

POLESTAR Management System

Installation Instructions

This document contains the information needed to install and adjust the POLESTAR Engine Management System. It assumes that the system already contains the required advance curve.

The POLESTAR Management System kit consists of the following parts:

1. POLESTAR 3 System ECU box
2. Hexagonal magnetic sensor
3. Steel timing disc
4. Wiring loom
5. Knock sensor (Optional, internal to ECU)

The POLESTAR 3 system accurately controls an engine's ignition advance curve. It is triggered using a magnetic sensor directly from the crankshaft. It can be operated as a "wasted" or double spark system hence requiring no distributor, or in 'single coil' mode using a standard coil and distributor

The system is triggered when the slots in the timing disc pass through the magnetic sensor block. The sensor block is designed to be bolted to the engine in a suitable position with the timing disc attached to the crankshaft pulley so it can rotate with the engine.

It is VERY important that the trigger point on the disc passes the sensor at the correct point in the engine's cycle. The details of how to install the timing disc and sensor block are described below.

If you experience any problem then please contact POLESTAR Systems on 01264-333034.

Fitting the sensor and disc

Firstly a suitable place should be found to mount the sensor block. It should be positioned such that the timing disc, when fitted to the crankshaft pulley, can pass through the slot in the centre of the sensor. When fitting the system to an A-Series engine it is usually possible to attach the sensor via a small bracket bolted to the timing cover securing bolts, or possibly by bolting directly to the timing cover itself (see Figure 1)

The sensor should be located so that the disc penetrates as far as possible into the slot in the sensor. It is important that the disc cannot come into contact with the sensor body when the engine is running; otherwise the sensor and disk will be damaged.

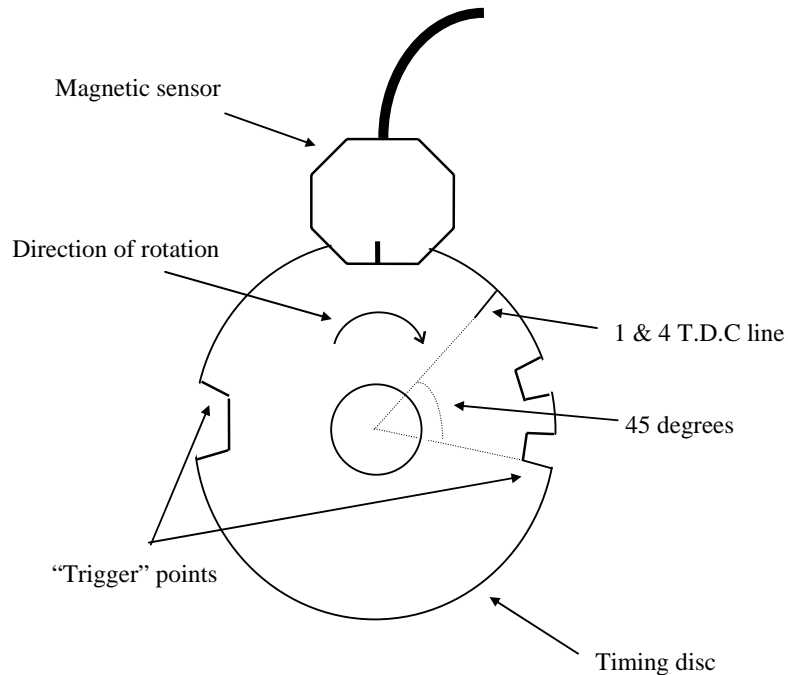


Figure 1 Typical Sensor Fitting on A-Series Engine

Whilst examining the sensor you will notice that it has a white line marked across the end. This will be needed later when fitting the timing disc.

Once the sensor has been loosely mounted it is then possible to mount the timing disc. Firstly take careful note of the direction in which the disc should rotate, this is clearly marked by an arrow on the disc.

Figure 2. Timing Disc and Sensor Alignment (multi-coil)



Also on the timing disc you will see a white line which marks “T.D.C.”, (this line is right on the edge of one of the slots in the disk). For the trigger point to occur at the correct time in the engine’s cycle this line should be lined up with the white line on the sensor body (mentioned above) when the engine is positioned with No.1 and No.4 pistons at Top Dead Centre. The best way to achieve this is as follows.

Having already mounted the sensor, place the timing disc over the back of the crankshaft pulley (but do not screw in place), then fit the pulley onto the engine. Now rotate the engine until it is itself positioned at T.D.C.

Once in this state it is then possible to rotate the timing disc on the back of the pulley (moving just the disc and not the engine) until the white line on it is matched with the white line on the sensor block. The crankshaft pulley and the timing disc should now be carefully marked so that the disc can be fitted to the pulley in exactly this position.

The pulley and disc should now be removed from the engine and the disc can be attached to the pulley in the previously marked position.

The disc as supplied contains no mounting holes, these should be drilled to suit the application. But it should be attached to the crankshaft pulley with at least 6 x M4 countersunk set screws (provided). The holes for the screws should be drilled symmetrically around the disc, and set as far away from the centre as possible (subject to the restrictions described below).

The crankshaft pulley on the A-Series engine is made in two pieces, which are then bonded together using rubber. This provides important vibration damping of the crankshaft. Note when fitting the timing disc to the pulley it is important that it is screwed to the solid part of the pulley and NOT to the section of the pulley which is rubber bonded. Obviously the rubber bonded section of the pulley vibrates whilst the engine is running hence if the timing disc is attached to it in-accuracies in engine timing will result, and there is a significant risk that the disc may vibrate sufficiently to come into contact with the sensor.

Igniton coil and leads (Single Coil mode only)

Using the correct coil

In single coil mode, the POLESTAR 3 system is designed to operate with a standard type ignition coil, recommended types are the Lucas "Gold" or Bosch "Blue" coils. Both of these are high output standard type coils. Coil types which state they are not suitable for use with contact-breaker ignition should **NOT** be used, and may result in damage to the system. The correct type of coil should have a primary resistance of not less than 3 Ohms.

Distributor Alignment

When operating in single coil mode the POLESTAR 3 system still requires that the engine be fitted with a distributor. Although the distributor does not control the engine timing it is still important that the rotor arm is pointing to the correct cylinder when the POLESTAR 3 system fires the ignition. It is also important that it continues to point at the correct cylinder as the ignition timing is advanced and retarded electronically.

Although this alignment is important it does not have to be done with particular accuracy. Most engines use rotor arms which have quite wide contacts which means that as long as it is pointing (by eye) towards the correct corner of the distributor cap when the engine is turned over by hand, then the alignment is usually acceptable.

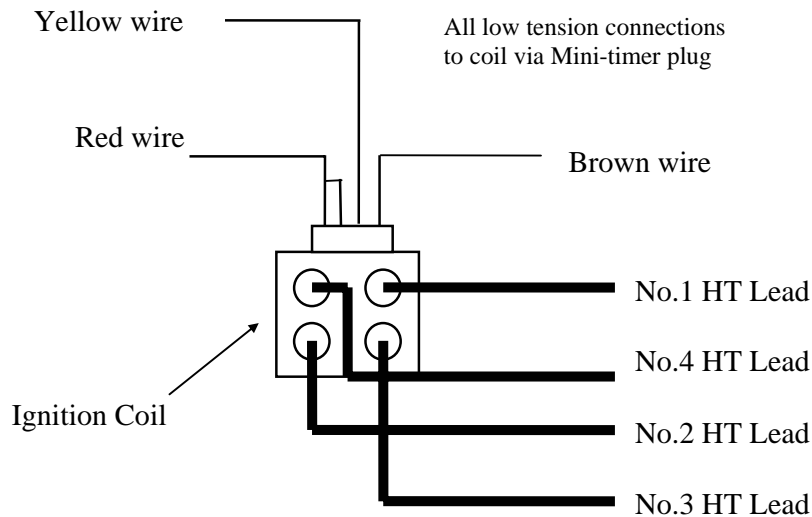
The simplest way to do this alignment is to first turn the engine until it is at TDC (1 and 4), then mark the distributor body alongside where No.1 and No.4 plug leads are connected. Now remove the distributor cap and check that the rotor arm is pointing directly at one of the marks you just made. If it is not then slacken the pinch bolt holding the distributor and rotate the distributor body until it is aligned with the nearest mark. An indication that this alignment may not be correct will be either, difficulty in starting the engine, or a misfire at high RPM.

Igniton coil and leads (Wasted Spark mode only)

The latest type POLESTAR 3 system (supplied after 30/10/2005) is designed to operate with a Sagem BAE04 double output ignition coil. The loom is fitted with a

plug to suit this coil. The coil is as fitted to the last twin-point injection Rover Mini's, (the same coil was also fitted to the Citroen ZX1.6i 1996-1997) it should be available from a local motor factors. If not, it can be ordered from Minispares (www.minispares.com part number GCL204). See Figure 3 below for the wiring for this coil.

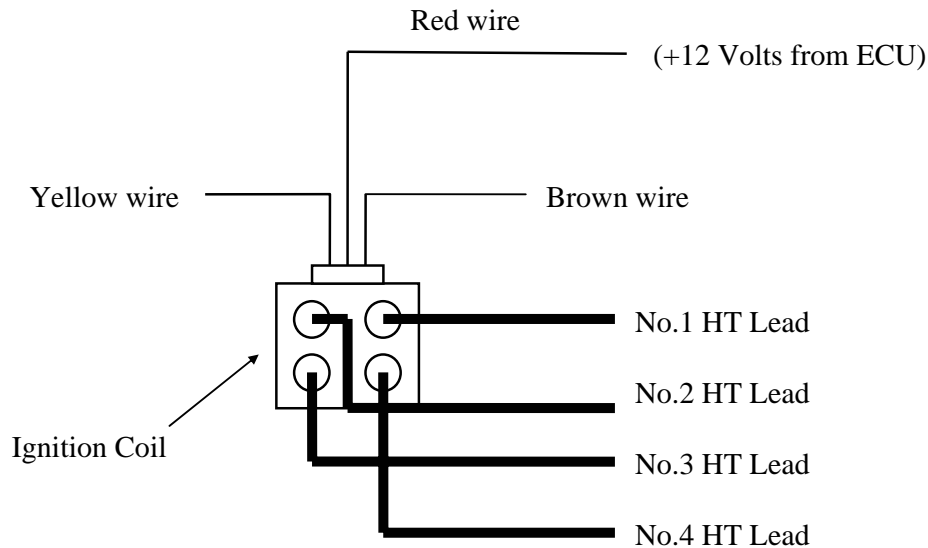
Figure 3 Ignition coil wiring diagram (Mini/Citreon coil)



Older POLESTAR 2 systems were designed to operate with the ignition coil and leads as fitted to a 1995 Ford Fiesta (or equivalent). Ford part number F6503280. This coil has three low tension connection and four high tension outputs each of which connect via an ignition lead to a spark plug (see Figure 4)

The low tension connections to the coil should be made using the three small red Lucas spade connectors provided after shortening the leads to the required length

Figure 4 Ignition coil wiring diagram (Ford coil)



Both these coil types are internally made up of four individual coils connected so that they can be fired as two sets of two pairs. When a pair of coils is fired by the management system a spark is generated from each of the two coils. Two sparks are generated at the same time, one spark being delivered to cylinder number 1 and the other to cylinder number 4. One of these cylinders will be on its compression stroke and the other will be just completing its exhaust stroke, so this spark has no effect, (and is said to be “wasted”). This cycle is then repeated with the other pair of coils connected to cylinders number 2 and number 3.

Fitting the Knock Sensor (if fitted)

The knock sensor is a sensitive vibration sensor which is tuned to ‘listen’ for knocks from the engine. The ECU activates the sensor just before it fires the ignition. If knock is detected then the ECU will automatically apply retard to the ignition timing until the knocking stops.

In order to function correctly the knock sensor needs to be bolted tightly to the engine block. **It must be fitted directly to the engine block with a single bolt through the middle of the sensor. No washers of any kind should be placed on either side of the sensor.** Possible locations for the sensor on an A-Series engine are on one of the lugs on the front of the block to which the alternator bracket is bolted, or adjacent to the engine steady bar above the clutch housing.

The electrical connection to the sensor is via a 2-way mini-timer plug which is already fitted to the wiring loom.

Connecting to the MAP sensor (if fitted)

A MAP (Manifold Absolute Pressure) sensor is contained inside the ECU. If your ECU has this installed then a small clear pipe will be seen coming out of the body of the ECU.

The MAP sensor is used to measure the pressure in the inlet manifold. This value is used in two ways. In a non-turbo engine this is a measure of the load on the engine and is used as one of the dimensions of the 3D map. In addition on a turbo engine this is used to measure boost pressure, this is used to calculate the amount of ignition timing retard to apply based on the configured 'boost retard' (in degrees per PSI).

It is important that the pipe from the ECU is connected to the inlet manifold on the engine side of the throttle butterfly. This is to ensure that it sees both vacuum and boost.

Connecting to and calibrating the Throttle Position Sensor

If your system is supplied with a throttle position sensor input then this has three wires inside a black sleeve (Red, Yellow and Black). Unless it is known at the time of supply which throttle sensor is being used no plug will be attached to the wires.

Figure 5 Throttle position sensor wiring

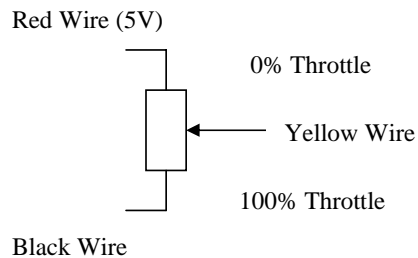


Figure 5 shows the correct wiring of the throttle sensor.

Before operating, the throttle position sensor must be calibrated to the ECU. Basically the ECU needs to know what the voltage measurement from the signal wire is for 0% and 100% throttle. The following procedure should be followed **WITHOUT** the engine running but with the ignition switched on so that the ECU has power. It is also necessary to install the write enable link in the ECU so the configuration data can be changed.

Connect the ECU to a laptop and run the POLESTAR Engine Development Software. When connected to the ECU with the POLESTAR ECU Manager Window showing, click the 'SetZero' button. The buttons at the bottom of the window will change, revealing a 'Setup Throttle' button. Click this button and the 'Throttle Setup' window will appear.

On this new window you need to click on the 'Calibrate Throttle' button, a window will appear asking for the throttle position to be set to the minimum or fully closed (idle) position. Click OK when the throttle is in this position.

A new window will appear asking for the throttle to be set to fully open or maximum position. Whilst holding the throttle in this position click OK. The throttle is now calibrated. Click 'Exit' to return to the normal mapping window.

The throttle position should now change from 0% to 100% as the throttle is opened and closed.

For more details please refer to the POLESTAR Engine Development Software instruction manual.

Fitting the POLESTAR System Box

The system box should **NOT** be located within the engine compartment of the car as it needs to be kept away from places of extreme temperature. Possible locations are, on the inside of the front bulkhead, or in the passenger foot well of a saloon car.

The system box is provided with rubber feet to protect it from severe vibration, these should **NOT** be removed, Two large self tapping screws or small bolts through the two mounting holes/slots provided are sufficient to hold the box in place.

When selecting the location of the system box it is recommended that sufficient room be allowed in front of the box so that it is possible to remove the end plate containing the POLESTAR logo. This allows access to the connector used for mapping the system via a laptop PC.

The system box is then connected to the wiring loom with a single multi-way connector.

The rest of the wires in the wiring loom should be connected as follows

1. Individual wires.

- | | | |
|-------------|---|--|
| RED wire | - | Connect to +12 Volt supply switched by the ignition switch. |
| BLACK wire | - | Fitted with ring connector, connect to earth |
| BLUE wire | - | Connect to trigger of standard Rev Counter |
| Yellow wire | - | (Only in Single Coil mode) This wire should be connected to the -ve side of a standard ignition coil. (The other side of the coil is connected to +12V via the ignition switch) |

2. Sleeved wires.

Thick black sleeve containing Red, Yellow and Brown wires.

(Not present in Single coil mode)

(only available when using the Ford coil, when using the Citroen/Mini twin point coil these wires are already fitted to a 4-way Mini-timer plug.)

- | | | |
|-------------|---|---|
| BROWN wire | - | Connect to the low tension terminal of the ignition coil for cylinders 1 and 4. |
| YELLOW wire | - | Connect to the low tension terminal of the ignition coil for cylinders 2 and 3 |
| RED wire | - | Connect to centre connector. |

Thin black sleeve ending with black/yellow/green sealed plug

- Connect to crank sensor

Red sleeve ending with 2 way mini-timer plug (if fitted)

- Connect to Knock sensor

Black sleeve ending with loose green, yellow and black wires (if fitted)

- Connect green and black wires to launch switch (this should be a push button normally open switch mounted on the steering wheel to activate the launch function.)
- Connect yellow and black wires to traction control disable switch, a standard normally open switch. When close traction control function disabled.

Thin black sleeve ending with Red/Yellow/Black wires (if fitted)

- Connect to throttle position sensor (see above for details of connections)

The Blue rev counter trigger wire is intended for use by rev counters, which cannot be adapted for use with a wasted spark system. For example, the rev counter as fitted to a Mini 1275GT or similar. This type of rev counter would only read at half speed if triggered directly from the coil.

NOTE: It is strongly recommended that the route taken by the wire to the magnetic sensor should NOT go close to the high-tension leads or ignition coil. Also it should NOT be tie-wrapped to the low-tension connections of the coil. All these situations can cause serious interference resulting in engine mis-fires.

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Finally it is also recommended that good quality (preferably silicon) ignition leads are used to cut down the risk of interference.

The length of the wiring loom is usually sufficient for most applications however it is possible for it to be extended. However do not extend the wires to the crank sensor longer than 2 metres

Setting up the system

Once the POLESTAR system has been fitted, the engine should be started and the ignition timing checked. This can only be done using an adjustable timing light, with reference to the advance timing curve supplied with the unit. If the timing is not correct it may be necessary to move the position of the sensor until the correct timing is achieved. (This adjustment can also be made electronically when a PC is connected to the unit, please refer to the POLESTAR Engine Development Software manual for details).

It is worth noting that most adjustable timing lights (Snap-On in particular) require an adapter in order to give the correct reading when used with a 'wasted spark' ignition system. This is because a wasted spark system generates sparks at twice the rate of a standard system. If no adapter is available then it is simply a matter of halving the value read from timing light for both advance and RPM.

Care and Maintenance

The POLESTAR 3 system box should not require any further adjustment once the ignition map has been set. Should it be necessary to remove the magnetic sensor from the engine, then the ignition timing should be re-checked when it is replaced..

The sensor itself should require little or no maintenance, as it relies on magnetism It is not sensitive to oil and dirt build up. However it is worth checking from time to time that the timing disc is not coming into contact with it in any way.

Inside the system box there is a single red LED indicator. This LED will flash briefly when the ignition is switched on it should then go off and remain off. This indicates that the unit has passed its own internal power-up checks. Should the LED remain illuminated then this means that the system has detected a failure. **When in this state the engine will not run, and the unit should be returned to POLESTAR.** If you have access to the above software package it is sometimes possible to restore operation by re-loading the advance curve into the EEPROM via the PC connection. For more details refer to the instructions supplied with the software.