Spitronics ECU - Spark and Timing - Guide

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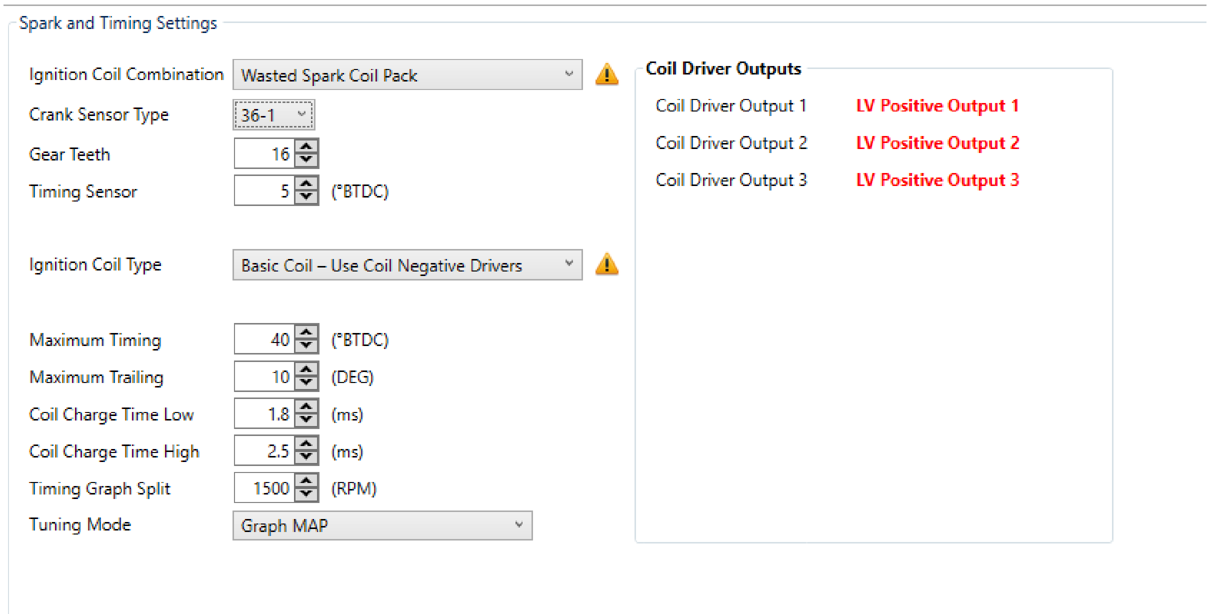
The **Spark & Timing** page contains the main ignition-system configuration settings used by the ECU.

Open:
Features → Spark & Timing



The settings shown depend on:

- Firmware.
- Engine configuration.
- ECU hardware.
- Available ignition drivers.
- Selected ignition system.

Some selections are deliberately hidden or locked by application-specific firmware so that only valid options are available to the tuner.

The main settings include:

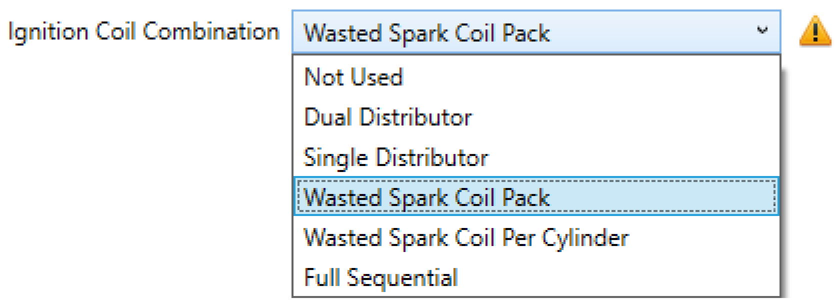
- Ignition Coil Combination.
- Crank Sensor Type.
- Gear Teeth.
- Timing Sensor.
- Ignition Coil Type.
- Maximum Timing.
- Maximum Trailing.
- Coil Charge Time Low.
- Coil Charge Time High.
- Timing Graph Split.
- Tuning Mode.
- Coil Driver Outputs.

Ignition Coil Combination

Ignition Coil Combination defines how the ECU distributes the ignition events between the available coils.

This software version can provide selections such as:

- Not Used.
- Dual Distributor.
- Single Distributor.
- Wasted Spark Coil Pack.
- Wasted Spark Coil Per Cylinder.
- Full Sequential.



Not every selection is available on every firmware.

The firmware may hide combinations that are not valid for the engine or ECU hardware.

Changing Ignition Coil Combination can also change which physical drivers are allocated to the coils.

For this reason it is a **Critical Setting**.

Do not change it on a running engine.

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Not Used

Select **Not Used** where the firmware does not require ignition control from the ECU.

This may be used in specialised applications where another system controls ignition.

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Single Distributor

A **Single Distributor** system uses one ignition coil.

The ECU controls the coil and the distributor mechanically directs each spark to the appropriate cylinder.

Advantages include:

- Only one ignition coil.
- Only one ignition driver.
- Full sequential spark distribution is achieved mechanically.

Disadvantages include:

- One coil must charge and fire for every cylinder.
- Available coil charge time decreases as RPM increases.
- Distributor cap and rotor gaps reduce available spark energy.
- Rotor Phasing becomes important.

Refer to:

Spitronics ECU - Setting Rotor Phasing for Distributors - Guide

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Dual Distributor

Dual Distributor activates two appropriately phased ignition outputs for engines that use two distributor systems.

Typical applications include some:

- V8 engines.
- V12 engines.
- OEM dual-distributor systems.

The coil and distributor phasing must correspond with the engine firing order.

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Wasted Spark Coil Pack

A **Wasted Spark Coil Pack** normally uses one dual-output coil for each pair of cylinders.

Two cylinders that move together are paired.

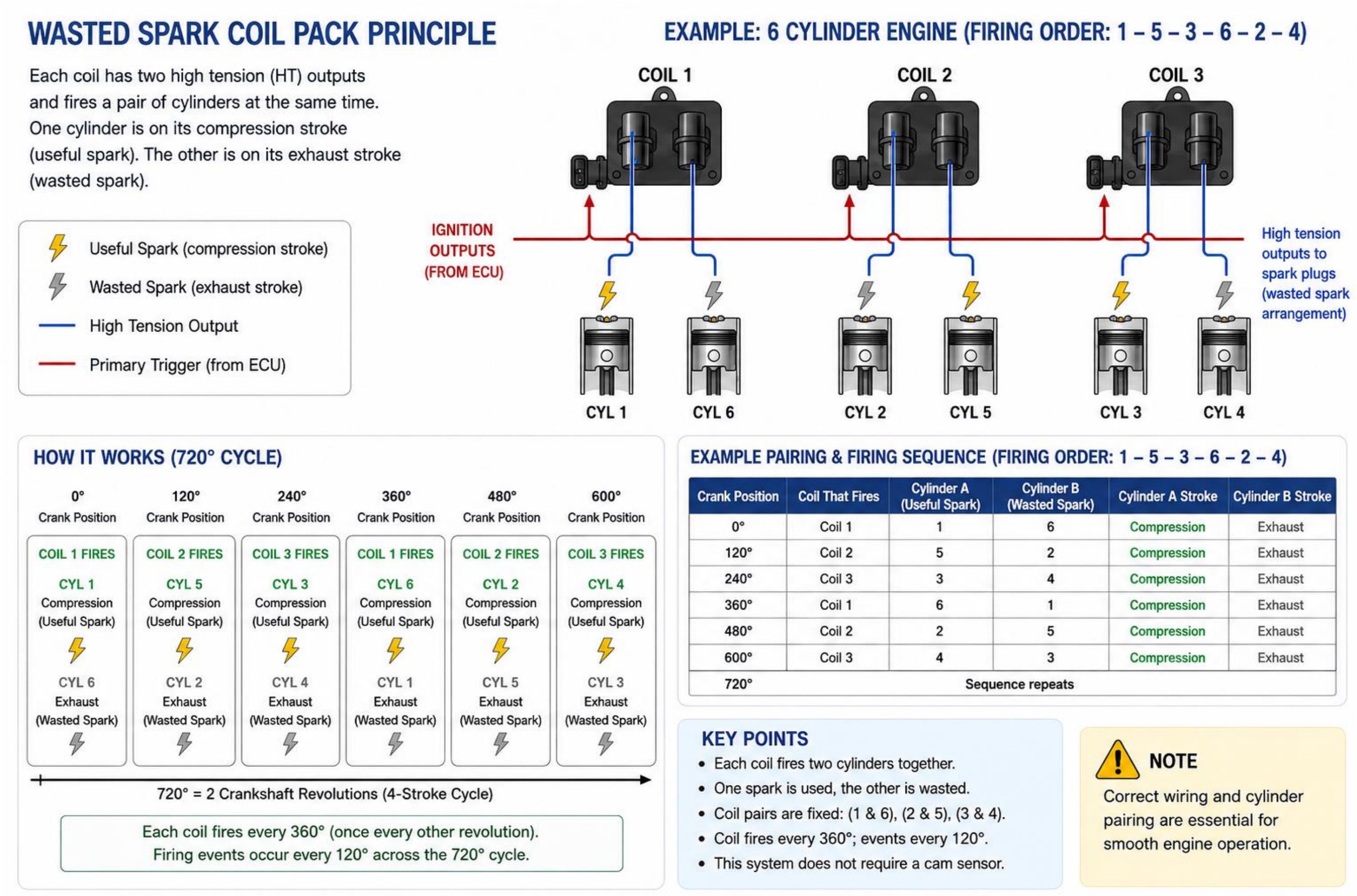
One cylinder is on its compression stroke while the paired cylinder is on its exhaust stroke.

Both spark plugs fire at the same time.

One spark therefore ignites the mixture while the other is a wasted spark.

Advantages include:

- Fewer coils and ignition drivers.
- No Cam Home signal required for normal wasted-spark operation.
- More available charge time than a single distributor coil.



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Wasted Spark Coil Pack vs Individual Coils

Wasted spark remains a simple and reliable ignition method, but a dual-output wasted-spark coil pack has practical disadvantages compared with individual coils. These differences become more important on high-boost racing engines where ignition voltage margin is critical.

Spark Plug Polarity

In a dual-output wasted-spark coil, the two spark plugs form part of the same secondary circuit. Current therefore flows through the two plugs in opposite directions. One plug fires from the centre electrode to the ground electrode, while the paired plug fires from the ground electrode to the centre electrode.

This causes different electrode wear between the paired cylinders. In practical use, Spitronics has observed that spark plug life can differ noticeably between the two cylinders of a wasted-spark pair.

Spark Plug Gap and Firing Voltage

The secondary current must establish a spark across both plug gaps. The exhaust-stroke cylinder is at low pressure and therefore requires much less firing voltage than the compression-stroke cylinder, but its gap is still part of the series spark path.

The total breakover voltage is therefore higher than with one coil firing one plug. On high-boost engines this reduces the available ignition-voltage margin and may require a smaller spark plug gap to maintain reliable ignition.

Ignition Energy

The energy stored in an ignition coil is determined by the coil design, magnetic core, inductance and primary current. A dual-output wasted-spark coil uses one stored-energy event to support both spark plugs, while an individual-coil system provides a separate coil and magnetic core for each plug.

If the coil designs are otherwise comparable, individual coils provide greater total magnetic-energy capability across the paired cylinders and place the complete ignition event on the cylinder that actually requires combustion. This becomes useful as cylinder pressure and boost increase.

Coil Charge Time

Do not select individual or Full Sequential ignition simply to gain more coil charge time. A correctly selected coil normally has sufficient time to reach its required charge current when fired once per crankshaft revolution. Once the coil has reached its required charge or magnetic saturation, additional available time does not create additional spark energy.

Wasted Spark Coil Per Cylinder

Wasted Spark Coil Per Cylinder is electrically different from a dual-output wasted-spark coil pack. Each individual coil fires only one spark plug, so the two-plug series circuit, opposite plug polarity and added second-gap breakover voltage do not apply. The coils are simply commanded in pairs every 360° of crankshaft rotation.

Full Sequential and NOS

Full Sequential ignition fires each cylinder only on its compression stroke and removes the wasted spark completely. Spitronics particularly recommends this arrangement for engines using nitrous oxide (NOS), where avoiding an unnecessary spark on the exhaust stroke provides an additional safety margin during valve overlap and mixture reversion conditions.

Spitronics Recommendation

Wasted spark remains suitable for many naturally aspirated and moderate-boost applications. For high-boost racing engines, where the spark must break down under very high cylinder pressure, Spitronics prefers individual coils where the ECU and installation allow it. The main advantages are improved spark-voltage margin, consistent spark-plug polarity and one coil energy source per spark plug.

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Wasted Spark Coil Per Cylinder

Wasted Spark Coil Per Cylinder uses one individual coil per spark plug, but the coils are still fired in wasted-spark sequence.

A pair of coils therefore fires together every 360° of crankshaft rotation.

Because each coil drives only one spark plug, this arrangement does not have the opposite-polarity and two-gap series-circuit disadvantages of a dual-output wasted-spark coil pack.

This arrangement is commonly useful where:

- Individual COP coils are fitted.
- No Cam Home signal is available.
- Full Sequential ignition is not required.

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Full Sequential

Full Sequential uses an individual ignition event for each cylinder once during the complete 720° four-stroke cycle.

Where individual coils are already used in wasted-spark sequence, changing to Full Sequential does not automatically increase spark energy if the coils already reach their required charge current. The main benefits are cylinder-specific ignition control and removal of the unnecessary exhaust-stroke spark.

This requires the ECU to know:

- Crank position.
- Engine stroke.

A valid Cam Home or equivalent synchronisation signal is therefore normally required.

Full Sequential ignition can be useful where the application requires exact cylinder-specific spark control. For NOS injected engines this method is very important.

Not all firmware or ECU hardware supports Full Sequential ignition.

The firmware will normally hide this selection where it is unavailable.

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Ignition Coil Configuration and Firing Order

The coil combination determines **how many ignition events and outputs are required**.

The actual coil wiring must still correspond with:

- Cylinder numbering.
- Engine firing order.
- Firmware output sequence.

Do not assume that Coil Driver Output 1 always connects to cylinder 1.

Always use the applicable wiring drawing and firing-order information.

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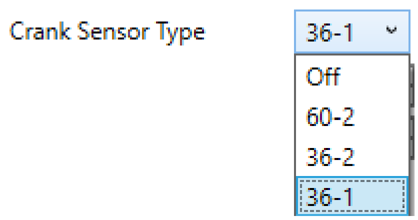
Crank Sensor Type

Crank Sensor Type selects the crank trigger pattern used by the firmware.

This software version can include:

- Off.
- 60-2.
- 36-2.
- 36-1.



This selection is normally hidden or locked because most firmware is built for a specific crank trigger pattern.

Some flexible firmware has been developed specifically to allow the trigger wheel to be selected in software.

Only select a crank pattern that matches the actual trigger wheel.

An incorrect selection can result in:

- No RPM.
- Crank errors.
- Incorrect timing.
- Incorrect synchronisation.

For detailed crank and cam information, refer to:
Spitronics ECU - Crank and Cam Sensors - Guide

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Gear Teeth

Gear Teeth provides the coarse crank-angle alignment between the physical trigger wheel and ECU timing.

For a missing-tooth wheel, the setting establishes the approximate number of trigger teeth between the synchronisation reference and the required crank position.

Conceptually:

Gear Teeth = coarse timing adjustment

For example, on a 36-tooth wheel:

360° ÷ 36 = 10° per tooth

Changing Gear Teeth by one tooth therefore changes the basic timing relationship by approximately 10° on a 36-tooth pattern.

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Timing Sensor

Timing Sensor provides the fine ignition timing adjustment after Gear Teeth has been set.

Conceptually:

Gear Teeth → Coarse adjustment

Timing Sensor → Fine adjustment

The available adjustment range depends on the trigger pattern and firmware.

Do not use these settings to tune ignition advance.

Their purpose is to make:

ECU commanded timing = actual crankshaft timing

Once this alignment is correct, ignition timing is tuned using the applicable Graph or Matrix.

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Ignition Timing Calibration

Actual ignition timing must be verified with a timing light before tuning the engine.

A practical procedure is:

1. Confirm stable Crank Sensor operation.
2. Set the ECU to a known fixed timing value.
3. A value around **10° BTDC** is convenient where a suitable pulley mark exists.
4. Check actual crankshaft timing with a timing light.
5. Adjust **Gear Teeth** for coarse correction where required.
6. Adjust **Timing Sensor** for fine correction.
7. Continue until the timing light agrees with the timing commanded by the ECU.
8. Recheck at more than one engine speed.

Important

Do not begin ignition tuning until actual timing agrees with ECU timing.

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Distributor Timing Calibration

When a distributor is used, do **not** rotate the distributor simply to make ECU timing agree with the timing light.

Rotating the distributor changes **Rotor Phasing**.

Rotor Phasing must first place the rotor correctly relative to the distributor-cap terminal.

ECU timing alignment is then corrected electronically using Gear Teeth and Timing Sensor.

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Timing Light Operation

A timing light must trigger reliably from the ignition system.

Depending on the installation, the pickup may be used on:

- Cylinder 1 HT lead.
- Suitable coil output.
- Suitable temporary extension lead.

If the timing light struggles to detect a COP ignition signal, additional turns of the trigger lead through the pickup can sometimes increase the signal detected by the timing light.

Always follow the timing-light manufacturer's instructions.

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Verify Timing Across RPM

Do not verify timing at only one engine speed.

After setting the alignment:

1. Lock the ECU timing.
2. Check timing at idle or low RPM.
3. Increase engine speed.
4. Confirm that actual timing remains aligned with ECU timing.

Timing that moves in the wrong direction as RPM changes can indicate:

- Incorrect VR Sensor polarity.
- Incorrect trigger edge.
- Trigger signal problems.
- Mechanical trigger movement.

Correct the trigger system before tuning.

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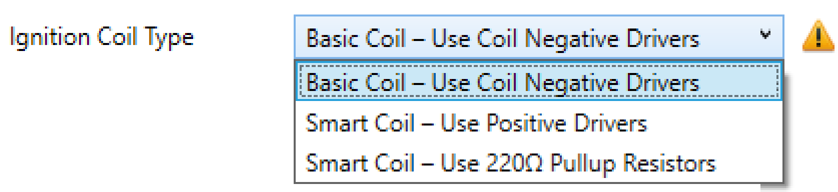
Ignition Coil Type

Ignition Coil Type tells the ECU what type of electrical driver is required for the ignition coils.

This software version can include:

- Basic Coil - Use Coil Negative Drivers.
- Smart Coil - Use Positive Drivers.
- Smart Coil - Use 220Ω Pullup Resistors.



This is a **Critical Setting** because changing the selection can change which physical ECU drivers are allocated to the coils.

Do not change Ignition Coil Type while the coils are connected and the engine is running.

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Basic Coil - Use Coil Negative Drivers

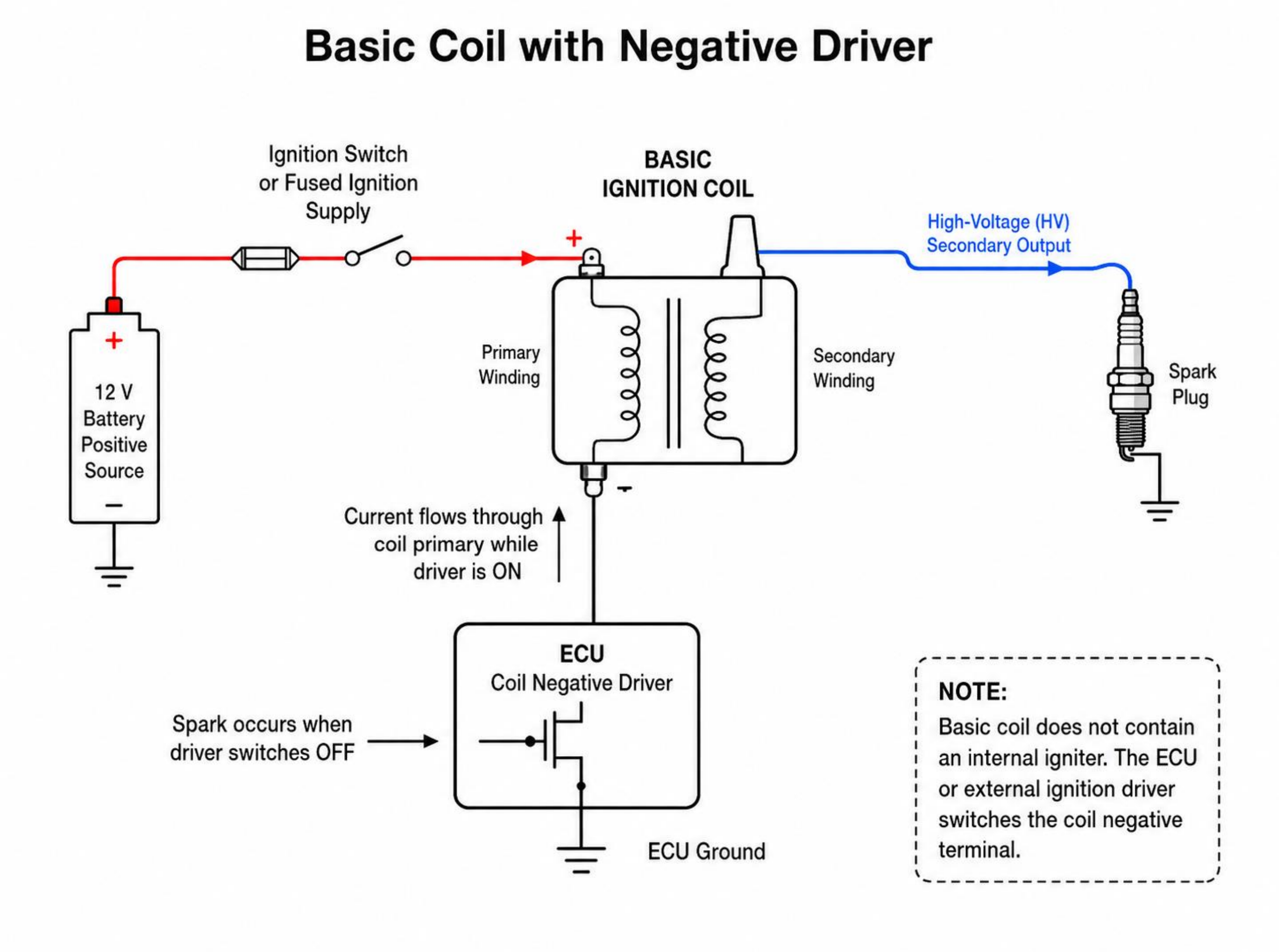
A **Basic Coil** does not contain its own high-current ignition driver.

The ECU or an external ignition module must therefore control the coil primary current.

A basic ignition coil is charged by switching its negative primary terminal toward Ground.

When the driver switches off, the collapsing magnetic field generates the high voltage required for the spark.

This requires a suitable high-current ignition driver.



Basic coils typically show a relatively low primary resistance when measured with a multimeter.

The practical coil-identification procedure uses approximately **0.3-1.5 Ω** as a useful indication for many conventional basic coils.

For detailed testing refer to:

Spitronics ECU - Ignition Coil Testing - Workshop Guide
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Smart Coil - Use Positive Drivers

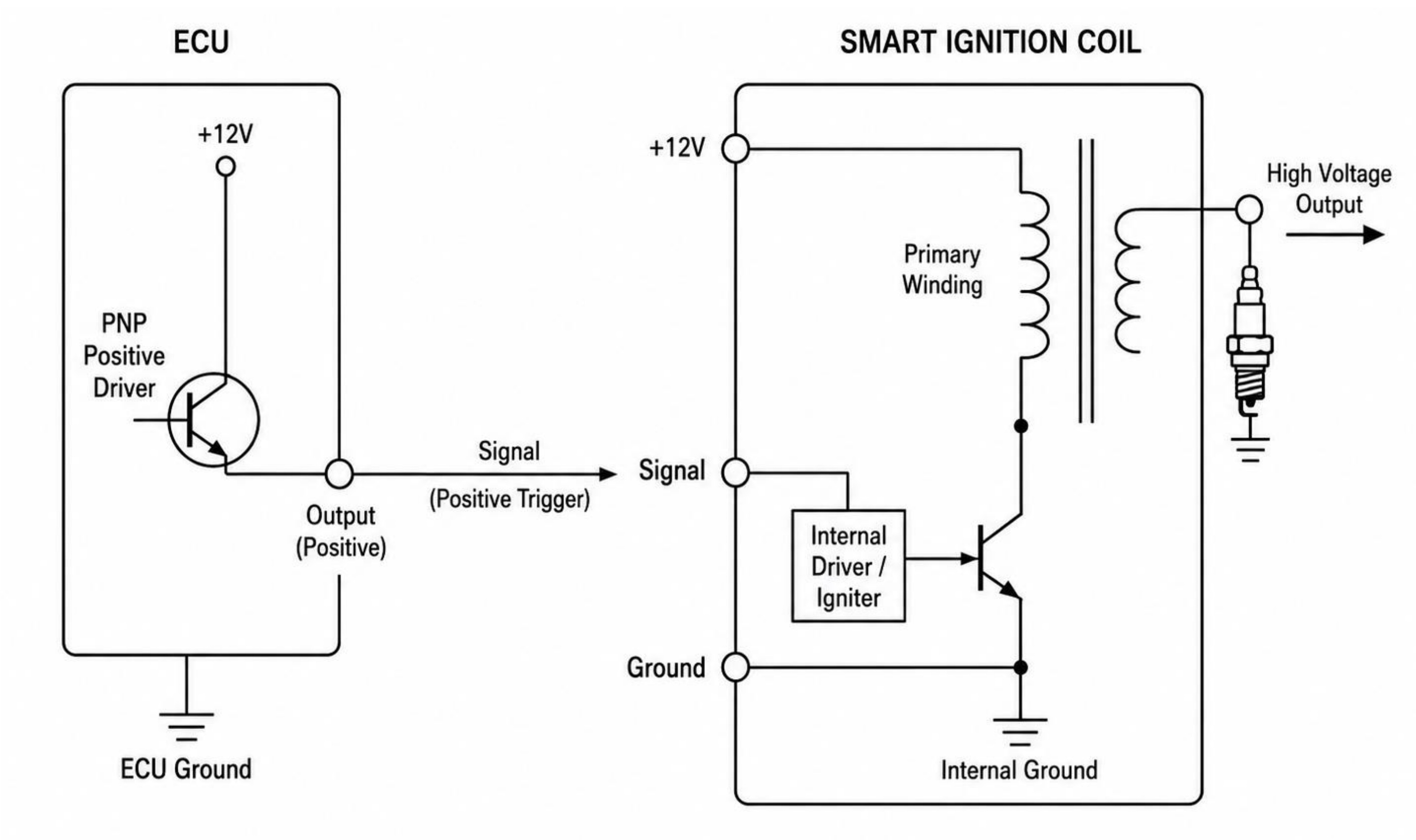
A **Smart Coil** contains its own high-current ignition driver.

The ECU therefore sends only a trigger command to the coil.

With:

Smart Coil - Use Positive Drivers

the ECU uses its positive ignition trigger drivers.



The actual trigger voltage and polarity requirements depend on the coil.

Do not assume every Smart Coil uses the same trigger arrangement.

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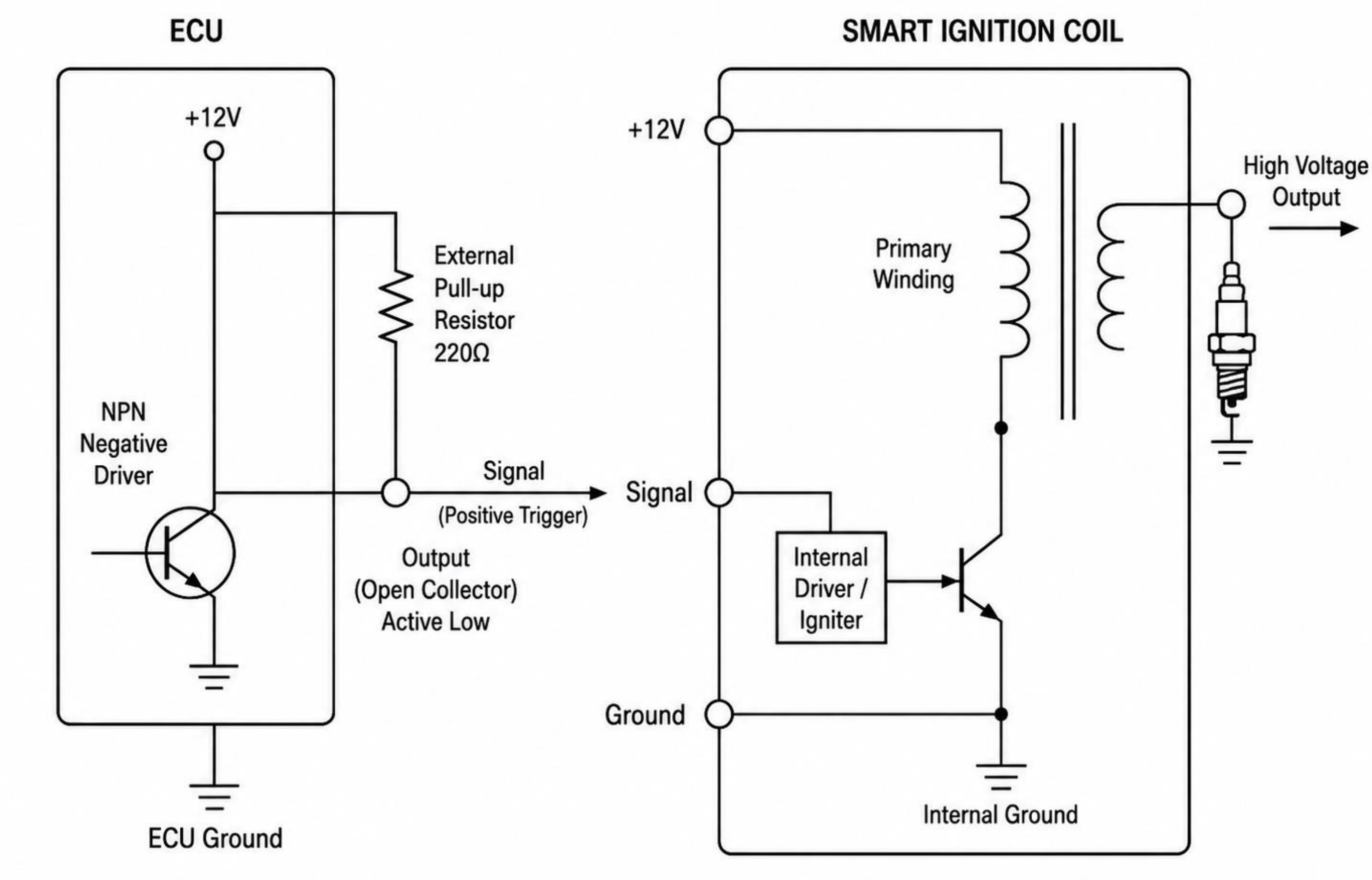
Smart Coil - Use 220Ω Pullup Resistors

This selection is used when a Smart Coil is driven from a suitable **negative ECU driver** and the trigger signal is inverted using a **220 Ω pull-up resistor** arrangement.

The pull-up creates the HIGH state while the negative driver pulls the Signal LOW.



This provides another method of generating a Smart Coil trigger signal when appropriate positive drivers are not being used.

Important

This is an electrical interface arrangement.

The correct:

- Driver.
- Pull-up connection.
- Trigger voltage.
- Coil pinout.

must be confirmed before the coil is connected.

Do not assume that every Smart Coil is compatible with this method.

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Basic vs Smart Coil Identification

If the coil type is unknown, do not guess from appearance alone.

A practical initial test is:

Basic Coil

Measure primary resistance.

A very low resistance between the primary terminals normally indicates a conventional coil winding.

Smart Coil

Use the multimeter Diode Test across the pins.

Directional semiconductor readings indicate internal electronic components and therefore suggest a built-in ignition driver.

Refer to the dedicated Coil Testing guide for the complete procedure.

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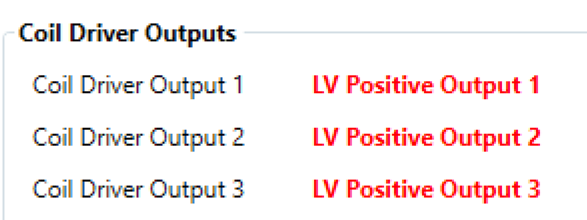
Coil Driver Outputs

Coil Driver Outputs shows which physical ECU drivers the firmware has allocated to the ignition system.

Example:

- Coil Driver Output 1 → LV Positive Output 1.
- Coil Driver Output 2 → LV Positive Output 2.
- Coil Driver Output 3 → LV Positive Output 3.



The displayed driver allocation can change according to:

- Ignition Coil Combination.

- Ignition Coil Type.
- Firmware.
- ECU hardware.
- Other enabled functions.

Always use the **current Driver Output shown in Cosmos** when confirming the wiring.

Do not rely on an old fixed output number.

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Driver Colour Identification

Cosmos uses colour to indicate the type of physical driver allocated.

Driver colour convention includes:

- **Black → Negative Output**
- **Red → Positive Output**
- **Green → General Purpose Output**
- **Blue → Coil Negative Output**
- **Purple → Combo Output**

The colour is an identification aid.

Always confirm the actual driver name and Product wiring before making electrical connections.

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Critical Coil Settings

The warning triangle next to:

- Ignition Coil Combination.
- Ignition Coil Type.

indicates that these settings can alter important hardware behaviour.

Changing these selections may:

- Activate different drivers.
- Disable existing drivers.
- Change driver polarity.
- Change which physical pins control the coils.

Incorrect settings can damage:

- Ignition coils.

- ECU ignition drivers.
- External ignition modules.

Configure the ignition system before connecting the coil outputs during initial installation.

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Maximum Timing

Maximum Timing defines the maximum ignition advance that the ECU is permitted to command.

Example:

Maximum Timing = 40° BTDC

If the combined Tune and compensation calculations request more timing than this value, the final ignition timing is limited to the configured maximum.

This is an upper safety limit.

It is not a substitute for correctly tuning the ignition system.

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Maximum Trailing

Maximum Trailing applies to Rotary ignition systems.

Rotary engines may use:

- Leading spark plug.
- Trailing spark plug.

The setting limits how far the Trailing spark may be positioned relative to the Leading spark.

Example:

Maximum Trailing = 10°

The firmware can hide this setting on applications where Trailing ignition is not used.

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Coil Charge Time

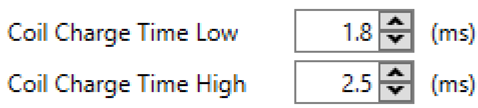
Ignition coils require time to build magnetic energy before the spark occurs.

This is called:

- Coil Charge Time.
- Dwell.

The Spitronics ECU uses two main settings:

- Coil Charge Time Low.
- Coil Charge Time High.



The ECU varies the requested coil charge time between these values according to engine operating conditions.

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Coil Charge Time Low

Coil Charge Time Low is the lower dwell value used under lighter engine operating conditions.

At low cylinder pressure, less stored ignition energy is normally required.

Using unnecessarily high dwell under these conditions only creates additional heat.

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Coil Charge Time High

Coil Charge Time High defines the upper normal dwell value available under higher engine load.

As cylinder pressure increases, more spark energy may be required and the ECU progressively increases coil charge time toward the High value.

The objective is not to use the highest possible charge time.

The objective is:

The minimum charge time that provides reliable spark energy, with an appropriate safety margin.

Refer to:

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Conservative Coil Charge Time

If the correct coil requirement is unknown, begin conservatively.

A practical conservative initial setting is approximately:

- Low = 1.5 ms.
- High = 2.0 ms.

The correct value must then be established for the actual coil.

Different coils can require significantly different charge times.

Do not copy dwell values from another ignition system simply because the coils appear similar.

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Excessive Coil Charge Time

Excessive charge time can cause:

- Coil overheating.
- Ignition-driver overheating.
- Coil failure.
- Driver failure.
- Misfire.
- Excessive current consumption.

More dwell does not necessarily create more spark energy once the coil has saturated.

During initial setup, individual coil power circuits can be protected with suitable fuses where appropriate.

A 5 A fuse per coil can be used as a practical sacrificial protection method during initial testing where appropriate.

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Timing Graph Split

Timing Graph Split sets the RPM point used to divide the low-RPM and high-RPM timing compensation regions in applicable Graph-based tuning modes.

Example:

1500 RPM

A practical starting point is typically about 500-1000 RPM above normal idle speed.

The final setting should suit the engine and the selected tuning strategy.

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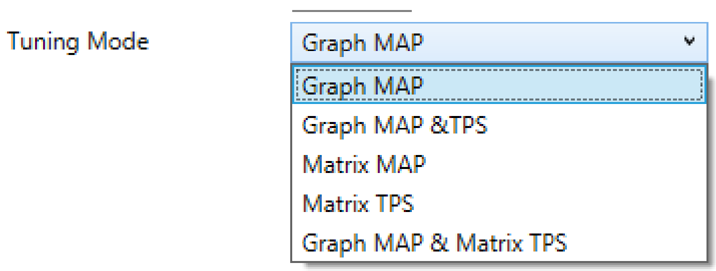
Tuning Mode

Tuning Mode determines which ignition tuning method is used.

This software version can include:

- Graph MAP.
- Graph MAP & TPS.
- Matrix MAP.
- Matrix TPS.
- Graph MAP & Matrix TPS.



Not all selections are shown on every firmware.

The firmware may hide methods that are not appropriate for the application.

This page selects the **method**.

The actual ignition tuning procedure is covered under the applicable Tuning, Graph and Matrix documentation.

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Graph MAP

Graph MAP uses manifold pressure and RPM as the main load and speed information for ignition tuning.

It is generally suitable for engines with a useful manifold-pressure signal.

The Graph method is particularly practical for:

- Road tuning.
- Naturally aspirated engines.
- Turbo engines with a stable MAP signal.

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Graph MAP & TPS

Graph MAP & TPS combines MAP and TPS information.

This can be useful where the MAP signal becomes less useful at low RPM or with certain intake arrangements.

TPS information can assist with load calculation where manifold vacuum is poor.

The exact operation depends on firmware.

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Matrix MAP

Matrix MAP uses:

MAP × RPM

as the main ignition tuning table.

This method is well suited to dyno tuning where load and RPM can be held accurately.

Detailed Matrix tuning is covered separately.

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Matrix TPS

Matrix TPS uses:

TPS × RPM

as the ignition tuning table.

It can be useful for naturally aspirated engines with poor manifold-pressure signals, including some individual-throttle-body installations.

Because TPS does not directly compensate for atmospheric pressure, Barometric Pressure compensation may be useful where the vehicle operates over large altitude changes.

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Graph MAP & Matrix TPS

This hybrid mode combines:

- TPS Matrix for the primary naturally aspirated operating region.
- MAP-based Graph information for pressure-related timing correction.

It can be useful for specialised turbo or race applications where TPS provides the more useful base load signal while MAP is still required for boost-related correction.

Detailed tuning of this method belongs in the Tuning documentation.

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Selecting a Tuning Mode

Select the tuning method according to:

- Engine type.
- Intake system.
- Quality of MAP signal.
- Turbo or naturally aspirated operation.
- Tuning equipment.
- Tuner preference.

Do not change the tuning method simply because another method appears more advanced.

The best method is the one that represents engine load reliably and can be tuned accurately.

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Distributor Rotor Phasing

Distributor systems require correct mechanical **Rotor Phasing**.

Rotor Phasing aligns:

- Rotor.
- Distributor cap terminal.
- Normal ignition timing range.

Incorrect phasing causes the spark to jump an excessive gap inside the distributor.

This can result in:

- Reduced spark energy.
- Electrical interference.
- Erratic misfires.

Refer to:

As a practical example, approximately 25° BTDC can be used as the centre of an operating range of roughly 14°-36° BTDC where this suits the application.

Spitronics ECU - Setting Rotor Phasing for Distributors - Guide

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Initial Ignition Setup Procedure

Before starting a newly installed engine:

1. Confirm the correct Crank Sensor configuration.
2. Confirm stable RPM during cranking.
3. Select the correct Ignition Coil Combination.
4. Select the correct Ignition Coil Type.
5. Confirm the displayed Coil Driver Outputs.
6. Check the physical coil wiring against the Product documentation.
7. Set conservative Coil Charge Time values.
8. Verify Rotor Phasing where a distributor is used.
9. Set a known fixed ignition timing value.
10. Check actual timing with a timing light.
11. Adjust Gear Teeth for coarse alignment.
12. Adjust Timing Sensor for fine alignment.
13. Verify timing again at different RPM.
14. Restore the required Maximum Timing.
15. Select the required Tuning Mode.
16. Only then begin ignition tuning.

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Common Problems

Symptom	Possible Cause	Check
No spark	Wrong Coil Combination	Check configuration
Coils become hot	Excessive Charge Time	Reduce dwell and investigate
Smart Coil does not trigger	Wrong Coil Type / driver method	Check trigger requirements
ECU driver overheats	Wrong coil or excessive current	Check Coil Type and dwell
Timing does not match software	Trigger alignment incorrect	Adjust Gear Teeth / Timing Sensor
Timing moves with RPM	Trigger polarity or signal problem	Check Crank Sensor
Distributor misfires	Rotor Phasing incorrect	Perform Rotor Phasing
No Full Sequential spark	No valid Cam synchronisation	Check Cam Home
Wrong cylinders fire	Coil outputs / firing order incorrect	Check wiring
Tuning Mode unavailable	Firmware hides unsupported method	Verify firmware
Coil output pin changes	Critical Setting changed driver allocation	Check Coil Driver Outputs
Weak spark at high RPM on distributor	Insufficient available coil charge time	Check single-coil system
Coil fails during initial setup	Wrong driver polarity or excessive dwell	Disconnect and verify configuration

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Safety

Ignition systems generate dangerous high voltages.

During installation and testing:

- Keep hands away from exposed ignition terminals.
- Do not hold a spark plug or HT lead while cranking.
- Secure spark plugs properly when conducting spark tests.
- Configure coil type before connecting ignition outputs.
- Use conservative dwell when coil requirements are unknown.
- Do not change Critical ignition settings while the engine is running.
- Verify actual ignition timing before allowing the engine to operate under load.

Incorrect ignition configuration can damage both the coils and ECU drivers.

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Setup Check

Before considering Spark & Timing setup complete, verify:

[ ] Ignition Coil Combination is correct.

[ ] Crank Sensor Type is correct where selectable.

[ ] Gear Teeth is approximately correct.

[ ] Timing Sensor has been calibrated.

[ ] Actual timing agrees with ECU timing.

[ ] Timing remains stable as RPM changes.

[ ] Ignition Coil Type is correct.

[ ] Smart or Basic coil type has been confirmed.

[ ] Coil Driver Outputs match the actual wiring.

[ ] Critical Settings have been transferred correctly.

[ ] Maximum Timing is safe.

[ ] Maximum Trailing is correct where applicable.

[ ] Coil Charge Time Low is appropriate.

[ ] Coil Charge Time High is appropriate.

[ ] Timing Graph Split is suitable.

[ ] Tuning Mode is appropriate for the engine.

[ ] Rotor Phasing is correct where a distributor is used.

[ ] Full Sequential applications have valid Cam synchronisation.

[ ] No coil or ignition driver is overheating.

[ ] Engine is ready for ignition tuning.

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