Spitronics ECU - Anti-Lag - Guide

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Overview

Anti-Lag is used on turbocharged engines to help maintain turbocharger speed and improve boost response when the throttle is closed or partially closed during racing.

The system operates by combining:

- Additional fuel.
- Retarded ignition timing.
- Airflow through the engine or directly into the exhaust.

The objective is to maintain combustion energy in the exhaust system so that the turbocharger continues to receive turbine energy during deceleration.

Anti-Lag can create very high exhaust temperatures and significant mechanical and thermal stress. It should therefore be used only on suitable applications and for short periods.

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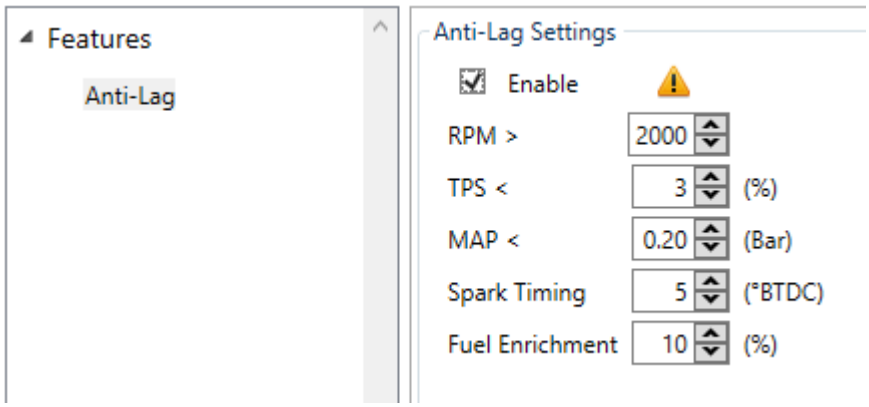
Anti-Lag Settings

Open:

Features → Anti-Lag



This software version includes:

- Enable.
- RPM >.
- TPS <.
- MAP <.
- Spark Timing.
- Fuel Enrichment.

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Enable

Select **Enable** to make the Anti-Lag function available.

Anti-Lag only becomes active when the configured RPM, TPS and MAP conditions are all satisfied.

Do not enable Anti-Lag until the normal engine Tune, boost control and required airflow method have been checked.

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Activation Conditions

Anti-Lag becomes active when:

RPM is above the RPM setting

AND

TPS is below the TPS setting

AND

MAP is below the MAP setting

Conceptually:

RPM > Limit
AND TPS < Limit
AND MAP < Limit
→ Anti-Lag Active

This identifies a high-RPM, low-throttle and low-load operating condition normally associated with deceleration.

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RPM >

RPM > sets the minimum engine speed above which Anti-Lag may operate.

Example:

2000 RPM

If engine RPM falls below this value, Anti-Lag is disabled.

Set this value high enough that Anti-Lag does not operate during idle or normal low-speed driving.

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TPS <

TPS < sets the maximum throttle position at which Anti-Lag may operate.

Example:

3%

TPS must remain below this value for Anti-Lag to stay active.

Set the value slightly above the normal closed-throttle TPS reading while allowing enough margin for normal sensor variation.

When the driver opens the throttle above this setting, Anti-Lag is disabled.

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MAP <

MAP < sets the manifold-pressure condition required for Anti-Lag activation.

Example:

0.20 Bar

Anti-Lag is allowed when MAP falls below this value.

This normally identifies a low-load or deceleration condition.

When manifold pressure rises above the configured threshold, Anti-Lag is deactivated and normal engine control resumes.

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Combined Activation Example

Using the example settings:

- RPM > 2000 RPM.
- TPS < 3%.
- MAP < 0.20 Bar.

Anti-Lag may become active when:

RPM = 3500 RPM

TPS = 1%

MAP = 0.15 Bar

If any one of the conditions is no longer satisfied, Anti-Lag is disabled.

For example, when the driver opens the throttle and manifold pressure rises above the configured MAP limit, normal Fuel and Spark control resumes.

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Spark Timing

Spark Timing determines the ignition timing used while Anti-Lag is active.

Example:

5° BTDC

Retarding ignition timing reduces the amount of combustion energy converted into crankshaft torque and moves more energy into the exhaust.

Increasing retard may increase:

- Turbocharger energy.
- Exhaust temperature.
- Exhaust noise.
- Anti-Lag effectiveness.

More aggressive retard also increases thermal stress.

Start with conservative settings and increase retard only where required.

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Timing After TDC

Very aggressive Anti-Lag systems may require ignition timing to be retarded beyond TDC so that the engine produces little useful crankshaft torque while more combustion energy is transferred into the exhaust.

This is an advanced tuning technique and should be approached cautiously.

Excessive ignition retard can cause extremely high exhaust temperature and place severe thermal stress on:

- Exhaust valves.
- Exhaust manifold.
- Turbocharger.
- Catalytic converter where fitted.

Use only as much timing retard as required to achieve the intended Anti-Lag response.

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Fuel Enrichment

Fuel Enrichment adds additional fuel while Anti-Lag is active.

Example:

10%

The additional fuel provides more combustible mixture for the delayed combustion process.

Higher enrichment may increase the Anti-Lag effect, but excessive fuel can cause:

- Spark-plug fouling.
- Bore wash.
- Oil contamination.
- Excessive exhaust temperature.
- Turbocharger damage.
- Catalytic converter damage.

Start with conservative enrichment and increase only where required.

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Airflow Requirement

Anti-Lag requires sufficient airflow as well as fuel.

When the throttle closes, normal engine airflow is greatly reduced.

For Anti-Lag to work effectively, enough air must therefore continue to reach the exhaust system.

Two common methods can be used.

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Air Bypass Valve Method

An air-bypass valve can route pressurised air from the turbo system before the throttle directly into the exhaust between the engine and turbocharger.

Conceptually:

Turbo Compressor → Bypass Valve → Exhaust Manifold → Turbo Turbine

This supplies additional air to the exhaust while the ECU provides Fuel Enrichment and retarded Spark Timing.

For valve wiring and ECU output connection, use the applicable firmware Pin Layout and Product documentation.

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Throttle Airflow Method

If an external bypass valve is not fitted, a small amount of airflow may be maintained through the engine.

This can be achieved by allowing a small minimum throttle opening.

On ETC-equipped engines, the electronic throttle may provide this airflow where supported.

Too much throttle opening can cause the engine to produce unwanted torque during Anti-Lag operation.

The airflow, Spark Timing and Fuel Enrichment must therefore be balanced together.

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How Anti-Lag Works

During normal deceleration:

Throttle closes → Airflow falls → Exhaust energy falls → Turbo slows

With Anti-Lag active:

Throttle closes → Activation conditions become true → Additional fuel + retarded timing + airflow → Exhaust energy increases → Turbo speed is maintained

When the driver opens the throttle again:

TPS or MAP exceeds the activation limit → Anti-Lag switches off → Normal engine control resumes

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Interaction with Fuel Cut

Normal overrun Fuel Cut removes fuel during deceleration.

Anti-Lag requires fuel during the same operating condition.

The Fuel Cut settings must therefore be configured so that they do not prevent the required Anti-Lag operation.

Refer to:

Features → Fuel and Timing

for the applicable Fuel Cut settings.

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Basic Setup Procedure

1. Complete the normal Fuel and Spark Tune.
2. Verify boost control.
3. Confirm TPS calibration.
4. Confirm MAP calibration.
5. Verify ignition timing physically.
6. Configure the required Anti-Lag airflow method.
7. Enable Anti-Lag.
8. Set a conservative minimum RPM.
9. Set TPS slightly above the normal closed-throttle value.
10. Set MAP for the required deceleration region.
11. Start with conservative Spark Timing.
12. Start with limited Fuel Enrichment.
13. Test operation for short periods.
14. Monitor boost and engine behaviour.
15. Increase the Anti-Lag effect only where required.

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Initial Testing

During initial testing, monitor:

- Engine RPM.

- TPS.
- MAP.
- Boost pressure.
- AFR or Lambda.
- Exhaust temperature where available.
- Turbocharger behaviour.

Confirm that Anti-Lag:

- Activates only in the intended operating area.
- Does not operate at idle.
- Switches off when the driver opens the throttle.
- Does not create uncontrolled boost.
- Does not cause excessive exhaust temperature.

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Adjusting RPM >

If Anti-Lag activates at too low an engine speed:

Increase:

RPM >

If it switches off too early during deceleration:

Reduce the value cautiously.

Do not allow Anti-Lag to remain active close to normal idle speed.

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Adjusting TPS <

If Anti-Lag does not activate when the throttle is released:

Check:

- TPS calibration.
- Closed-throttle TPS value.
- TPS < setting.

If Anti-Lag remains active after the driver begins opening the throttle:

Reduce the TPS threshold.

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Adjusting MAP <

If Anti-Lag activates during normal driving:

Adjust the MAP threshold so that the function is restricted to the intended deceleration region.

If Anti-Lag does not activate during throttle lift:

Check the actual MAP value in Realtime Data and adjust the threshold accordingly.

Use measured operating values rather than assuming one setting will suit every engine.

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Adjusting Spark Timing

If the Anti-Lag effect is weak, additional ignition retard may increase exhaust energy.

Make timing changes in small steps.

If exhaust temperature becomes excessive, reduce the amount of retard immediately.

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Adjusting Fuel Enrichment

If the mixture is too lean during Anti-Lag:

Increase Fuel Enrichment slightly.

If the engine becomes excessively rich:

Reduce Fuel Enrichment.

Excess fuel without enough airflow will not necessarily improve Anti-Lag operation.

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Turbocharger and Exhaust Stress

Anti-Lag places much greater thermal load on the turbo and exhaust system than normal engine operation.

Possible effects include:

- Very high turbine inlet temperature.
- Turbocharger thermal stress.
- Turbocharger overspeed.
- Exhaust manifold cracking.
- Turbine housing damage.
- Exhaust valve heating.
- Spark-plug fouling.
- Increased fuel consumption.
- Fuel contamination of engine oil.

Avoid prolonged Anti-Lag operation.

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Boost Control

Anti-Lag can maintain turbocharger speed while the throttle is closed.

This may alter normal boost behaviour.

Always verify:

[ ] Wastegate operation is correct.

[ ] Boost Control remains effective.

[ ] Boost does not rise unexpectedly.

[ ] Turbocharger operation remains controlled.

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Catalytic Converters

Aggressive Anti-Lag should not be used where a catalytic converter must be protected.

Fuel and oxygen burning in the exhaust can cause extreme catalyst temperature and permanent damage.

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Exhaust System

The exhaust system must be suitable for Anti-Lag operation.

Inspect:

- Exhaust manifold.
- Turbocharger flange.
- Turbine housing.
- Wastegate.
- Exhaust joints.

Anti-Lag can expose weak or damaged exhaust components very quickly.

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Fault Finding

Symptom	Possible Cause	Adjustment / Check
Anti-Lag does not activate	Activation conditions not satisfied	Check RPM, TPS and MAP
Activates near idle	RPM threshold too low	Increase RPM >
Remains active when throttle opens	TPS threshold too high	Check TPS <
Switches off too early	MAP threshold unsuitable	Check MAP <
Weak turbo response	Insufficient airflow, retard or enrichment	Check all three
Engine produces too much torque	Spark Timing too advanced or throttle too open	Increase retard or reduce airflow
Excessive exhaust heat	Too much timing retard or fuel	Reduce Anti-Lag effect
AFR or Lambda excessively rich	Fuel Enrichment too high or insufficient airflow	Reduce fuel or check airflow
Boost rises unexpectedly	Excessive turbine energy	Reduce Anti-Lag and check boost control
Turbo slows immediately	Insufficient exhaust energy	Check airflow, Spark Timing and Fuel Enrichment

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Setup Check

Before using Anti-Lag:

[ ] Normal engine Tune is correct.

[ ] TPS is calibrated.

[ ] MAP is calibrated.

[ ] Ignition timing has been physically verified.

[ ] Turbocharger and exhaust system are suitable.

[ ] Airflow method is configured.

[ ] Anti-Lag is enabled.

[ ] RPM threshold is safe.

[ ] TPS threshold is correct.

[ ] MAP threshold is correct.

[ ] Spark Timing is conservative.

[ ] Fuel Enrichment is conservative.

[ ] Fuel Cut does not interfere with Anti-Lag operation.

[ ] Boost Control has been verified.

[ ] AFR or Lambda is monitored.

[ ] Exhaust temperature is monitored where possible.

[ ] Testing is performed for short periods.

[ ] Catalytic converter is protected where fitted.

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Related Documents

Refer to the applicable manuals for:

- Fuel and Timing.
- Spark and Timing.
- Engine Limits.
- Launch Control.
- ETC.
- MAP Sensor.
- TPS Setup and Calibration.
- Boost Control where applicable.

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