull away without hesitation.
6. Transition smoothly into the warm-engine Tune.

Back to Top

Typical Cold-Tuning Symptoms

Too Little Cold Fuel

Typical symptoms:

- Hard starting.
- Lean AFR.
- Stalling.
- Poor throttle response.
- Engine requires throttle to remain running.

Increase the applicable cold fuel compensation.

Too Much Cold Fuel

Typical symptoms:

- Black smoke.
- Rich AFR.
- Fouled spark plugs.
- Rough idle.
- Poor fuel economy.

Reduce the applicable cold fuel compensation.

Too Much Cold Timing

Typical symptoms:

- Starter motor fights the engine.
- Kickback while starting.
- Harsh idle.

Reduce cold timing compensation.

Too Little Cold Timing

Typical symptoms:

- Weak idle.
- Engine stalls easily.
- Poor combustion immediately after starting.

Increase cold timing compensation slightly.

Back to Top

Fault Finding

If the coolant-temperature reading is incorrect, determine whether the problem is caused by:

1. Sensor.
2. Wiring.
3. Calibration.
4. Only then tuning.

Do not alter the Tune to compensate for an incorrect sensor reading.

Symptom	Likely Cause	Check
Reads coldest possible temperature	Open circuit	Check disconnected sensor, wiring and connector
Reads hottest possible temperature	Input shorted to Ground	Check signal wiring
Reading stable but incorrect	Wrong sensor curve or calibration	Verify sensor resistance and calibration

Symptom	Likely Cause	Check
Reading jumps	Intermittent wiring or Ground	Check connector and wiring
Hot reading differs slightly from actual	Calibration offset	Correct calibration at operating temperature
Reading changes when second Device is connected	Two pull-ups loading circuit	Check Tap-In configuration

Back to Top

Temperature Reading Changes When Another Device Is Connected

This is a strong indication that the two Devices may both be loading the sensor circuit.

Check whether:

- Both Devices have active pull-up resistors.
- The second Device is genuinely configured for Tap-In.
- Grounds are compatible.
- The sensor type is suitable for sharing.

Do not attempt to correct this with software calibration.

Correct the electrical circuit first.

Back to Top

Input Protection and Sensor Supply

The coolant input includes filtering and voltage protection.

Where a Tap-In jumper is used, opening the jumper removes only the internal pull-up. The remaining input circuitry stays connected.

Vehicle-facing sensors are supplied from a regulated sensor supply.

Some Spitronics hardware separates the external sensor supply from the processor supply to reduce the possibility of vehicle wiring interference reaching sensitive onboard electronics.

Back to Top

Setup Check

Before relying on Coolant Temperature information, verify:

[ ] Correct coolant sensor is fitted.

[ ] Sensor is an appropriate two-wire NTC type.

[ ] Sensor resistance is reasonable for actual temperature.

[ ] Sensor Ground returns correctly to the ECU.

[ ] Realtime temperature reading is believable when cold.

[ ] Temperature rises smoothly during warm-up.

[ ] Calibration is correct at normal operating temperature.

[ ] Open and short-circuit tests behave correctly where required.

[ ] Shared sensor installations use only one compatible pull-up.

[ ] Single-wire gauge senders are not used.

[ ] Warm-engine base Tune is correct before coolant compensation is adjusted.

[ ] Coolant compensation returns to zero in the normal operating range.

[ ] Over-temperature compensation is treated only as an additional protection measure.

Back to Top