Spitronics - Electronic Throttle Control - Manual

Introduction

The Spitronics Electronic Throttle Control (ETC) system provides electronic control between the accelerator pedal and an electronic throttle body.

With a conventional mechanical throttle, the accelerator pedal is connected directly to the throttle plate by a cable or mechanical linkage. With Electronic Throttle Control there is no direct mechanical connection between the pedal and throttle.

The accelerator pedal contains position sensors that indicate the driver's request. The ETC reads the **Pedal TPS**, calculates the required **Throttle Target**, and controls the throttle motor until the **Throttle TPS** reaches the requested position.

The basic control path is therefore:
Pedal TPS → Throttle Target → Throttle TPS

These three values are displayed together in the RealTime Data area and form an important part of ETC setup and diagnostics.

Electronic control allows the throttle to perform considerably more than simply following the accelerator pedal. The system can modify or limit throttle opening according to engine operating conditions.

Functions include:
- Adjustable pedal response
- Closed-loop throttle position control
- Idle Speed Control
- Cold-start and warm-up assistance
- Multiple Tunes

- RPM-based throttle limiting
  MAP/boost-based throttle limiting
- Cold-engine throttle limiting
- Over-temperature engine protection
- Pedal and throttle sensor diagnostics

Throttle Target

An important concept when working with ETC is the **Throttle Target**.

Throttle Target is the position that the Device is currently requesting from the electronic throttle. It is not necessarily the same as Pedal TPS.

For example, the driver may press the accelerator to 50%, but the Pedal Response Graph may request only 30% throttle opening. The Throttle Target will therefore be 30%.

Other functions can further modify or limit this Target. MAP limiting, RPM limiting, temperature protection and Idle Control can all influence the final throttle position requested by the Device.

The throttle control system then drives the motor until the actual **Throttle TPS** follows this Target.

Diagnostic Tip: When diagnosing ETC operation, always compare **Pedal TPS**, **Throttle Target** and **Throttle TPS**. These three values quickly indicate whether a problem originates from the pedal input, the calculated request, or the throttle control itself.

Safety Information

Electronic Throttle Control directly controls engine power. Incorrect wiring, calibration or settings can cause unexpected throttle movement.

Installation and initial setup must therefore be completed before the vehicle is driven.

Before Starting the Engine

Complete the initial throttle setup with the engine stopped.

Verify that:

- The accelerator pedal reads correctly from released to fully depressed.
- Both pedal position signals operate correctly. (newer Devices only)
- The electronic throttle has been correctly calibrated.
- Both throttle position signals operate correctly. (newer Devices only)
- Throttle movement is in the correct direction.
- The throttle moves smoothly throughout its operating range.
- Throttle TPS follows Throttle Target correctly.
- The throttle returns to a safe position when control is removed.
- Sensor diagnostic limits are correctly configured.
- No active Pedal TPS or Throttle TPS DTCs remain.

Keep clear of the throttle plate while testing. Electronic throttles contain powerful motors and gearboxes and can move suddenly during setup.

Throttle Test Mode

Throttle Test Mode is provided to assist with installation and setup.

Only use this function while the vehicle is stationary and under controlled conditions.

Where practical, perform initial throttle testing with the engine stopped so that unexpected throttle movement cannot cause an increase in engine speed.

Warning: Do not drive the vehicle while unresolved Electronic Throttle Control DTCs are present.

Wiring and Installation

Complete and verify the wiring before attempting pedal or throttle calibration. Electronic Throttle Control directly controls engine power, so poor power, ground or sensor connections must be corrected before software setup begins.

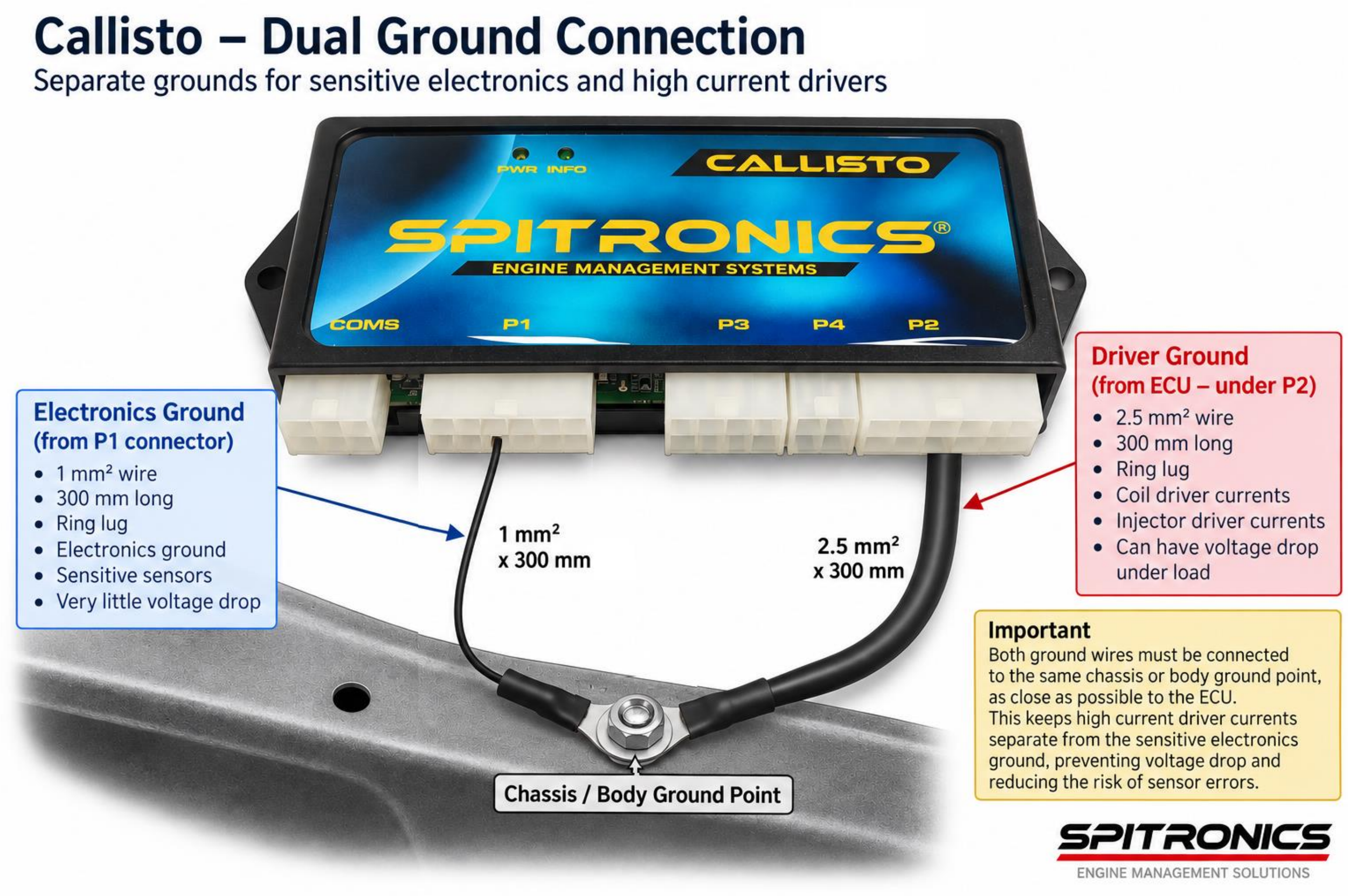
The exact connector pin numbers depend on the Device and firmware. Use the pin layout supplied for the applicable Device together with this section.

Power Supply and Grounds

The ETC uses Battery Power and Ignition Power. Battery Power supplies the Device and throttle control system, while Ignition Power indicates the vehicle ignition-switch state.

- Use a correctly fused battery supply suitable for the Device and throttle motor current.
- Use secure ground connections with low resistance to the engine/chassis electrical ground.
- Do not share a weak ground path with high-current loads such as ignition coils, injectors, fans or starter wiring.
- Keep sensor grounds and sensor wiring away from throttle-motor and other high-current wiring where practical.

After wiring, confirm that Battery and Ignition Voltage are sensible in RealTime Data and remain stable while the throttle is moving.



Accelerator Pedal Wiring

Electronic accelerator pedals normally contain two position sensor signals. Newer Devices use both signals for calibration and diagnostic monitoring.

- Connect the sensor supply, sensor ground and both Pedal TPS signals according to the applicable pin layout.
- Do not assume that two pedal signals use the same voltage range or direction. The calibration procedure establishes their correct relationship.
- Before driving, verify smooth operation through the complete pedal travel and confirm that no Pedal TPS DTC is generated.

Electronic Throttle Body Wiring

The electronic throttle body contains a DC motor and throttle position sensors. Both the motor wiring and position feedback must be correct before normal control is enabled.

- Connect the two throttle-motor wires to the specified motor outputs.
- Connect the throttle sensor supply, sensor ground and Throttle TPS signals according to the applicable pin layout.
- Do not interchange sensor supply and ground connections.
- Initial motor-direction and sensor-range checks must be performed with the engine stopped.

Warning: The throttle plate can move suddenly and with considerable force whenever the ETC is powered. Keep fingers, tools and loose objects clear of the throttle body.

MAP Sensor Wiring

The MAP Sensor input is optional for basic throttle operation. When enabled, it provides manifold absolute pressure information for RealTime display and the MAP Throttle Limit Graph.

Connect a suitable MAP sensor according to the applicable Device pin layout. Use the correct sensor supply and sensor ground, and route the signal away from ignition and other high-noise wiring where practical.

With the engine stopped, the displayed MAP pressure should be reasonably close to the local barometric pressure. Complete Sensor Calibration before enabling MAP-based throttle limiting.

RPM Input

RPM is optional for basic pedal-to-throttle operation, but is required for Idle Control and RPM-based throttle limiting.

The RPM signal may be taken from a suitable ECU, ignition or engine-speed output provided that the signal is electrically compatible with the ETC input. Route the signal away from ignition and other high-noise wiring where practical. After setup, compare RealTime RPM with the actual engine speed at more than one RPM.

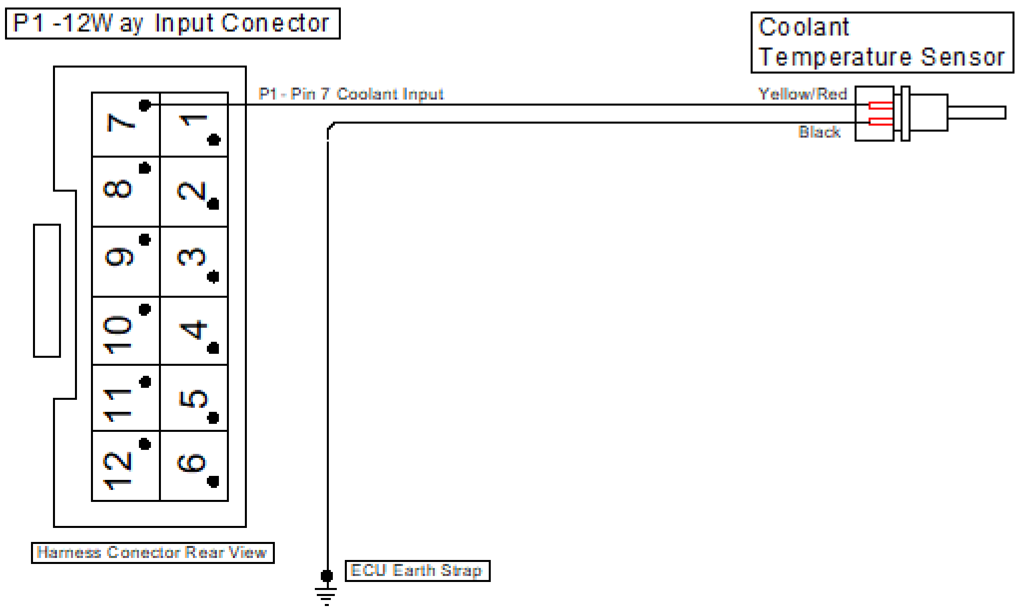
Coolant Temperature Sensor Wiring

Coolant Temperature is optional for basic ETC operation, but is required for cold-start airflow assistance and coolant-based throttle protection. There are two practical installation methods.

Option 1 - Dedicated ETC Coolant Sensor

This is the preferred method when the existing engine sensor circuit is unknown or cannot be shared safely. Install a separate compatible temperature sensor in a position that measures engine coolant temperature and connect it directly to the ETC coolant input and sensor ground.

A dedicated sensor prevents the ETC input circuit from changing the signal used by the original ECU and makes calibration and fault finding more predictable.



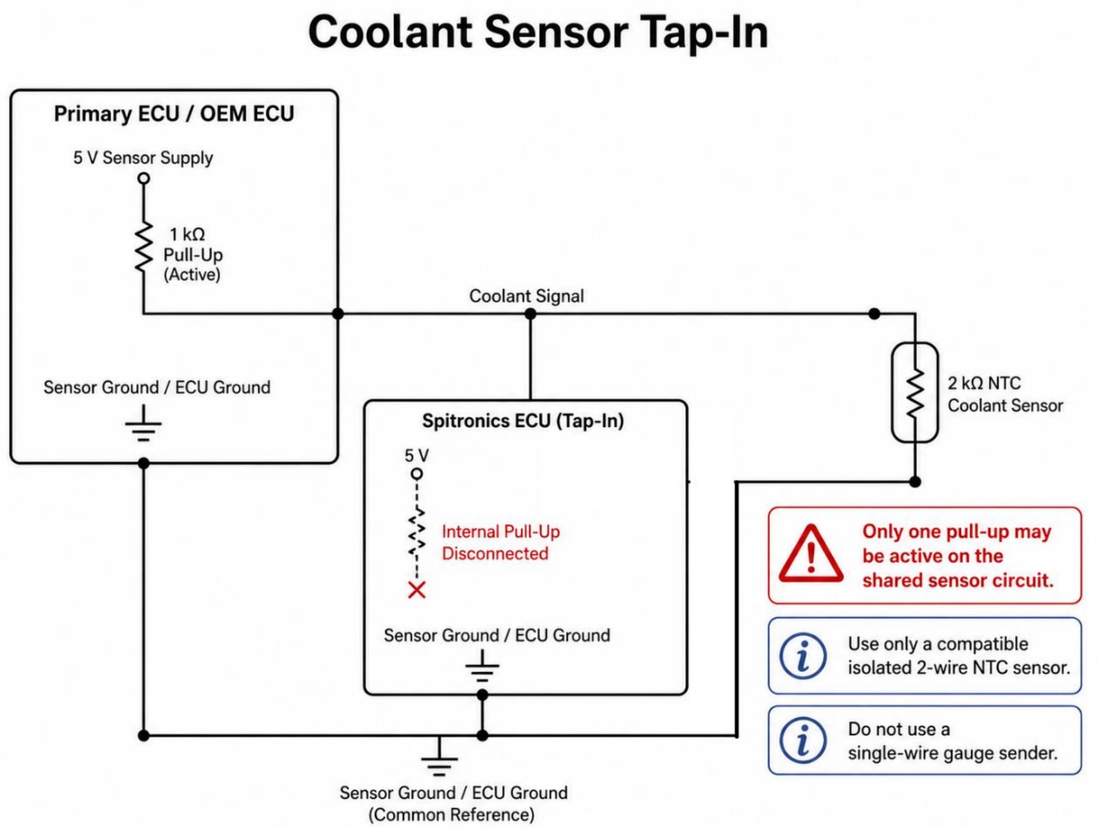
Option 2 - Tap into an Existing Coolant Sensor

The existing engine coolant sensor may be shared only when the electrical arrangement is known to be compatible. Many coolant sensors are resistive NTC sensors and the original ECU uses an internal pull-up resistor to create the measured voltage. Connecting a second controller can change this circuit and therefore change the temperature seen by one or both controllers.

Before tapping into an existing sensor:

- Identify the sensor type and existing ECU wiring.
- Confirm whether the ETC input or the original ECU applies a pull-up to the signal.
- Confirm that connecting the ETC will not alter the original ECU temperature reading or interfere with its diagnostics.
- Measure and compare the sensor voltage and temperature reading before and after the ETC is connected.
- Verify the ETC temperature against ambient temperature when cold and through normal warm-up before enabling any coolant-based throttle limits.

Important: If compatibility cannot be confirmed, do not tap into the original sensor circuit. Fit a dedicated ETC coolant sensor instead.



Tune Selection Input

Where Multiple Tunes are used, connect the Tune Selection input according to the applicable Device pin layout and selection method. Confirm the selected mode by watching Active Tune in RealTime Data before relying on Tune-specific throttle behaviour.

Wiring Check Before Power-Up

Before applying power for the first calibration, verify:

- Battery power and fuse protection.
- Ignition power.
- Ground connections.
- Pedal sensor supply, ground and both signal wires.
- Throttle motor wiring.
- Throttle sensor supply, ground and both signal wires.
- MAP Sensor input, if used.
- RPM input, if used.
- Coolant Temperature input, if used.
- Tune Selection wiring, if used.

Do not continue to software calibration until the wiring has been checked and any uncertainty around sensor supply or ground connections has been resolved.

Software Overview

The Cosmos ETC software is divided into several areas that remain consistent while moving between the different setup pages.

Understanding these areas makes the remainder of the manual easier to follow.

Content Tree

The **Content Tree** is displayed on the left side of the software.
It provides access to the available setup and tuning pages and is divided into logical groups:

Device Information

Identifies the connected Device, hardware, firmware and licensing.

Inputs

Contains configuration and calibration for the signals used by the ETC.

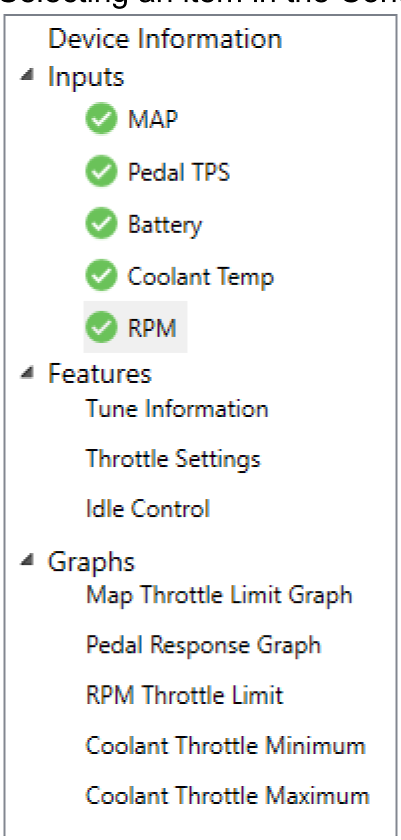
Features

Contains the main ETC operating and control settings.

Graphs

Contains the adjustable graphs used to modify or limit throttle operation according to pedal position, MAP pressure, RPM and coolant temperature.

Selecting an item in the Content Tree opens that page in the centre of the software.



Tuning Palette

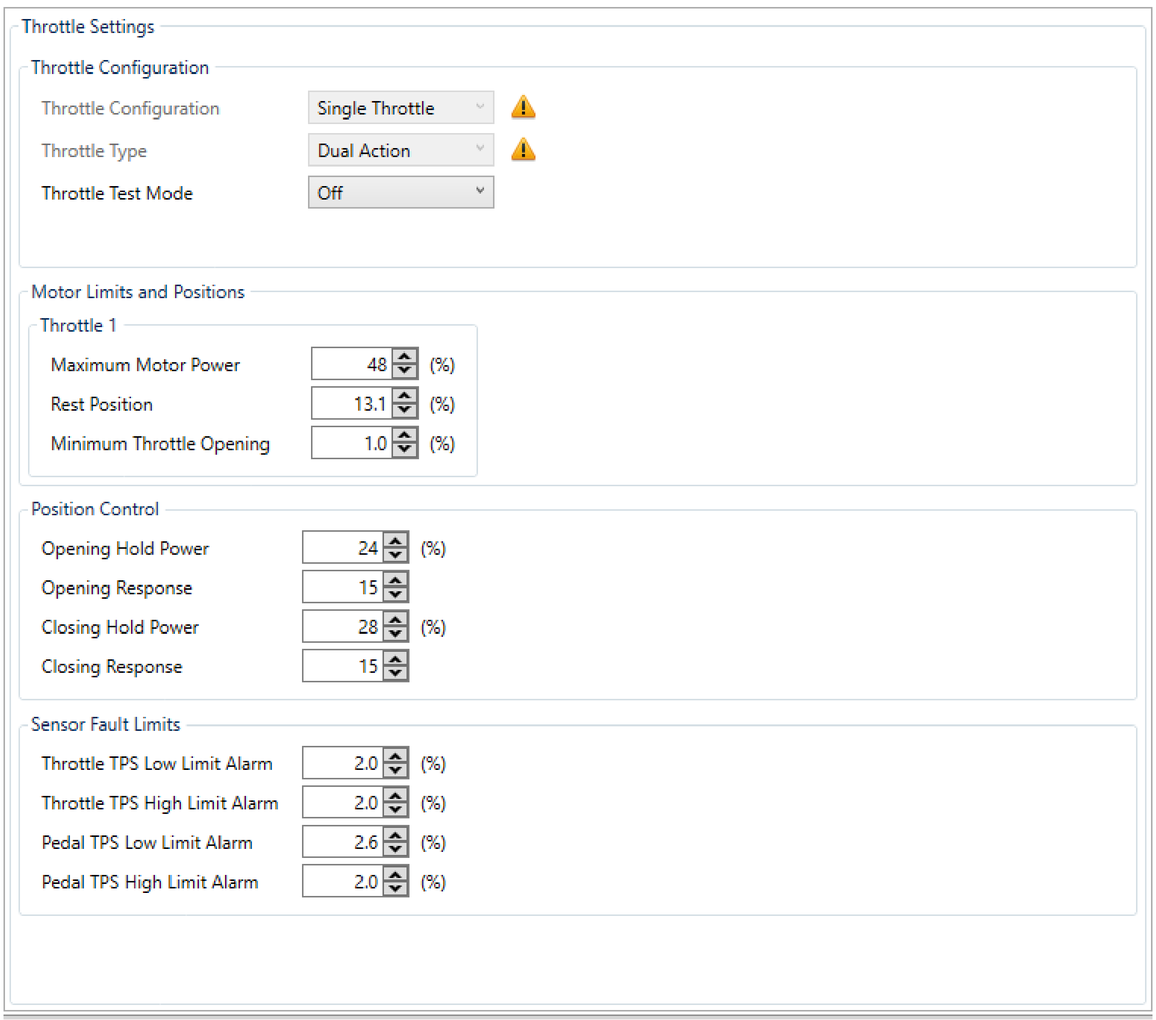
The centre section is called the **Tuning Palette**.

This is the main working area of Cosmos.

Depending on the selected Content Tree item, the Tuning Palette may display:

- Settings
- Calibration functions
- Selection options
- Control parameters
- Tuning graphs

Only the Tuning Palette changes as different pages are selected. The Content Tree and RealTime Data remain visible, allowing the tuner to adjust settings while observing the Device operation.



RealTime Data

The right side of the software displays the most important ETC operating values.

These values update while the Device is connected and are particularly useful during calibration, tuning and fault finding.

MAP Sensor

Displays the current manifold absolute pressure when the MAP input is enabled.

The RealTime value is displayed in bar. With the engine stopped it should be close to the local barometric pressure. The MAP value is also used by the MAP Throttle Limit Graph.

RPM

Displays the current engine speed.

RPM is processed with **10 RPM resolution**.

Pedal TPS 1

Displays the calibrated accelerator pedal position.

Pedal position is displayed with **0.1% resolution**.

Throttle Target

Displays the throttle opening currently requested by the ETC control system.

This value is particularly important because it shows the result after the Device has processed the driver's request and any active control functions. Throttle Target resolution is displayed with **0.1% resolution**.

Throttle TPS 1

Displays the actual calibrated throttle position.

Throttle position is displayed with **0.1% resolution**.

During normal operation, Throttle TPS should follow Throttle Target closely.

Battery

Displays the main battery supply voltage. (Not yet implemented on Callisto)

Ignition

Displays the ignition-switched supply voltage.

The ETC has separate battery and ignition power inputs. The ignition input allows the Device to detect when the vehicle ignition has been switched off.

This allows controlled shutdown functions to be performed where required before the Device removes its internal battery power.

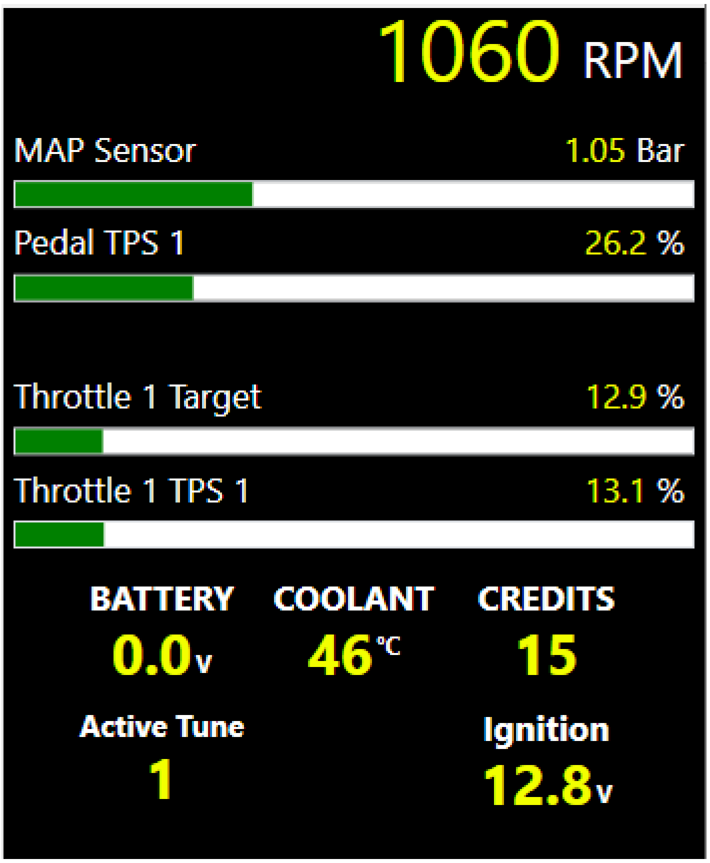
Coolant

Displays the current engine coolant temperature.

Active Tune
Displays the Tune currently controlling the ETC.

This is useful where Multiple Tunes are enabled because the tuner can confirm which Tune is active without leaving the current tuning page.

Credits
Displays the available Device activation credits required by the loaded firmware.



Using RealTime Data for ETC Diagnosis
The three most useful values during ETC diagnosis are:
Pedal TPS 1 → Throttle Target → Throttle TPS 1

They represent three different stages of operation.
If **Pedal TPS changes correctly but Throttle Target does not**, investigate the configuration, Pedal Response Graph or an active throttle limit.

If **Throttle Target changes correctly but Throttle TPS does not follow it**, investigate the throttle calibration, motor control settings, wiring, throttle body or an active DTC.

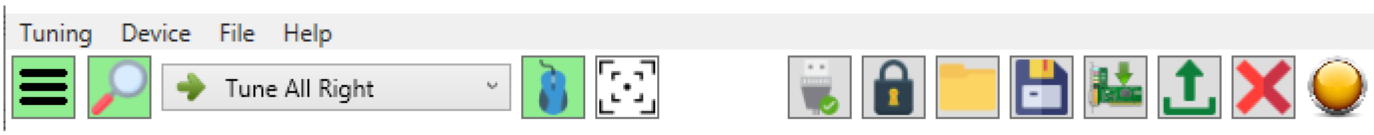
If **Pedal TPS itself is incorrect**, investigate pedal calibration, wiring and the pedal sensors before adjusting the throttle control.

This simple sequence prevents unnecessary adjustment of the throttle controller when the actual problem is somewhere else.

Toolbars

The toolbars at the top of Cosmos provide quick access to common software and Device functions. These include functions such as opening and saving Tunes, transferring information between the PC and Device, and other software operations.

Only ETC-specific functions are covered in detail in this manual. General Cosmos file and software operation is covered in the relevant Cosmos software documentation.

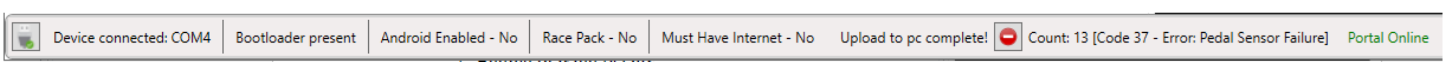


Information Bar

The Information Bar at the bottom of the software provides important status information.

Depending on Device and software configuration, this may include:

- Device connection status
- Communication port
- Bootloader status
- Android status
- Race Pack status
- Internet requirement
- File or programming status
- DTC count
- Current DTC information
- Portal connection status



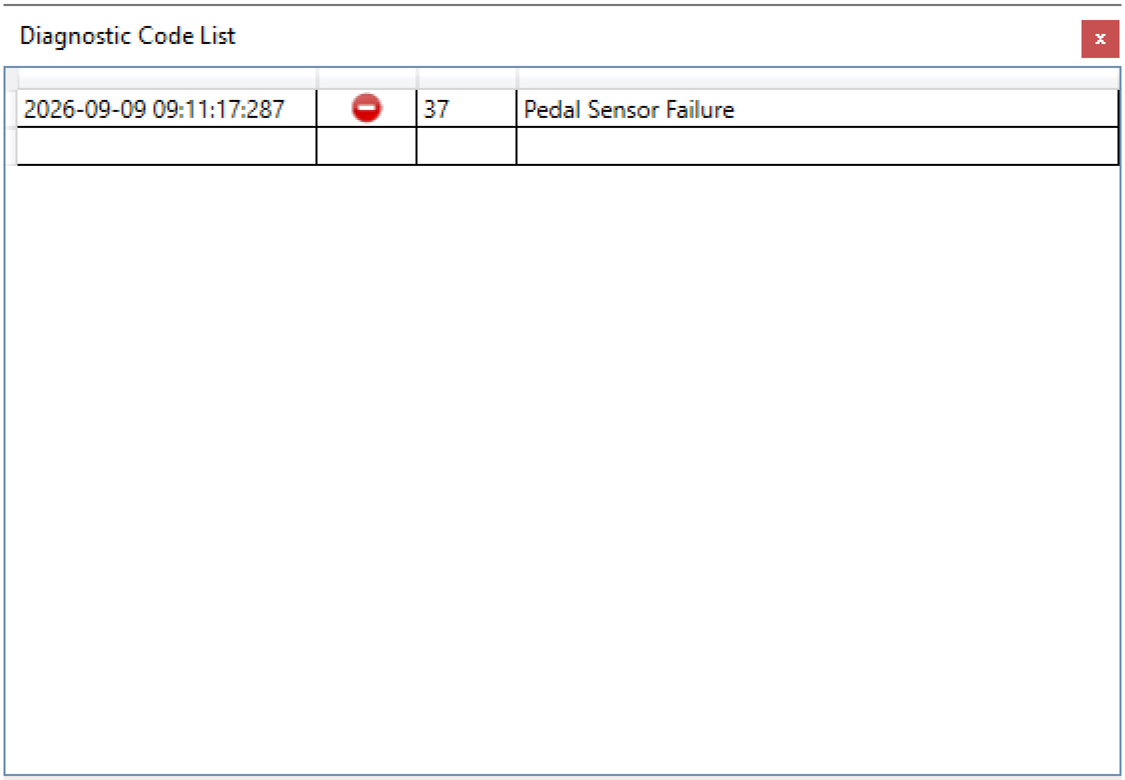
DTC Display

When a Diagnostic Trouble Code is active, the Information Bar displays the error information.

For example:
Code 37 – Error: Pedal Sensor Failure
The DTC count indicates the number of detected diagnostic events or faults according to the Device diagnostic system.

An active ETC DTC should be investigated before normal vehicle operation.

Click the error-count icon to open the list of DTC codes detected since the list was last opened or since the DTCs were cleared with the C hot key.



Device Information

The Device Information page identifies the hardware and firmware currently connected to Cosmos.

This page is useful when checking an installation, requesting technical support or confirming that the correct firmware is installed.

Hardware

Device Serial Number
The unique serial number assigned to the Device.

The serial number is also used by the software for Device identification and file management.

Board Number
Identifies the hardware board version fitted to the Device.

This information can be important when determining hardware compatibility or providing technical support.

Hardware Type
Identifies the Device hardware platform.

Firmware Type Locked
Identifies the firmware type allocated to the Device.

Firmware Number Locked

Identifies the firmware number allocated to the Device.

Brand Code
Identifies the product branding configuration.

These hardware identification values are normally informational and are not tuning settings.

Firmware

This section identifies the firmware currently operating in the Device.

Firmware Type
Displays the application type.
For this system:
Electronic Throttle Control

Firmware Version
Displays the installed firmware revision.

This is useful when comparing software operation, documentation and technical support information.

Firmware Number
Identifies the specific firmware configuration.

Configuration
Displays the ETC configuration used by the firmware.

Licensing

Credits
Displays the number of activation credits activated for this Device. This must match the firmware required credits.

Activation Date
Displays the Device activation date.

Status
Displays the current activation status.

A correctly activated Device will display:
Active

Inputs

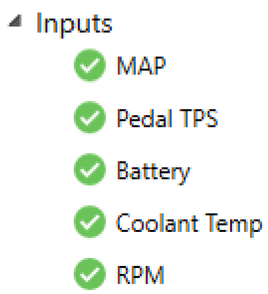
The Inputs section contains the signals required by the ETC to determine driver demand and engine operating conditions.

Not every input is required for basic electronic throttle operation. Optional inputs can be enabled when the related functions are required.

The available input pages are:

MAP Sensor
- Pedal TPS
- Battery
- Coolant Temperature
- RPM
- Tune Selection

Where an input is disabled, settings and functions that depend on that input may also be hidden or unavailable.



MAP Sensor

The MAP Sensor input measures manifold absolute pressure. It is optional for basic pedal-to-throttle control and is primarily used for boost/pressure-based throttle limiting.

Enable - Enables the MAP Sensor input and its RealTime value.

Filter - Enables additional MAP signal filtering where a steadier pressure signal is required. Use only as much filtering as needed so that protection response remains suitably quick.

Sensor Calibration - Opens the MAP Sensor Calibration window containing Range Gain and Zero Offset.

For initial calibration, set Zero Offset to 0.0 and start Range Gain at its maximum value. With the engine stopped, reduce Range Gain until the displayed pressure matches the barometric pressure at the vehicle location. Increase Zero Offset only if the lowest manifold pressure cannot reach the required low value. After changing Zero Offset, recheck Range Gain because the two settings influence each other slightly.

MAP Scale - Sets the full pressure range used by the MAP Throttle Limit Graph. The value is entered in bar; for example, 3.0 sets a graph range up to 3.0 bar absolute.

Important: The MAP value is absolute pressure. A graph point of 3.0 bar therefore means 3.0 bar absolute manifold pressure, not 3.0 bar boost above atmosphere.

Pedal TPS

The accelerator pedal provides the driver's requested throttle input.

Electronic accelerator pedals normally contain two position sensor signals. These provide redundant information so that the Device can monitor the pedal operation and detect a sensor or wiring fault.

The pedal must be calibrated before the ETC is operated.

Enable
Enables the Pedal TPS input.

Pedal position is displayed in the RealTime Data area with **0.1% resolution**.

After calibration:

- 0.0% represents the released pedal position.

- 100.0% represents the fully depressed pedal position.

The calibrated percentage is used by the ETC rather than the original sensor voltage.

Enable Pedal Response Graph

Enables the **Pedal Response Graph**.

When disabled, pedal movement uses the normal direct throttle request defined by the system.

When enabled, the Pedal Response Graph allows the relationship between pedal position and requested throttle opening to be modified.

This can be used to create different throttle characteristics without changing the physical pedal calibration.

For example, the first half of the pedal travel can be made less sensitive for improved low-speed control while still allowing 100% throttle opening at full pedal.

The graph is discussed in detail under Pedal Response Graph.

Calibrate Pedal TPS

Select Calibrate Pedal TPS to establish the released and fully depressed pedal positions. The calibration also forms part of the electronic-throttle calibration procedure described later in this manual.

Before calibration, verify that Pedal TPS 1 increases as the pedal is pressed and that the raw signal remains clear of both electrical rails. As a practical guide, retain about 5% diagnostic headroom at each end of travel.

For the complete sensor-range, motor-power and throttle calibration procedure, refer to the Spitronics - Electronic Throttle Control Calibration - Guide.

Dual Pedal Sensors (newer Devices only)

The two pedal position signals provide an important ETC safety check.

Depending on the accelerator pedal design, the two raw sensor signals may operate in the same direction, opposite directions or use different signal ranges.

The calibration converts these signals into a common pedal position that the Device can compare. The ETC can therefore detect disagreement between the two pedal signals rather than relying only on a single position sensor.

The permitted disagreement is configured using the **Pedal TPS Low Limit Alarm** and **Pedal TPS High Limit Alarm** settings under Throttle Settings.

A pedal sensor DTC must be investigated before the vehicle is driven.

<u>Battery</u>
The ETC has two power inputs:

- Battery Power
- Ignition Power

These provide the Device with information about both the main electrical supply and the ignition-switch status.

Enable
Enables Battery Voltage in the RealTime Data display.

Disabling this setting only removes the value from the RealTime display. Battery and ignition voltage monitoring required internally by the Device remains operational.

Battery Voltage (newer Devices only)
Battery Voltage represents the main power supply available to the Device.

The value is useful during setup and diagnostics because an electronic throttle motor can draw significant current during operation. Poor supply wiring, weak connections or low battery voltage can therefore affect throttle operation.

If abnormal throttle behaviour occurs, verify that the battery voltage remains stable while the throttle is moving.

Note on older products this was the Ignition voltage.

<u>Ignition Voltage</u>
Ignition Voltage represents the ignition-switched power input.

The Device uses this signal to determine when the vehicle ignition has been switched off.

The ETC may remain powered from the battery supply for a controlled period after the ignition input disappears.

This allows the Device to complete required shutdown functions before internal battery power is switched off.

Depending on the application, shutdown may take operating conditions such as engine RPM or coolant temperature into account.

The Device also monitors supply voltage to ensure that voltage is at a safe level before performing operations such as writing information to Flash memory.

Diagnostic Tip: If the Device does not switch on or shut down as expected, compare **Battery Voltage** and **Ignition Voltage** in RealTime Data before investigating the ETC control settings.

Coolant Temperature

The Coolant Temperature input allows throttle operation to respond to engine temperature.

It is not required for basic pedal-to-throttle operation, but enables important functions such as:

- Cold-start airflow assistance
- Warm-up idle compensation
- Cold-engine throttle protection
- Over-temperature throttle protection

Enable

Enables the Coolant Temperature input and the functions that depend on it.

The current temperature is displayed in the RealTime Data area.

Coolant temperature is displayed in whole degrees Celsius.

Calibrate Coolant Temperature Sensor

Select **Calibrate Coolant Temperature Sensor** to configure the temperature sensor used by the installation.

The correct calibration is important because all temperature-related throttle functions depend on this value.

After calibration, verify the RealTime coolant temperature before enabling temperature-based throttle control.

With a cold engine that has been standing for several hours, coolant temperature should normally be reasonably close to ambient temperature.

As the engine warms, the value should increase progressively without sudden jumps.

Important: Do not configure coolant throttle protection until the temperature sensor reading has been verified. An incorrect sensor calibration could cause throttle limiting at the wrong engine temperature.

Coolant Throttle Minimum Graph

Enables the **Coolant Throttle Minimum Graph**.
This graph defines the minimum throttle opening according to coolant temperature.

Its main purpose is to provide additional airflow when the engine is cold.

A cold engine may require more throttle opening to maintain idle speed. As the engine warms, the minimum permitted opening can progressively reduce toward the normal warm operating value.

This provides smooth cold-start and warm-up assistance without requiring a separate idle valve.

The graph is covered in detail under Coolant Throttle Minimum.

Coolant Throttle Maximum Graph

Enables the **Coolant Throttle Maximum Graph**.

This graph defines the maximum permitted throttle opening according to coolant temperature.
It can be used at both ends of the temperature range.

When the engine is cold, maximum throttle opening can be reduced to discourage high engine load before normal operating temperature is reached.

At normal temperature, full throttle operation can be permitted.

If the engine overheats, maximum throttle opening can progressively be reduced to limit engine power and help protect the engine.

The graph is covered in detail under Coolant Throttle Maximum.

RPM

The RPM input provides engine-speed information to the ETC.

Basic pedal-to-throttle operation can function without RPM, but engine speed is required for functions such as:

- Idle Speed Control
- RPM Throttle Limiting
- Engine-speed-dependent protection

Enable

Enables the RPM input.

When RPM is disabled, functions requiring engine speed are not available.

The current engine speed is displayed in RealTime Data.

RPM is processed and adjusted in **10 RPM increments**, providing sufficient resolution for accurate ETC idle-speed control.

Trigger Edge

Selects which electrical edge of the incoming RPM signal is used for RPM measurement.

The available selection allows the ETC to be matched to the RPM signal source.

The correct edge should provide a clean and stable RPM reading.

If the RPM value is unstable or incorrect, verify the signal source, wiring, Trigger Edge and RPM calibration before attempting to tune Idle Control.

Calibrate RPM

Select **Calibrate RPM** to configure the relationship between the incoming RPM pulses and actual engine speed.

The calibration must correspond with the signal source connected to the ETC.

Different installations may provide very different numbers of pulses per engine revolution. The calibration allows the same ETC system to operate with these different signal sources.

After calibration, compare the RealTime RPM with the known engine speed.

Verify the reading at more than one engine speed where possible.

For example, a calibration that accidentally produces double or half the correct RPM may appear believable at idle but will make all RPM-dependent ETC functions operate incorrectly.

RPM Range

Sets the RPM operating range used by the software and related functions.

The range should be high enough to cover the maximum expected engine speed.

The current software provides an operating range suitable for engines up to **15 000 RPM**.

Enable RPM Throttle Limit

Enables the **RPM Throttle Limit Graph**.

This graph defines the maximum permitted throttle opening according to engine speed.

It allows the ETC to progressively restrict throttle opening as RPM approaches a defined operating limit.

Unlike a conventional hard fuel or ignition cut, throttle limiting can begin progressively before the maximum engine speed is reached.

This can provide smoother engine protection where appropriate.

The graph is discussed in detail under RPM Throttle Limit.

Tune Selection

The ETC supports Multiple Tunes.

A Tune can contain different ETC operating characteristics, allowing the driver or tuner to select between different throttle behaviours without recalibrating the pedal or throttle hardware.

Typical applications include:

- Economy response
- Normal road response
- Performance response
- Reduced throttle response for poor traction conditions
- Application-specific operating modes

Enable Multiple Tunes
Enables the Multiple Tune function.

When Multiple Tunes are not required, this function can remain disabled to simplify the installation.

Tune Selection

Determines which Tune is selected for operation.

The currently operating Tune is displayed as **Active Tune** in the RealTime Data area.

This is important during tuning because the selected input or operating condition may change the Active Tune while another software page is open.

Always verify **Active Tune** before adjusting or diagnosing Tune-specific throttle behaviour.

Changing Tunes

A Tune change affects the throttle control characteristics associated with the selected Tune.

The ETC must manage Tune changes without requiring the driver to release the accelerator pedal first.

For example, if an economy Tune is active while climbing a hill and the driver selects a performance Tune, the new throttle response must become available without requiring the pedal to first return to zero.

The ETC therefore transitions from the current operating condition into the newly selected Tune rather than waiting for a new pedal cycle.

Tuning Tip: When testing Multiple Tunes, watch **Pedal TPS**, **Throttle Target** and **Active Tune** together. This makes it easy to verify that the Tune has changed and that the new Pedal Response is being applied correctly.

Safety: Do not change Tunes while driving in traffic during initial testing. A newly selected Tune may request more throttle and cause a sudden change in vehicle response.

Input Setup Check

Before continuing to the main Throttle Settings, perform a basic check of all enabled inputs.
With the Device connected to Cosmos, verify:

- Pedal TPS moves smoothly through the complete pedal range.

MAP pressure is sensible when MAP is enabled.

- Battery and Ignition Voltage readings are sensible.
-
- Coolant Temperature corresponds with actual engine temperature.
- RPM corresponds with actual engine speed.
-
- Active Tune corresponds with the selected Tune.

Do not proceed with detailed throttle tuning while an input required by that function is incorrect.

Correct input information is the foundation for all ETC control functions.

Features

The Features section contains the main settings that determine how the ETC operates after the input signals have been calibrated.

The available pages are:

- Tune Information
- Throttle Settings
- Idle Control

Throttle Settings configure the basic electronic throttle control. These settings should be correctly adjusted before functions such as Idle Control and the throttle limiting graphs are tuned.

Tune Information

Tune Information allows identification and description information to be stored with the Tune.

This information does not directly affect throttle operation but is useful for identifying Tune files and recording application information.

Tune Name
Enter a meaningful name that identifies the Tune or vehicle application.

A useful Tune name makes saved files easier to identify later and helps prevent the incorrect Tune from being loaded into a Device.

Description
The Description field can be used to record additional information about the Tune.

Useful information may include:

- Vehicle or engine application
- Throttle body type
- Pedal type
- Purpose of the Tune
- Important setup information
- Tuner notes

Throttle Settings

Throttle Settings contains the primary control parameters for the electronic throttle body.
These settings determine:

- Throttle configuration
- Motor power
- Mechanical rest position
- Minimum throttle position
- Opening control
- Closing control
- Pedal sensor diagnostic limits
- Throttle sensor diagnostic limits

Correct adjustment of this page is essential before the ETC is used to control an engine.

Throttle Configuration

Selects the number of electronic throttle bodies controlled by the Device. Select Single Throttle for a normal one-throttle installation. Select Dual Throttle only on hardware that supports a second electronic throttle.
When Dual Throttle is selected, the second throttle Target and TPS channels become available and the applicable throttle modulation graph can control the two throttle targets independently.

Throttle Type

Selects the motor drive arrangement used by the electronic throttle. Single Action and Dual Action are selected according to the throttle hardware and the applicable Device configuration.

The correct Throttle Type must be selected before throttle calibration and motor-control testing.

Throttle Test Mode

Throttle Test Mode is used during initial setup and testing of the electronic throttle.

It allows throttle operation to be checked without relying on normal vehicle operation.

Use Test Mode to verify:

- Correct motor direction

- Correct throttle position feedback
- Smooth throttle movement
- Opening and closing control
- Throttle Target tracking

Always perform initial throttle testing with the engine stopped.

Warning: Keep fingers, tools and loose objects away from the throttle plate during testing. Electronic throttle motors can move suddenly and with considerable force.

<u>Show TPS 2</u>

Displays the secondary Pedal TPS and Throttle TPS channels in the RealTime Data area during setup and diagnostics.

TPS 2 channels remain active for redundant sensor monitoring in the background. Hiding them only reduces screen clutter; it does not disable the safety monitoring.

<u>Understanding the Mechanical Rest Position</u>

An electronic throttle body contains return springs that move the throttle toward a mechanical **Rest Position** when no motor power is applied.

The Rest Position is normally partially open rather than completely closed.

This provides a mechanical limp-home airflow if electronic throttle control is lost.

The Rest Position is also important to the control system because the spring force changes direction around this point.

When the throttle is above Rest Position, the return spring generally assists movement toward the Rest Position.

When the throttle is below Rest Position, the opposing spring arrangement acts in the opposite direction.

The ETC therefore has to control the throttle correctly on both sides of this mechanical balance point. This is especially important during Idle Control because the required idle opening may operate close to, or even cross, the mechanical Rest Position.

Rest Position is determined after Throttle TPS is calibrated automatically. During the initial test functions, the software displays raw range values rather than calibrated throttle values. Rest Position can then be fine-adjusted independently of the calibrated Throttle TPS minimum and maximum.

Maximum Motor Power

Maximum Motor Power limits the maximum drive that the ETC may apply to the throttle motor.

The setting protects the throttle motor and ETC output drivers from unnecessary current while still allowing sufficient force for fast and reliable throttle movement.

A higher value allows the controller to apply more motor force.

A value that is too low may result in:

- Slow throttle movement
- Failure to reach Throttle Target quickly
- Poor control against strong return springs
- Difficulty reaching the extremes of throttle travel

Excessive motor power should not be used simply to compensate for incorrect control settings or a mechanically sticking throttle.

Setup Tip: Use only enough Maximum Motor Power to provide reliable throttle movement throughout the operating range.

Rest Position

Rest Position defines the calibrated throttle position where the throttle naturally settles when motor drive is removed.

The value is expressed as throttle opening percentage with **0.1% resolution**.
For example:

12.5% = mechanical throttle Rest Position of 12.5%

The Rest Position should be determined from the actual throttle body rather than estimated.

To establish the position, remove motor control and observe the Throttle TPS value where the throttle naturally settles.

Correct Rest Position information is particularly important because the motor control characteristics change as the throttle crosses this point.

Minimum Throttle Opening

Minimum Throttle Opening defines the lowest throttle position that the ETC is normally permitted to command.

The value is expressed with **0.1% resolution**.

This prevents the controller from attempting to force the throttle beyond the required minimum operating position.

The setting should not be confused with Rest Position.

For example:
Rest Position = 12.5%
does not mean that the ETC cannot control the throttle below 12.5%.

Motor power can actively drive the throttle below its natural Rest Position when required.

A **Minimum Throttle Opening of 1.0%** would therefore allow the controller to close the throttle considerably further than its mechanical Rest Position.

Throttle Motor Control

The ETC uses closed-loop position control.

The basic control principle is:
Throttle Target → Position Error → Motor Control → Throttle TPS

The Device continuously compares the requested Throttle Target with the actual Throttle TPS position.

If the throttle is not at the requested position, motor drive is adjusted until the position error is reduced.

Separate opening and closing settings are provided because an electronic throttle is mechanically asymmetric.

Spring force, friction and motor load are not identical in both directions.

Opening Hold Power

Opening Hold Power provides the base motor drive associated with holding the throttle in the opening direction.

The electronic throttle return spring continuously applies force to the throttle plate. The motor therefore requires a certain amount of drive simply to maintain a position before additional correction is applied.

Correct Hold Power reduces the amount of correction required from the position controller.

If Opening Hold Power is too low, the controller must continually add correction to maintain the requested opening.

If it is unnecessarily high, the controller must compensate in the opposite direction and control may become less stable.

The correct setting provides a good balance where relatively little additional correction is required to maintain position.

Opening Response

Opening Response determines how strongly the ETC reacts when the actual throttle position is below the requested Throttle Target.

Increasing Opening Response makes the throttle react more aggressively to position error.

A higher setting can provide:

- Faster throttle opening
- Faster Target tracking
- Stronger correction against spring force

If set too high, it may cause:

- Overshoot
- Oscillation
- Unstable throttle position
- Unnecessarily aggressive motor operation

If set too low, throttle response may feel slow and Throttle TPS may lag behind Throttle Target.

The objective is not to achieve the highest possible response value, but to obtain fast and stable Target tracking.

Closing Hold Power

Closing Hold Power provides the base motor drive associated with holding or controlling the throttle in the closing direction.

Because the throttle spring forces differ above and below the mechanical Rest Position, the required closing drive may differ significantly from the opening drive.

Correct Closing Hold Power helps the controller maintain accurate position without requiring excessive closed-loop correction.

Closing Response

Closing Response determines how strongly the ETC reacts when the actual throttle position is above the requested Throttle Target.

Increasing the value makes the throttle close more aggressively toward the Target.
If Closing Response is too high, the throttle may overshoot or oscillate.

If it is too low, the throttle may return slowly and remain above the requested Target.

Closing behaviour is particularly important when the driver releases the accelerator because the throttle must return smoothly toward idle without producing unnecessary oscillation or engine-speed instability.

Hold Power and Response

Hold Power and Response perform different jobs.

Hold Power provides the basic motor force required to maintain throttle position against the mechanical spring.

Response determines how strongly the controller reacts to the remaining difference between Target and actual position.

A useful way to view the control is:
Motor Drive = Hold Power + Position Correction

The Hold Power should therefore be adjusted first so that the throttle is reasonably balanced.

Response can then be adjusted to make Throttle TPS follow Throttle Target accurately.

Trying to correct badly adjusted Hold Power using excessive Response will normally make the throttle more difficult to control.

Throttle Setup Reference

The Hold Power settings should be established before Response is fine-tuned. The complete step-by-step procedure is covered under Initial Setup and Calibration and in the dedicated Electronic Throttle Control Calibration Guide.

Low-Opening Throttle Control

Small throttle openings require particular attention.

A large throttle body fitted to a relatively small engine can produce a significant airflow change from a very small movement of the throttle plate.

This becomes particularly noticeable during Idle Control.

Throttle position is therefore calculated and displayed with **0.1% resolution**, allowing small changes in throttle position to be observed during setup.

Mechanical effects also become more noticeable at small openings, including:

- Static friction
- Gearbox backlash
- Return spring force
- The mechanical Rest Position

- Throttle plate airflow sensitivity

A throttle that appears correctly controlled during normal pedal operation should therefore also be checked carefully at the small openings used during idle.

Throttle Sensor Diagnostics

Electronic throttle control relies on the throttle position sensors to determine actual throttle position.

The redundant sensor signals allow the Device to detect disagreement or a sensor operating outside its expected relationship.

Separate diagnostic limits are provided for the lower and upper areas of sensor travel.

Throttle TPS Low Limit Alarm

Sets the permitted Throttle TPS sensor deviation near the lower end of throttle travel.

The setting uses **0.1% resolution**.

If the relationship between the redundant throttle sensors exceeds the permitted limit, the Device can generate a Throttle TPS diagnostic fault.

Throttle TPS High Limit Alarm

Sets the permitted Throttle TPS sensor deviation near the upper end of throttle travel.

Separate Low and High limits allow the diagnostic tolerance to accommodate the actual sensor characteristics across the complete operating range.

Pedal TPS Low Limit Alarm

Sets the permitted difference between the redundant accelerator pedal position signals near the lower end of pedal travel.

The setting uses **0.1% resolution**.

Pedal TPS High Limit Alarm

Sets the permitted difference between the pedal signals near the upper end of pedal travel.

The diagnostic limits should be large enough to accommodate normal sensor tolerance but small enough to reliably detect a sensor or wiring fault.

Important: Do not increase a TPS Alarm Limit simply to hide an active DTC. First verify calibration, wiring and sensor operation and determine why the two signals disagree.

Checking Sensor Diagnostic Limits

After calibration, slowly operate the pedal and throttle through their complete ranges.

Verify that no DTC occurs during normal operation.

Particular attention should be paid to:

- Fully released pedal

- Fully depressed pedal
- Minimum throttle opening
- Mechanical Rest Position
- Maximum throttle opening

If a DTC occurs only near one end of travel, investigate the corresponding Low or High sensor relationship before changing the Alarm Limit.

The diagnostic limits are safety settings and should only be adjusted after the sensor operation has been verified.

Idle Control

The ETC can control engine idle speed by automatically adjusting throttle opening.

When Idle Control is active, the Device compares actual engine RPM with the configured **Target RPM**.

If engine speed falls below Target RPM, the ETC progressively increases throttle opening.

If engine speed rises above Target RPM, the ETC progressively reduces throttle opening.

This forms a separate outer control loop around the normal throttle position controller:
Target RPM → Idle Correction → Throttle Target → Throttle Position → Engine RPM

The throttle position controller remains responsible for physically moving the throttle. Idle Control only determines how much throttle opening is required to maintain the desired engine speed.

Enabled

Enables ETC Idle Control.

RPM must be correctly configured before Idle Control can operate correctly.

Do not attempt to tune Idle Control until the basic throttle position control is stable.

Target RPM

Sets the desired engine idle speed.

Target RPM is adjustable in **10 RPM increments**.

Example:
810 RPM = desired idle speed of 810 RPM

The correct Target RPM depends on the engine, camshaft, load and intended application.

The Target should first be set to a speed at which the engine can idle reliably.

It can then be reduced if required after the remainder of the idle control has been tuned.

Cranking Opening

Cranking Opening defines the throttle opening used while the engine is being started.
A cold or stationary engine normally requires more airflow during cranking than it requires once running.

Increasing Cranking Opening provides additional starting air.

Too little opening may cause difficult starting or require the accelerator pedal to be pressed.

Too much opening may cause the engine to flare to an unnecessarily high RPM immediately after starting.

The correct setting should allow the engine to start without accelerator assistance and transition smoothly into Idle Control.

Open Rate

Open Rate controls how quickly Idle Control increases throttle opening when engine speed is below Target RPM.

A higher value causes a faster increase in throttle opening.
If the value is too low:

- RPM may recover too slowly.
- The engine may stall when load is applied.
- Idle may drop excessively when electrical or mechanical loads change.

If the value is too high:

- Throttle correction may be excessive.
- RPM may overshoot the Target.
- Idle may begin hunting.

Closing Rate

Closing Rate controls how quickly Idle Control reduces throttle opening when engine speed is above Target RPM.

A higher value closes the idle correction more quickly.

If Closing Rate is too low, RPM may remain above Target for too long.

If it is too high, the throttle may close too quickly, causing RPM to fall below Target and forcing the Open Rate to correct again.

This repeated correction can result in idle hunting.

Open Rate and Closing Rate should therefore be adjusted together to obtain a stable response around Target RPM.

Maximum Idle Opening

Maximum Idle Opening limits the maximum throttle opening that Idle Control is allowed to request.

This prevents the idle controller from opening the throttle excessively while attempting to recover engine speed.

The correct value must still provide enough airflow for the engine to maintain idle under its highest expected idle load.

Examples include:

- Cold engine operation
- Alternator load
- Air-conditioning load
- Automatic transmission engagement
- Power steering load

A value that is too low may prevent Idle Control from reaching Target RPM under load.

A value that is unnecessarily high allows a large throttle request if the RPM signal or idle tuning is incorrect.

Idle Active TPS

Idle Active TPS determines the accelerator pedal range in which Idle Control is permitted to operate.

When the driver presses the accelerator beyond this threshold, normal pedal control takes priority.

When the pedal is released back into the idle region, the ETC can transition back to Idle Control.

The setting should provide enough margin to prevent small pedal-sensor variations from repeatedly switching Idle Control on and off.

Dashpot Damper

The **Dashpot Damper** controls the transition back to idle when the driver releases the accelerator.

If the throttle closes immediately to the normal idle position after higher engine speed, RPM may fall too quickly and undershoot the Target RPM.

The Dashpot function temporarily slows the return toward normal idle control.

This allows engine speed to reduce progressively and gives Idle Control time to take over smoothly.

Increasing Dashpot Damper increases the damping effect.

Too little damping may result in:

- Rapid RPM drop
- RPM undershoot
- Engine stalling when approaching a stop

Too much damping may result in:

- RPM hanging above Target
- Slow return to idle
- Unwanted engine braking behaviour

The correct setting allows RPM to return smoothly to Target without hanging or dropping below the desired idle speed.

Idle Control Setup

Only tune Idle Control after the throttle position control is stable, RPM reads correctly and the engine has a reasonable base Tune. Set a safe Target RPM, establish suitable Cranking Opening and Maximum Idle Opening, then adjust Open Rate, Closing Rate and Dashpot for stable return to Target RPM.

Detailed idle tuning, including fuel and ignition interaction, is covered in the dedicated Spitronics Idle Control Guide.

Idle Control and the Mechanical Rest Position

Some installations require the throttle to operate close to its mechanical Rest Position during idle.

A large throttle body on a small engine may require only a very small throttle opening to maintain idle.

During increased idle load, the ETC may need to move through the Rest Position to provide enough airflow to maintain Target RPM.

For example, a vehicle moving slowly without accelerator input may effectively be driven by Idle Control. When the vehicle encounters a slight incline, additional throttle opening may be required to maintain the Target RPM.

For this reason, correct control on **both sides of the Rest Position** is important.

If the throttle behaves differently as it crosses Rest Position, first verify the basic Opening Hold Power, Closing Hold Power and Response settings before attempting to compensate using Idle Control.

Coolant Compensation and Idle Control

A cold engine normally requires more airflow than a warm engine.

The **Coolant Throttle Minimum Graph** can be used together with Idle Control to provide this additional opening.

The graph establishes a temperature-dependent minimum throttle opening while Idle Control makes the smaller RPM corrections required to maintain Target RPM.

As the engine warms, the minimum opening can progressively reduce.

This separates two different jobs:
Coolant Throttle Minimum provides the basic temperature-related airflow requirement.
Idle Control corrects the remaining RPM error.

This generally provides more predictable operation than forcing the RPM controller to make the complete cold-start airflow correction by itself.

Further Idle Control Information

ETC Idle Control forms part of the wider Spitronics Idle Control strategy.

For additional information on idle behaviour, setup principles and tuning, refer to the dedicated **Spitronics Idle Control Guide**.

Graphs

The Graphs section allows the ETC to modify or limit throttle operation according to pedal position, MAP pressure, engine RPM and coolant temperature.

The available graphs are:

MAP Throttle Limit Graph
- Pedal Response Graph
- RPM Throttle Limit
- Coolant Throttle Minimum
- Coolant Throttle Maximum

The Device interpolates between the graph points. This provides smooth transitions between settings rather than changing throttle limits abruptly when moving from one graph point to the next.

When tuning a graph with the Device connected, use the RealTime Data to verify the effect of the graph on actual operation.

MAP Throttle Limit Graph

The MAP Throttle Limit Graph defines the maximum throttle opening permitted at different manifold absolute pressures. Its main purpose is boost and over-pressure control / protection.

The horizontal axis represents MAP pressure in bar over the range selected by MAP Scale. The vertical axis represents Maximum Throttle Opening %.

Below the required limiting pressure, the graph can remain at 100% so that MAP has no effect on normal throttle operation. As pressure approaches the required limit, the graph can progressively reduce the maximum permitted Throttle Target.

For example, if the driver requests 80% throttle but the MAP graph allows a maximum of 55% at the current pressure, the resulting Throttle Target cannot exceed 55%. The graph is a maximum limit; it never forces the throttle to open further than another function requests.

Use smooth transitions so the throttle is reduced progressively rather than abruptly. Test the protection under controlled conditions and monitor MAP Sensor, Pedal TPS, Throttle Target and Throttle TPS.

Important: MAP-based throttle limiting should complement, not replace, the ECU's normal boost, fuel, ignition and engine-protection strategies.

Pedal Response Graph

The **Pedal Response Graph** determines the relationship between accelerator pedal position and Throttle Target.

The horizontal axis represents:
Pedal TPS %

The vertical axis represents:
Throttle Target %

The graph allows pedal response to be changed without changing the pedal or throttle calibration.

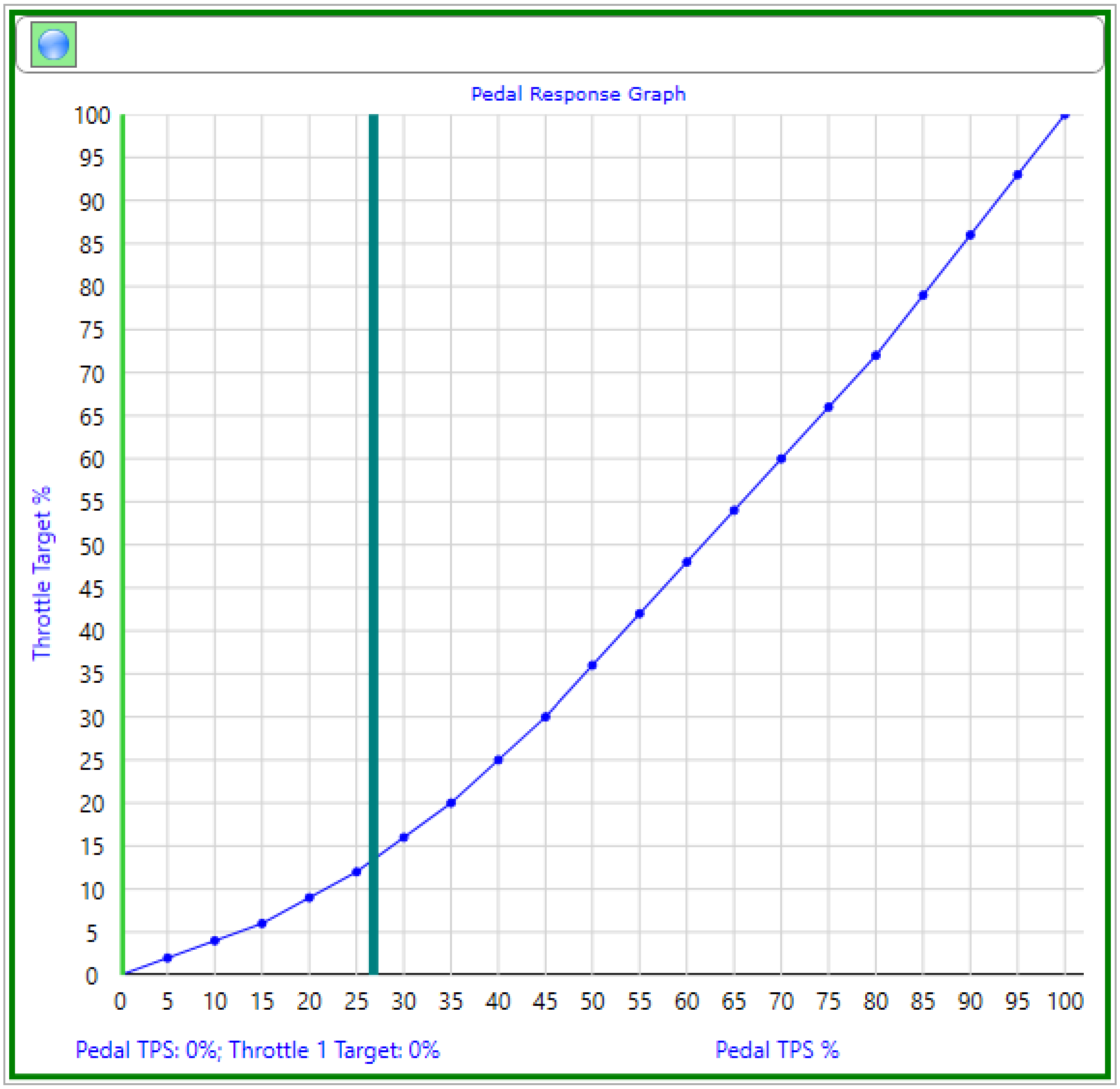
Direct Pedal Response

A straight 1:1 relationship provides approximately the same throttle request as pedal position.

For example:

Pedal TPS	Throttle Target
10%	10%
25%	25%
50%	50%
75%	75%
100%	100%

This provides a direct relationship between pedal movement and requested throttle position.



Progressive Pedal Response

The graph can reduce throttle movement during the first part of pedal travel while retaining full throttle at maximum pedal position.

For example:

Pedal TPS	Throttle Target
10%	5%
25%	15%
50%	35%
75%	65%
100%	100%

This provides finer throttle control at small pedal openings.

It can be useful for:

- Large throttle bodies
- Powerful engines
- Low-speed driving
- Off-road driving
- Improved drivability
- Reduced sensitivity during pull-away

A large throttle body can produce a significant change in airflow from a very small movement of the throttle plate. Reducing the throttle response during the first part of pedal travel gives the driver more usable pedal movement over this sensitive area.

Aggressive Pedal Response

The graph can also request more throttle movement during the first part of pedal travel.

For example:

Pedal TPS	**Throttle Target**
10%	15%
25%	40%
50%	70%
75%	90%
100%	100%

This creates a more aggressive pedal feel.

It does not create additional engine power. It simply reaches a larger throttle opening with less pedal movement.

Tuning Note: A more aggressive Pedal Response Graph can make a vehicle feel more powerful because the throttle opens faster relative to pedal movement, but maximum available throttle opening remains unchanged.

Tuning the Pedal Response Graph

Start with a smooth progressive graph.

With the engine running, slowly operate the accelerator while watching:
Pedal TPS → Throttle Target → Throttle TPS

Pedal TPS shows what the driver is requesting.

Throttle Target shows the result produced by the graph and any other active ETC functions.
Throttle TPS shows the actual throttle position.

Adjust the graph according to the required pedal feel.

Avoid unnecessary sharp changes between adjacent graph points. Smooth changes normally provide better drivability.

Where Multiple Tunes are used, different Pedal Response Graphs can provide different driving characteristics while using the same pedal and throttle hardware.

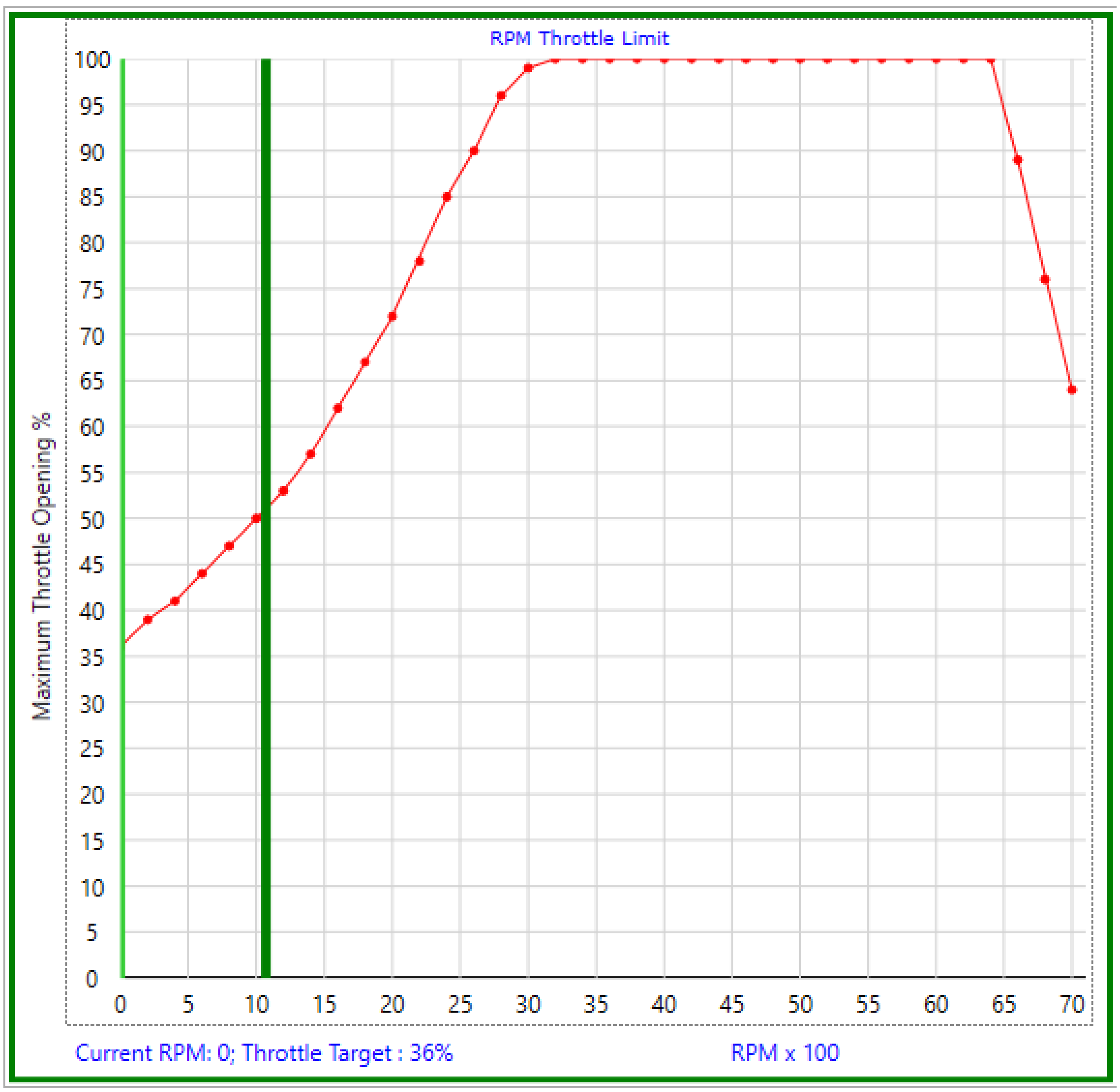
RPM Throttle Limit

The **RPM Throttle Limit Graph** determines the maximum throttle opening permitted at different engine speeds.

The horizontal axis represents engine RPM.

The vertical axis represents:
Maximum Throttle Opening %

The function must be enabled on the RPM Input page before the graph becomes active.



Operation

During normal operation, the ETC calculates the required Throttle Target from the driver's pedal request.

The RPM Throttle Limit then determines the maximum throttle opening permitted at the current engine speed.

If the requested throttle opening is below the graph limit, normal throttle operation continues.

If the requested opening exceeds the graph limit, the ETC restricts the Throttle Target to the maximum value allowed by the graph.

For example:
Pedal request = 80%
RPM graph maximum = 60%

The resulting Throttle Target cannot exceed **60%**.

Progressive RPM Limiting

The graph can progressively reduce maximum throttle opening as engine speed approaches the required limit.

Example:

Engine RPM	Maximum Throttle
5500	100%
6000	100%
6200	80%
6400	50%
6500	20%
6600	Minimum required opening

This progressively removes available throttle as engine speed increases.

Because the Device interpolates between graph points, the reduction can be made smooth rather than changing suddenly from full throttle to a restricted position.

Applications

The RPM Throttle Limit can be used for:

- Maximum engine-speed protection
- Progressive throttle limiting
- Reduced engine power at high RPM
- Application-specific operating limits

The graph should be configured so that the throttle reduction begins early enough for the engine to respond before reaching an unsafe engine speed.

The exact settings depend on engine response, vehicle inertia and application.

Important: The RPM Throttle Limit should not be considered a replacement for all other engine protection systems. Where an ECU also provides conventional RPM limiting, the ETC throttle limit can provide a progressive first stage before the ECU's final protection limit is reached.

Checking the RPM Limit

Before testing at high engine speed, inspect the complete graph and confirm that the values are sensible.

During controlled testing, monitor:

- RPM
- Pedal TPS
- Throttle Target
- Throttle TPS

When the RPM limit becomes active, Pedal TPS may remain high while Throttle Target is reduced by the graph.

This makes the limiting action easy to identify in RealTime Data.

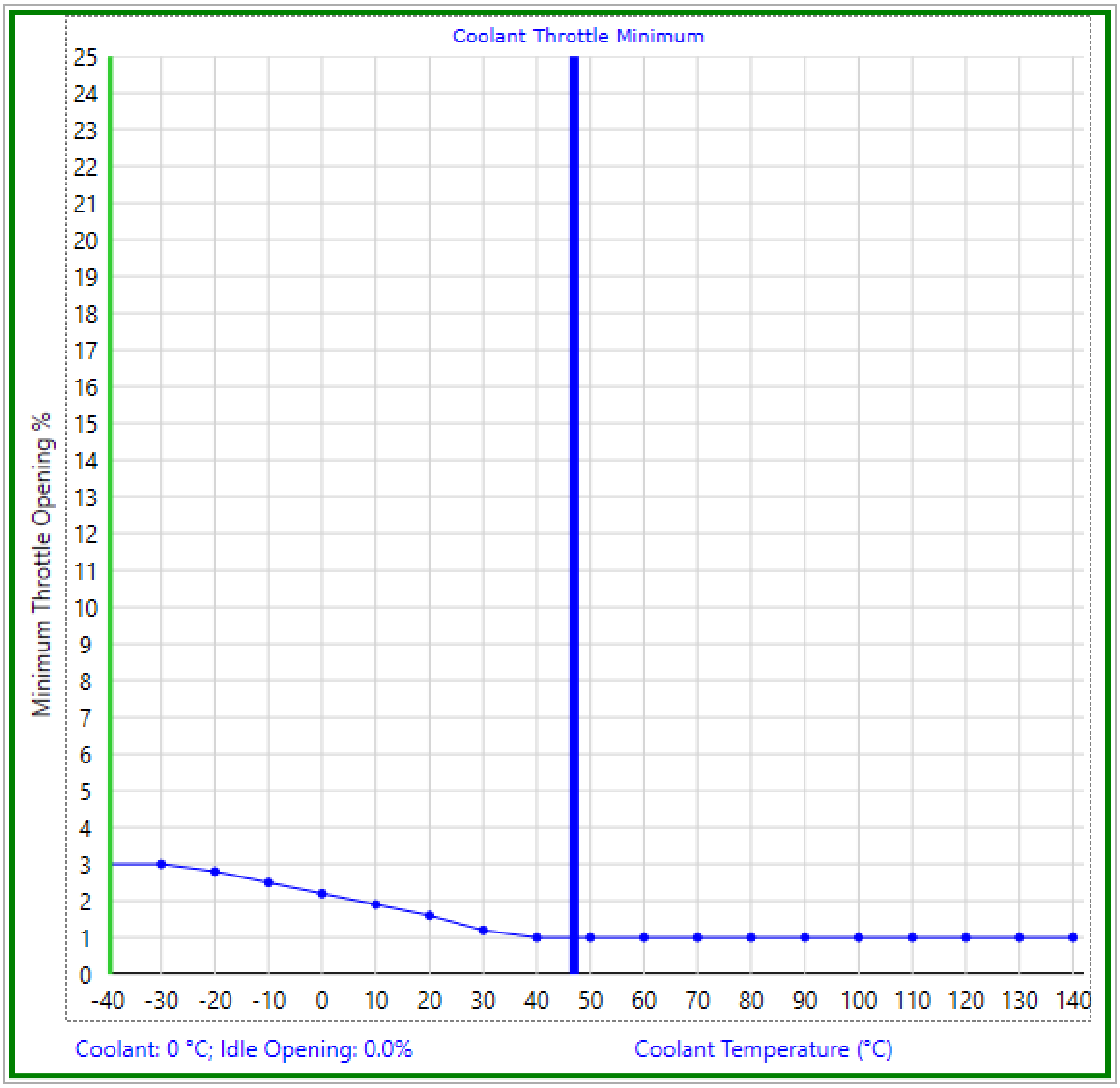
Coolant Throttle Minimum

The **Coolant Throttle Minimum Graph** determines the minimum throttle opening permitted according to engine coolant temperature.

The horizontal axis represents:
Coolant Temperature °C

The vertical axis represents:
Minimum Throttle Opening %

The function must be enabled on the Coolant Temperature Input page before the graph becomes active.



Purpose

A cold engine normally requires additional airflow during starting and warm-up.

The Coolant Throttle Minimum Graph allows a larger minimum throttle opening to be used while the engine is cold.

As coolant temperature increases, the minimum opening can progressively reduce toward the normal warm-engine value.

Example:

Coolant Temperature	**Minimum Throttle**
-20°C	8.0%
0°C	7.0%
20°C	5.5%
40°C	4.0%

Coolant Temperature	Minimum Throttle
60°C	3.0%
80°C	2.0%

These values are examples only. The required opening depends strongly on throttle size and engine airflow requirements.

Interaction with Normal Throttle Control

The graph establishes a **minimum permitted throttle opening**.

If another ETC function requests a throttle position above this value, the higher request is allowed.

If the requested throttle position is below the minimum defined by the graph, the Coolant Throttle Minimum becomes the controlling value.

This makes the graph useful for establishing the basic cold-engine airflow requirement while still allowing normal throttle operation.

Interaction with Idle Control

Coolant Throttle Minimum and Idle Control perform related but different functions.

The Coolant Throttle Minimum Graph provides a basic throttle opening according to engine temperature.

Idle Control then adjusts throttle opening according to actual engine RPM.

A useful tuning philosophy is therefore:
Coolant Temperature → Basic required cold opening
followed by:

RPM Error → Idle correction
This prevents the Idle Control system from having to create the entire cold-engine airflow requirement by RPM correction alone.

Tuning the Minimum Graph

First establish the throttle opening required for stable idle with the engine fully warm.
This provides the warm end of the graph.

Cold-engine values can then be developed during genuine cold starts.

Do not attempt to tune the complete cold section of the graph using a warm engine.

Observe:

- Coolant Temperature
- RPM
- Throttle Target

- Throttle TPS

The objective is to provide sufficient cold airflow without causing excessive engine speed after starting.

As the engine warms, throttle opening should reduce smoothly toward the normal warm idle requirement.

Coolant Throttle Maximum

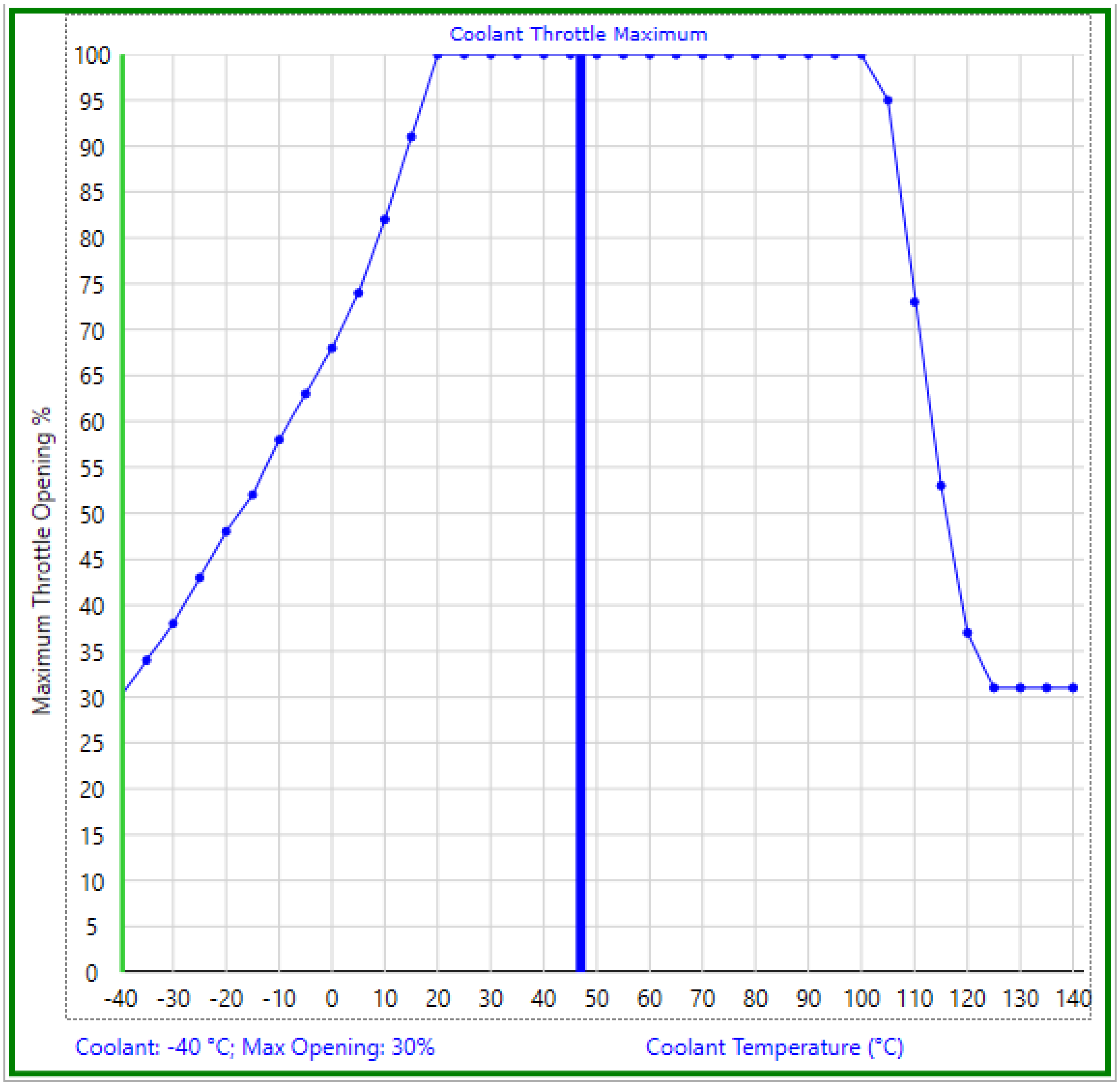
The **Coolant Throttle Maximum Graph** determines the maximum throttle opening permitted according to coolant temperature.

The horizontal axis represents:
Coolant Temperature °C

The vertical axis represents:
Maximum Throttle Opening %

The function must be enabled on the Coolant Temperature Input page before the graph becomes active.

This graph is primarily an engine-protection function.



<u>Cold-Engine Protection</u>

High engine load immediately after a cold start may be undesirable.

The graph can limit maximum throttle opening while the engine is cold and progressively increase the available throttle as normal operating temperature is reached.

Example:

Coolant Temperature	**Maximum Throttle**
-20°C	40%
0°C	50%
20°C	65%
40°C	80%
60°C	100%
90°C	100%

This does not prevent the driver from pressing the accelerator further.

Instead, the ETC limits the resulting Throttle Target.

Over-Temperature Protection

The same graph can reduce available throttle if coolant temperature rises above the normal operating range.

For example:

Coolant Temperature	Maximum Throttle
95°C	100%
100°C	100%
105°C	80%
110°C	50%
115°C	25%
120°C	Minimum safe opening

The values above are examples only and should not be treated as recommended limits for every engine.

Different engines have different normal operating temperatures and safe temperature limits.

The important principle is that the throttle can be reduced progressively as temperature becomes unsafe.

Why Progressive Limiting is Useful

A simple protection system may change immediately from unrestricted operation to a severe power limit.

ETC allows a more progressive approach.

For example:
Normal temperature
Full throttle remains available.
Temperature beginning to rise
Maximum throttle is reduced moderately.
Temperature continues increasing
Available throttle is reduced further.
Critical temperature
Only the configured safe throttle opening remains available.

This gives the driver a clear reduction in available engine power while still allowing the vehicle to be moved where appropriate.

Interaction with Driver Demand

The maximum graph acts as a limit on the requested throttle.

For example:
Pedal TPS = 100%
Pedal Response request = 100%
Coolant Maximum = 40%
The resulting Throttle Target is limited to **40%**.

The driver may therefore continue pressing the pedal fully while the Device protects the engine by restricting actual throttle opening.

Minimum and Maximum Graphs Together

The two coolant graphs establish an allowable throttle operating window.

At any particular coolant temperature:
Coolant Throttle Minimum
defines the lowest permitted throttle opening.
and
Coolant Throttle Maximum
defines the highest permitted throttle opening.

Normal throttle control operates inside this window.

Conceptually:
Minimum Throttle ≤ Throttle Target ≤ Maximum Throttle

For example:
Coolant Temperature = 20°C
Minimum Throttle = 5.0%
Maximum Throttle = 65.0%

The ETC may therefore control the throttle between these limits according to pedal demand and other active functions.

Multiple Throttle Limits

More than one maximum-throttle function may be active at the same time. The ETC obeys the most restrictive active maximum from MAP, RPM and Coolant protection.

Example: Pedal request = 80%, RPM maximum = 60%, Coolant maximum = 70% and MAP maximum = 50%. The resulting Throttle Target cannot exceed 50%.

If Pedal TPS is high but Throttle Target is lower than expected, check the active MAP, RPM and Coolant limits before assuming that the throttle body has a fault.

Graph Tuning Guidelines

When configuring ETC graphs:
- Start with conservative values.

- Keep transitions smooth.
- Avoid unnecessary sharp changes between adjacent points.
- Verify the complete graph before driving the vehicle.
- Watch Throttle Target while testing.
- Confirm that Throttle TPS follows the resulting Target correctly.
- Test protection functions under controlled conditions before relying on them.

The graph defines what the Device **should request**.

The throttle controller determines whether the physical throttle **actually reaches that request**.

For this reason, the basic Throttle Settings must be correctly tuned before graph behaviour is evaluated.

Initial Setup and Calibration

This chapter gives the commissioning sequence for a new ETC installation. It is intentionally shorter than the dedicated calibration document. For the full step-by-step procedure and calibration screenshots, refer to the Spitronics - Electronic Throttle Control Calibration - Guide.

Perform the basic pedal and throttle setup with the vehicle stationary and the engine switched off. Do not enable Idle Control, Pedal Response or protection graphs until the basic throttle follows its Target correctly.

Before Calibration

- Verify the wiring against the applicable Device pin layout and the Wiring and Installation chapter.
- Load a suitable Startup Tune from the Portal in Cosmos.
- Confirm the correct Device, firmware and activation status.
- Check Battery and Ignition Voltage and correct any excessive voltage drop.
- Keep fingers, tools and loose objects clear of the throttle plate whenever the Device is powered.

For the safest first power-up, the calibration guide starts with only P1 and the Comms connector connected. The throttle connector is connected only after the pedal signal and initial safe motor-power settings have been verified.

Basic Throttle Calibration

Disable Target-Modifying Functions

Before basic calibration, disable MAP Sensor, Pedal Response Graph, RPM, Idle Control and both Coolant Throttle graphs. When the automatic calibration process is activated, functions that can influence Throttle Target are disabled automatically for the duration of calibration.

Check Raw TPS Ranges

Use Rest Position Test so that throttle motor drive is removed. Pedal TPS 1 must increase as the pedal is pressed. Throttle TPS 1 must increase as the throttle is opened.

The raw Pedal TPS and Throttle TPS signals should remain clear of both electrical rails. As a practical guide, retain about 5% diagnostic headroom at both ends of travel. If a signal reaches a rail, verify that the correct TPS track is connected. If a signal moves in the wrong direction, correct the sensor wiring or polarity before continuing.

Record the throttle fully-open, fully-closed and mechanical Rest Position values as Raw Open, Raw Close and Raw Rest. The unused electrical margin allows the ETC to detect supply, ground and sensor faults. DTC 37 indicates Pedal Sensor Failure and DTC 38 indicates Throttle Sensor Failure.

Determine Maximum Motor Power

Start with low motor power. Use Open Test and increase Opening Hold Power in small steps until Raw Open is just reached. Then compare Open Test with Rest Position Test and increase power only until the throttle opens at a suitably quick rate. Use the lowest value that gives reliable movement and does not slam the throttle against its mechanical stop. Enter this value as Maximum Motor Power.

Determine Opening and Closing Hold Power

Opening Hold Power and Closing Hold Power are established independently with Response inactive. For Opening Hold Power, use Open Test. Record the value where Raw Open is just reached as Open High, then reduce the value until Raw Rest is just reached and record Open Low.

Opening Hold Power = (Open High + Open Low) / 2

For Closing Hold Power, use Close Test. Record the value where Raw Close is just reached as Close High, then reduce the value until Raw Rest is just reached and record Close Low.

Closing Hold Power = (Close High + Close Low) / 2

Automatic Pedal and Throttle Calibration

Open Pedal TPS Calibration, perform the pedal calibration and select Save. Saving the pedal calibration also starts the automatic electronic-throttle calibration. The Device opens the throttle, returns it to Rest Position, closes it, returns it to Rest Position again and captures the required calibration values.

After calibration, Pedal TPS and Throttle TPS operate in calibrated 0.0-100.0% ranges. With all modifying features disabled, Pedal TPS, Throttle Target and Throttle TPS should follow each other through the normal operating range, except where Minimum Throttle Opening prevents a lower Target.

Rest Position, Response and Final Motor Power

After calibration, verify Rest Position in the calibrated throttle range. If required, remove throttle motor power so the spring returns the throttle to its mechanical Rest Position and compare Throttle TPS with the Rest Position setting.

Start Opening Response and Closing Response with moderate values. Increase the relevant Response until Target tracking becomes quick, then reduce it if the throttle becomes nervous, shudders or oscillates. Finally fine-tune Maximum Motor Power so the throttle follows Target quickly without excessive mechanical impact.

Configure Optional Inputs and Functions

MAP Sensor and Boost Protection

Enable MAP, complete Sensor Calibration and verify the RealTime pressure. With the engine stopped, MAP should be close to local barometric pressure. Set MAP Scale to cover the required absolute-pressure range before tuning the MAP Throttle Limit Graph.

RPM

Enable RPM, select the correct Trigger Edge and complete RPM calibration. Verify the reading at idle and at a higher engine speed before enabling Idle Control or RPM Throttle Limiting.

Coolant Temperature

Enable and calibrate Coolant Temperature only after the sensor reading has been verified. On a cold engine the reading should be reasonably close to ambient temperature and should increase progressively during warm-up.

Idle Control

Only begin Idle Control setup after throttle control is stable, RPM reads correctly and the engine has a reasonable base Tune. Detailed idle tuning is covered in the Spitronics Idle Control Guide.

Pedal Response and Protection Graphs

Once basic throttle control is correct, enable and tune the required Pedal Response, MAP Throttle Limit, RPM Throttle Limit and Coolant Throttle graphs. Start with conservative values and test each protection function deliberately under controlled conditions.

Final Stationary Check

- Pedal and throttle calibration are correct and movement is smooth.
- Rest Position and Minimum Throttle Opening are correct.
- Throttle TPS follows Throttle Target through slow and fast pedal movements.
- RPM, MAP and Coolant values are correct where those inputs are used.
- Battery and Ignition Voltage are sensible.
- Active Tune is correct.
- No active ETC DTCs remain.
- The throttle returns correctly when the pedal is released and when motor control is removed.

First Road Test

Perform the first road test cautiously at low load and with small accelerator movements. Check low-speed pedal response, Target tracking, return to idle, gear-change behaviour and operation under normal idle loads before progressing to high-load testing.

Protection graphs should be tested deliberately under controlled conditions rather than assumed to work because their settings look correct in the software.

Setup Sequence Quick Reference

Wiring -> Startup Tune -> Supply Voltage -> Raw TPS Check -> Maximum Motor Power -> Opening/Closing Hold Power -> Automatic Calibration -> Rest Position -> Response -> TPS Diagnostics -> MAP / RPM / Coolant -> Idle Control -> Pedal Response -> Protection Graphs -> Stationary Check -> Road Test

---

Diagnostics and DTC

Electronic Throttle Control directly controls engine power and therefore requires continuous monitoring of the signals used to determine pedal and throttle position.

The Device monitors the ETC system during operation and generates a **Diagnostic Trouble Code (DTC)** when a monitored condition falls outside its permitted limits.

An active DTC is displayed in the Information Bar at the bottom of Cosmos.

The display provides the DTC number and a short description of the detected fault.
Example:

Code 37 – Pedal Sensor Failure

A DTC should be treated as an indication of the area where the fault was detected. It does not necessarily mean that the sensor itself is defective.

The cause may also be:

- Incorrect calibration
- Incorrect wiring
- Poor electrical connection
- Sensor supply fault
- Ground fault
- Incorrect diagnostic settings
- Mechanical throttle problem

Always investigate the cause before replacing components.

Using RealTime Data for Diagnosis

The RealTime Data display is one of the most useful diagnostic tools in the ETC system.

For throttle-related problems, start with:
Pedal TPS → Throttle Target → Throttle TPS
These values represent the three main stages of ETC operation.
Pedal TPS
Shows what the Device reads from the accelerator pedal.

If Pedal TPS does not correspond with actual pedal movement, investigate the pedal system first.

Possible causes include:
- Incorrect pedal calibration
- Pedal sensor fault
- Wiring fault
- Sensor supply or ground problem

Do not adjust throttle motor settings to correct an incorrect Pedal TPS signal.

Throttle Target
Shows the throttle position currently requested by the control system.

Throttle Target may differ from Pedal TPS because it can be influenced by ETC functions such as:
- Pedal Response
- Idle Control
  MAP Throttle Limit
- RPM Throttle Limit
- Coolant Throttle Minimum
- Coolant Throttle Maximum

If Pedal TPS is correct but Throttle Target is not what you expect, investigate the active ETC settings and graphs.

Throttle TPS
Shows the actual position of the electronic throttle.

If Throttle Target changes correctly but Throttle TPS does not follow it, the problem is in the throttle control side of the system.

Investigate:
- Throttle calibration
- Motor wiring
- Throttle TPS wiring
- Maximum Motor Power
- Opening and Closing Hold Power
- Opening and Closing Response
- Mechanical throttle operation
- Active DTCs

This diagnostic sequence can save considerable time because it identifies which part of the ETC control path is causing the problem.

Pedal Sensor Faults

Electronic accelerator pedals use redundant position signals for safety monitoring.

The Device compares these signals and checks that they remain within the permitted relationship throughout pedal travel.

A Pedal Sensor DTC may be caused by:

- Incorrect pedal calibration
- Incorrect sensor wiring
- Open-circuit signal wire
- Short circuit
- Incorrect 5 V sensor supply
- Poor sensor ground
- Faulty accelerator pedal
- Diagnostic limits set too tightly

Diagnostic Procedure

With the ignition on and engine stopped:
Slowly move the pedal from fully released to fully depressed.

Observe the Pedal TPS values.
The readings should change smoothly throughout the complete pedal range.

Pay particular attention near:

- Fully released pedal
- Fully depressed pedal

If the DTC occurs only near one end of pedal travel, check the corresponding Low or High diagnostic relationship.

If the signal suddenly jumps, disappears or moves unexpectedly, investigate the wiring and pedal before changing the diagnostic limits.

Important: Do not increase Pedal TPS Alarm Limits simply to suppress a DTC caused by incorrect calibration or wiring.

Throttle Sensor Faults

The electronic throttle body also contains redundant position sensors.

These allow the Device to verify the actual throttle position independently of the motor command.

A Throttle TPS DTC may be caused by:

- Incorrect throttle calibration
- Incorrect TPS wiring
- Sensor supply fault
- Sensor ground fault
- Faulty throttle position sensor
- Mechanical throttle problem
- Diagnostic limits set too tightly

Diagnostic Procedure

With the engine stopped, slowly operate the throttle through its permitted range using the ETC setup functions.

Observe Throttle TPS throughout the movement.

The position should change smoothly without sudden jumps.

Check operation:
- Below Rest Position
- At Rest Position
- Above Rest Position
- Near minimum opening
- Near maximum opening

A fault that occurs only at one end of travel may indicate that the redundant sensor relationship changes near that end of the calibrated range.

Investigate the calibration and sensor signals before increasing the Alarm Limit.

Supply Voltage Faults

The ETC monitors its electrical supply.

Low voltage can affect:
- Throttle motor power
- Sensor readings
- Device operation
- Flash programming
- Controlled shutdown

The Device generates a low-voltage DTC when the monitored supply falls below the configured safe operating level.

If a voltage-related DTC occurs, check the RealTime Battery and Ignition Voltage values.

Then inspect:
- Battery condition

- Battery terminals
- Device power wiring
- Ignition supply wiring
- Ground connections
- Connector terminals
- Voltage drop while the throttle motor operates

A voltage that appears correct with the throttle stationary may drop when the motor is driven.

For this reason, observe the supply while operating the throttle.

DTC Reset and Verification

After correcting the cause of a DTC, operate the system through the conditions that originally produced the fault.

Do not consider the problem repaired simply because the DTC is no longer displayed immediately after restarting the Device.

Verify the complete operating range again.

For pedal and throttle faults, slowly test from minimum to maximum position and back again.

For RPM or temperature-related faults, verify the RealTime sensor value.

For voltage faults, test the electrical supply while the throttle motor is operating.

Troubleshooting

The following section provides a practical starting point for common ETC problems.

Throttle Does Not Move

Check

Verify:

- Device is powered and communicating.
- No active ETC DTC prevents operation.
- Throttle Test Mode and configuration are correct.
- Throttle motor wiring is correct.
- Throttle TPS is calibrated.
- Maximum Motor Power is not set too low.
- Throttle body is mechanically free.

RealTime Check

Watch:
Throttle Target
and
Throttle TPS

If Target changes but TPS remains stationary, concentrate on the throttle motor, wiring, motor power and mechanical throttle.

If Target does not change, investigate the input or control function generating the Target.

Throttle Moves in the Wrong Direction

Stop testing immediately.

Do not attempt to correct reversed physical operation by increasing Response or Hold Power.

Check:

- Throttle motor wiring
- Selected throttle configuration
- Throttle sensor direction
- Throttle calibration

Correct the configuration before continuing.

Throttle Does Not Reach Target

Possible Causes

- Maximum Motor Power too low
- Incorrect Hold Power
- Response too low
- Mechanical throttle resistance
- Incorrect calibration
- Supply voltage drop
- An active throttle limit

Check

Compare:
Pedal TPS → Throttle Target → Throttle TPS

If Throttle Target itself is limited, check the active graphs and control functions.

If Target is correct but TPS cannot reach it, investigate the physical throttle control.

Throttle Response Is Too Slow

If Throttle TPS follows Target correctly but with excessive delay:

Check:

- Maximum Motor Power
- Opening Response
- Closing Response
- Hold Power
- Battery Voltage
- Mechanical throttle operation

Increase Response progressively rather than making large adjustments.

After every change, test both slow and rapid throttle movement.

Throttle Overshoots Target

Overshoot normally indicates that the position controller is responding too aggressively or that the basic motor drive is not correctly balanced.

Check:

- Opening Response
- Closing Response
- Opening Hold Power
- Closing Hold Power

Reduce the relevant Response and test again.

Do not evaluate only one throttle position. Test at small, medium and large openings.

Throttle Oscillates Around Target

A throttle that continually moves above and below Target may have excessive controller response.

Possible causes include:

- Opening Response too high
- Closing Response too high
- Incorrect Hold Power
- Mechanical friction
- Gearbox backlash
- Operation close to the mechanical Rest Position

Reduce the relevant Response and observe the effect.

If the problem occurs mainly at very small throttle openings, test carefully around the Rest Position.

A large throttle body on a small engine may require particularly precise control in this area because very small throttle movement can produce a noticeable change in airflow.

Throttle Sticks at Small Openings

Electronic throttle bodies can exhibit static friction at small movements.

The throttle may remain stationary while the controller gradually increases motor force and then suddenly move when the friction is overcome.

Possible contributors include:

- Throttle plate contamination
- Mechanical wear
- Gearbox friction
- Return spring force
- Control behaviour around Rest Position

First verify that the throttle body is mechanically sound and clean.

Then verify the basic Hold Power and Response settings.

Do not use excessive controller gain to overcome a mechanically sticking throttle because this can cause overshoot when the throttle begins moving.

Throttle Behaves Differently Across Rest Position

The internal spring force changes direction around the mechanical Rest Position.

It is therefore possible for a throttle to control well above Rest Position but behave differently below it. Verify that the entered Rest Position corresponds with the actual mechanical position.

Then check the Opening and Closing Hold Power and Response settings on both sides of Rest Position.

This condition is particularly important when the required idle throttle opening operates close to Rest Position.

Engine Will Not Start Without Pressing the Pedal

Check:

- Cranking Opening
- Coolant Temperature reading
- Coolant Throttle Minimum
- Basic engine fuel and ignition Tune

If increasing Cranking Opening improves starting, additional starting airflow may be required.

Do not use excessive Cranking Opening. The engine should start cleanly without immediately flaring to an unnecessarily high RPM.

Engine Flares After Starting

Possible causes include:

- Cranking Opening too high
- Coolant Throttle Minimum too high
- Idle Control opening too large
- Incorrect RPM reading
- Incorrect coolant temperature

Observe:

- RPM
- Throttle Target
- Throttle TPS
- Coolant Temperature

Determine which function is requesting the excessive throttle opening before changing settings.

Idle RPM Is Below Target

Check:

- RPM calibration
- Maximum Idle Opening
- Open Rate
- Coolant Throttle Minimum
- Throttle position control
- Available engine torque at the selected Target RPM

Watch Throttle Target.

If Idle Control has already reached Maximum Idle Opening and RPM remains below Target, the controller is asking for all the airflow it is permitted to use.

Increasing Open Rate will not solve this condition.

Either more permitted throttle opening is required or the engine has another problem preventing it from maintaining Target RPM.

Idle RPM Is Above Target

Check:

- Minimum Throttle Opening
- Coolant Throttle Minimum
- Closing Rate
- Dashpot Damper
- Mechanical Rest Position
- Air leaks
- Throttle plate position

Watch Throttle Target.

If Throttle Target is already at the minimum permitted position but RPM remains too high, the idle controller cannot reduce airflow any further.

Investigate the minimum throttle setting, coolant minimum graph, throttle body and possible engine air leaks.

Idle Hunts Above and Below Target

Idle hunting occurs when the control system continually over-corrects the RPM error.

Possible causes include:

- Open Rate too high
- Closing Rate too high
- Incorrect basic throttle opening
- Throttle position oscillation
- Incorrect RPM signal
- Engine Tune instability

First verify that Throttle TPS itself is stable.

If Throttle TPS is oscillating around Target, correct the throttle position controller before adjusting Idle Control.

If throttle position is stable but RPM continues oscillating, investigate the Idle Control rates and engine Tune.

Engine Stalls When Pedal Is Released

Check:

- Dashpot Damper
- Closing Rate
- Minimum Throttle Opening
- Idle Active TPS
- Target RPM
- Coolant Throttle Minimum

Watch RPM and Throttle Target as the pedal is released.

If Throttle Target falls too quickly before Idle Control takes over, increase the required transition damping.

If Target remains appropriate but engine RPM still falls excessively, investigate the engine Tune and required idle airflow.

RPM Hangs Above Idle

Possible causes include:

- Dashpot Damper too high
- Closing Rate too low
- Minimum Throttle Opening too high
- Coolant Throttle Minimum too high
- Pedal TPS not returning correctly
- Idle Active TPS setting
- Mechanical throttle problem

Check Pedal TPS first.

If the pedal has returned to zero but Throttle Target remains elevated, determine which ETC function is maintaining the higher Target.

Incorrect RPM Reading

If the displayed RPM does not correspond with actual engine speed, check:

- RPM signal source
- Wiring
- Trigger Edge
- RPM calibration
- Number of pulses per revolution
- Signal quality

A reading that is exactly half or double the expected RPM usually indicates incorrect pulse calibration. Correct RPM operation before tuning Idle Control or RPM Throttle Limiting.

Incorrect MAP Reading

If the displayed MAP pressure is obviously incorrect, check the sensor wiring, sensor supply and ground, MAP Scale and Sensor Calibration.

With the engine stopped, compare the MAP value with the local barometric pressure. Recheck Range Gain and Zero Offset before using MAP-based throttle limiting.

Incorrect Coolant Temperature

If the displayed temperature is obviously incorrect:

Check:

- Selected sensor calibration
- Sensor wiring
- Sensor ground
- Sensor supply/pull-up circuit
- Connector condition

On a cold engine, compare Coolant Temperature with ambient temperature as a quick reasonableness check.

Do not use coolant-based throttle limiting until the temperature reading has been verified.

Throttle Will Not Open Fully

First check **Throttle Target**.

If Pedal TPS reaches 100% but Target remains below 100%, check:

- Pedal Response Graph
  MAP Throttle Limit
- RPM Throttle Limit
- Coolant Throttle Maximum
- Active Tune

If Throttle Target reaches 100% but Throttle TPS does not, check:

- Maximum Motor Power
- Opening Response
- Opening Hold Power
- Throttle calibration
- Mechanical throttle travel
- Battery Voltage

This distinction is important:
Target limited = software/control request
TPS cannot reach Target = throttle control or mechanical problem

Unexpected Throttle Limiting

If the vehicle suddenly has less throttle available than expected, compare:

- Pedal TPS
- Throttle Target
- Throttle TPS
- RPM
- Coolant Temperature
- Active Tune

If Pedal TPS is high but Throttle Target is lower, check:

MAP Throttle Limit

- RPM Throttle Limit
- Coolant Throttle Maximum
- Pedal Response Graph
- Active Tune
- Active DTCs

If Target is correct but Throttle TPS is lower, investigate the physical throttle control instead.

Multiple Tune Does Not Behave as Expected

Verify **Active Tune** in RealTime Data.

Do not assume that the Tune displayed or edited in the software is necessarily the Tune currently controlling the throttle.

Confirm:

- Multiple Tunes enabled
- Tune Selection input
- Active Tune
- Pedal Response Graph for the selected Tune
- Other Tune-specific settings

Diagnostic Quick Reference

When an ETC problem occurs, use the following sequence before changing settings:

Check DTC
↓
Check Pedal TPS
↓
Check Throttle Target
↓
Check Throttle TPS
↓
Check RPM, MAP and Coolant if relevant
↓
Identify which stage is incorrect
↓
Only then adjust or repair that part of the system

The most useful rule for ETC fault finding is:

Do not tune around a fault.

Calibration, wiring and mechanical problems should be corrected before control settings are changed to compensate for them.

Specifications

This section provides a quick reference to the main operating ranges, resolutions and terminology used by the Electronic Throttle Control system.

Control Resolution

Function	Range / Resolution
Pedal TPS	0.0–100.0%, 0.1% resolution
Throttle TPS	0.0–100.0%, 0.1% resolution
Throttle Target	0.0–100.0%, 0.1% resolution
MAP Sensor	Display in 0.1 bar; graph range set by MAP Scale
Throttle Settings	0.1% where position is specified
Idle Target RPM	10 RPM increments
Engine RPM	10 RPM resolution
RPM Operating Range	Up to 15 000 RPM

Function	Range / Resolution
Coolant Temperature	Whole °C display
Battery Voltage	0.1 V resolution
Ignition Voltage	0.1 V resolution
Active Tunes	1

RealTime Data

The main ETC RealTime values are:

RealTime Value	Description
MAP Sensor	Current manifold absolute pressure
RPM	Current engine speed
Pedal TPS 1	Calibrated accelerator pedal position
Throttle Target	Throttle position currently requested by the ETC
Throttle TPS 1	Actual calibrated throttle position
Battery	Main Device supply voltage
Ignition	Ignition-switched supply voltage
Coolant	Engine coolant temperature
Active Tune	Tune currently controlling the Device
Credits	Available Device activation credits

ETC Control Path

The basic ETC control path is:

Pedal TPS → Throttle Target → Throttle TPS

Pedal TPS represents the driver's accelerator request.

Throttle Target represents the throttle position calculated by the ETC after the applicable control functions and limits have been applied.

Throttle TPS represents the actual physical throttle position.
Comparing these three values provides a quick method of identifying where an ETC control problem originates.

Available Control Functions

The first-release ETC software provides:

- Closed-loop electronic throttle position control
- Dual Pedal TPS monitoring
- Dual Throttle TPS monitoring
- Adjustable Pedal Response
- Idle Speed Control
- Cranking throttle control
- Dashpot control

- Multiple Tunes
  MAP/boost-based throttle limiting
- RPM-based throttle limiting
- Coolant-based minimum throttle control
- Coolant-based maximum throttle control
- Cold-engine throttle protection
- Over-temperature throttle protection
- Supply voltage monitoring
- Diagnostic Trouble Codes

Required Inputs

Basic electronic throttle operation requires:

- Accelerator Pedal Position
- Throttle Position
- Throttle Motor
- Battery Power
- Ignition Power

Additional functions require the applicable inputs:

Function	**Additional Input Required**
Idle Speed Control	RPM
RPM Throttle Limit	RPM
MAP Throttle Limit	MAP Sensor
Cold-start / Warm-up Control	Coolant Temperature
Coolant Throttle Protection	Coolant Temperature
Multiple Tune Selection	Tune Selection

Related Documentation

Additional information is available in the following Spitronics documentation:
Electronic Throttle Control Calibration Guide

Complete pedal and throttle calibration procedure, including raw TPS checks, motor-power setup, Hold Power and Response adjustment.

Idle Control Guide
Detailed information on idle control operation, setup and tuning.
Cosmos Software Documentation
General software operation, Tune file management, Device programming and software functions.

ETC Wiring Documentation
Device pin connections, power supply, accelerator pedal and electronic throttle wiring.