POLE*STAR HS* Management System

Installation Instructions

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

The POLE*STAR HS* Management System kit consists of the following parts:

1. POLE*STAR HS* System ECU box
2. Hexagonal magnetic sensor (optional)
3. Steel timing disc (optional)
4. Wiring loom (optional)

The POLE*STAR HS* 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 can be triggered either via a 36-1 toothed wheel with crankshaft VR type sensor, or via and original slotted disk and hexagonal sensor as fitted to previous versions of the POLE*STAR* ECU.

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 POLE*STAR* Systems on 07713-638045.

Aligning a 36-1 Disc and VR type Sensor

If your ECU is to be used with a POLE*STAR* hexagonal sensor and disc then please skip to the next section.

The 36-1 trigger disc and sensor should be fitted according to the manufacturer's instructions, however it is important that they are fitted with a known alignment. This alignment is then configured in the ECU mapping software and loaded into the ECU.

Figure 1shows a 36-1 trigger wheel fitted to an A-Series Mini engine. The engine has been rotated so that No.1 and No. 4 cylinders are at TDC. Note how the centre of the sensor is positioned on the trailing edge of a tooth.

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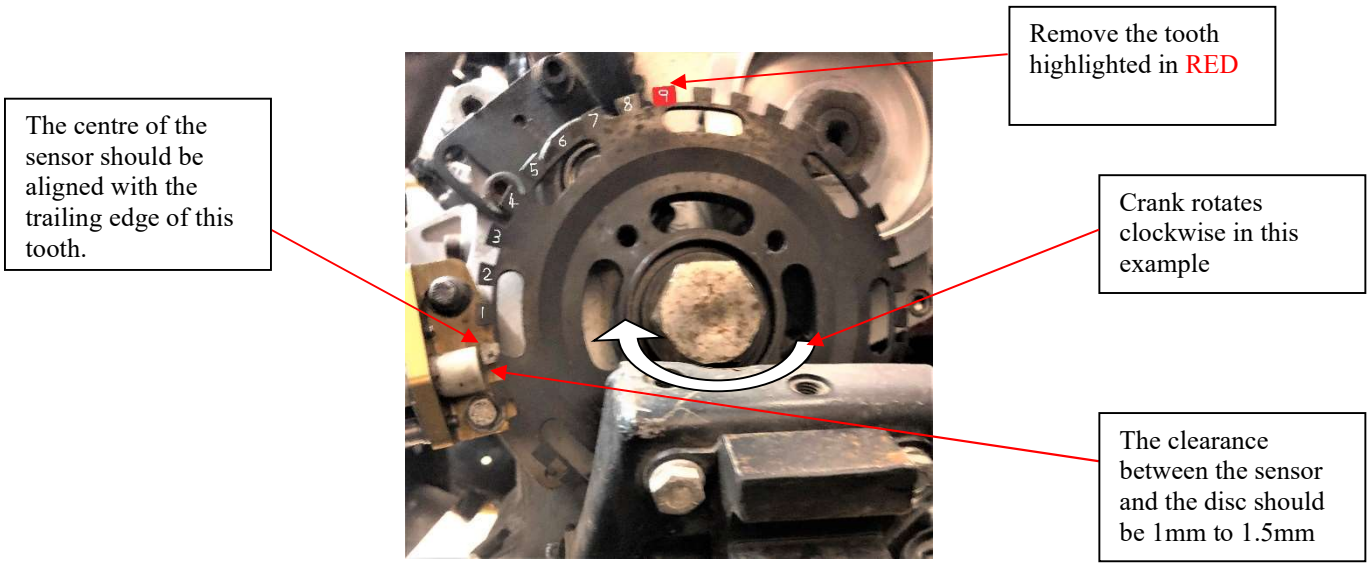
The trigger wheel used here is supplied by MED and requires that you remove one tooth to create a "missing tooth" position required for the ECU to synchronize with the engine. It is recommended that the "missing tooth" is positioned 90 degrees in the direction of the engine rotation from the tooth aligned with the sensor.

Since each tooth represents 10 degrees it is simple to count 9 teeth from the tooth at the sensor position (marked 1-9 in the photo). With the sensor fitted in this position the 'Sensor Position' in the mapping software's 'Setup window' should be configured with 90. This is the most common position used by manufacturers on engines already having a 36-1 trigger wheel fitted (Ford for example).

Figure 1: Correct Alignment of crank VR sensor



Small amounts (+/-5 degrees) of misalignment can be corrected with the offset adjustment in the PC software.

Using a feeler gauge measure the clearance between the face of the crank sensor and the 36-1 disc, this should be in the range of 1mm to 1.5mm,

Fitting the POLE*STAR* hexagonal sensor and disc

If your ECU is to be used with a 36-1 multi-toothed trigger wheel please refer to the previous section.

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.

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

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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 2)

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 2 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.

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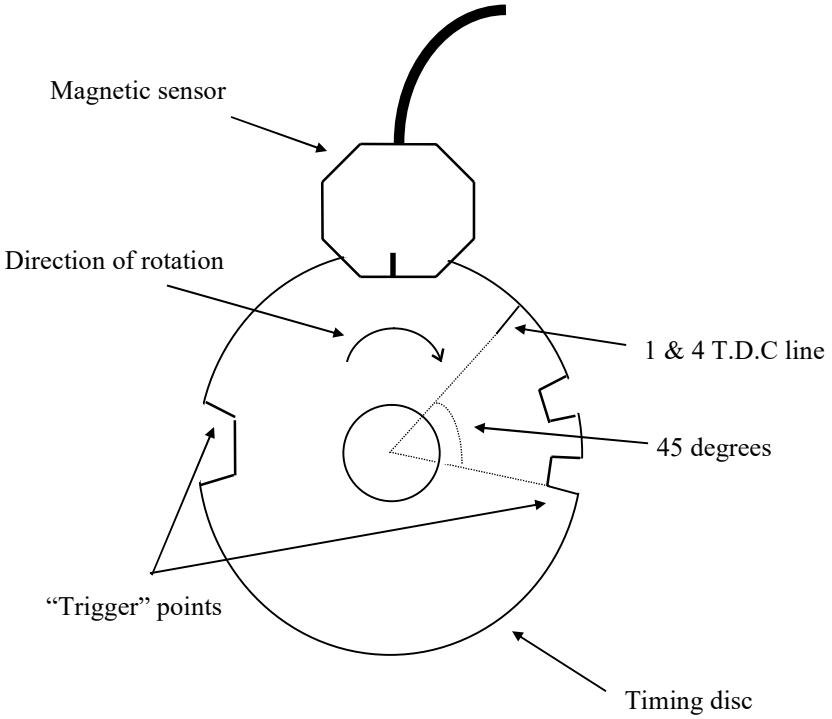

Figure 3. POLE*STAR* Timing Disc and Sensor Alignment (multi-coil)

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).

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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)

If your ECU is being used with a modern 'multipoint' coil in wasted spark mode please skip this section.

Using the correct coil

In single coil mode, the POLE*STAR HS* 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.**

When using a hexagonal POLE*STAR* crank sensor and trigger wheel the switched side of a single coil should be connected to the Coil Driver 2 output for the ECU. When using a 36-1 trigger disk and VR sensor the switched side of the coil should be connected to Coil Driver 1 from the ECU.

Distributor Alignment (Single Coil mode only)

When operating in single coil mode the POLE*STAR HS* 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 POLE*STAR HS* 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

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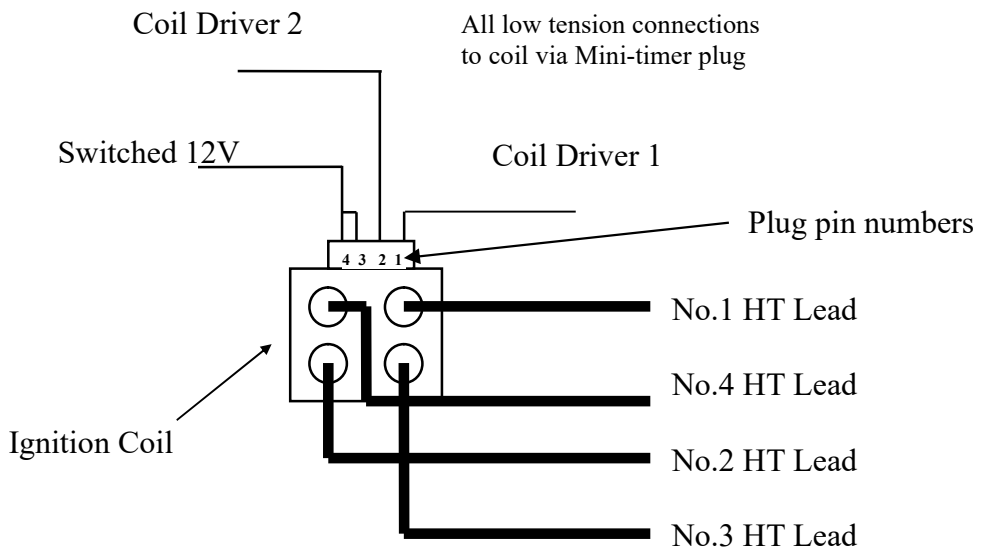
nearest mark. An indication that this alignment may not be correct will be either, difficulty in starting the engine, or a misfire at high RPM.

Igniton coil and leads (Wasted Spark mode only)

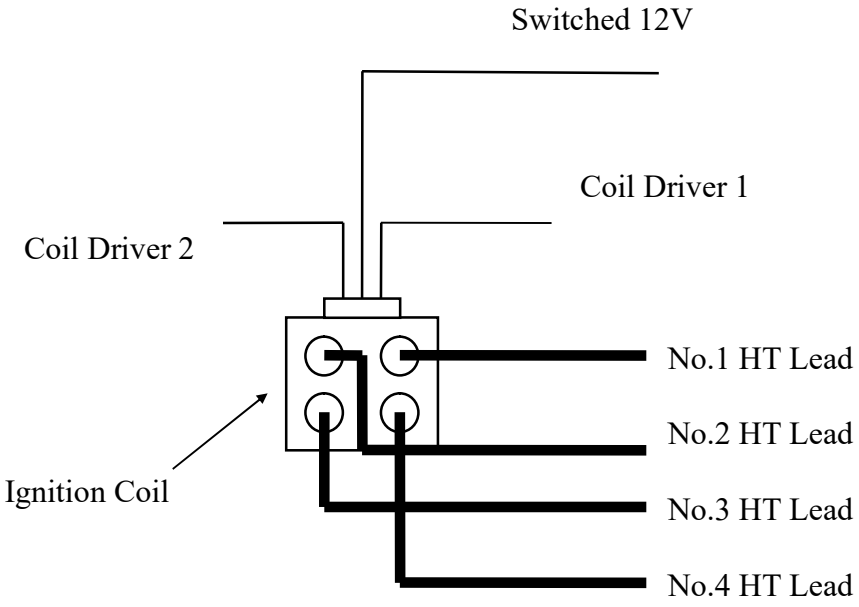
The POLE*STAR HS* system can operate with a number of multipoint coils although The coil as fitted to the last twin-point injection Rover Mini's works well, (the same coil was also fitted to the Citroen ZX1.6i 1996-1997) it should be available from a local motor factors. If not, it can be ordered from Minispares (www.minispares.com part number GCL204). See Figure 4 below for the wiring for this coil. The HT ignition leads for the twin-point Mini can be used, however they are a little short.

Figure 4 Ignition coil wiring diagram (Mini/Citroen coil)



Another possible coil is that as fitted to a 1995 Ford Fiesta (or equivalent). There is an old Ford part number of 928F12029CA, but there are equivalents around such as the CAMBIARE VE520051 which works very well. 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 5). CAMBIARE also supply some quality HT ignition leads for this coil part number VE522125.

Figure 5 Ignition coil wiring diagram (Ford/Cambiare 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.

Connecting to the MAP sensor (if fitted)

A MAP (Manifold Absolute Pressure) sensor is contained inside the ECU. If your ECU has one installed then a small 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

Figure 6 Throttle position sensor wiring

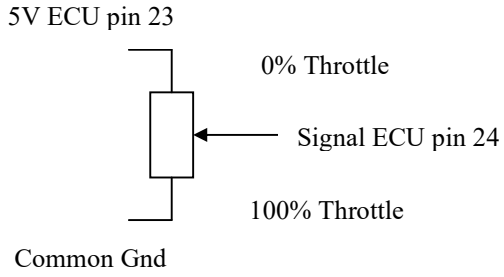


Figure 6 shows the correct wiring of the throttle sensor.

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.

Connect the ECU to a laptop and run the POLE*STAR* Engine Development Software. When connected to the ECU with the POLE*STAR* ECU Manager Window showing, click the 'Throttle' button, 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 is 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 POLE*STAR* Engine Development Software instruction manual.

Fitting the POLE*STAR HS* 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.

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 at the end of the box so that it is possible remove the dust plug and insert

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the USB cable for connecting the ECU to a PC. This allows access to the connector used for mapping the system via a laptop PC.

NOTE: It is strongly recommended that the route taken by the wire to the crank 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.

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

Finally it is strongly recommended that 'Resistive' type spark plugs are used in order to limit any chance of interference and mis-fires. Most plug types have an equivalent 'Resistor' version (NGK generally include an 'R' in the type number.

Setting up the system

Once the POLE*STAR HS* 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 POLE*STAR* 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.

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36-pin Connector pin-outs

Pin Number	Signal Name
1	Main Ground (GND)
2	+12V (BATT)
3	Injector Driver 4
4	Injector Driver 3
5	Injector Driver 2
6	Injector Driver 1
7	Traction control disable
8	Launch enable switch
9	Coil Driver 4
10	Coil Driver 3
11	Coil Driver 2
12	Coil Driver 1
13	Crank VR Sensor +ve
14	Crank VR Sensor –ve
15	Water Temperature Sensor
16	Air Temperature Sensor
17	Lambda Input (0-5V)
18	Dyno BHP (0-5V)
19	External MAP Sensor Signal (0-5V)
20	Rev Counter Output
21	MAP Sensor Power (+5V)
22	Not used
23	Throttle Sensor Power (+5V, Weber pot pin 1)
24	Throttle Sensor Signal(Weber pot pin 2)
25	POLEstar Crank Sensor Signal (Sensor Brown) Or Hall Effect Crank Sensor Signal (+12V)
26	POLEstar Crank Sensor Power (+12V, Sensor Red) Or Hall Effect Crank Sensor Power (+12V)
27	CAM Sensor Hall Effect Signal Or Hall Effect Crank Sensor Signal (+5V)
28	CAM Sensor Hall-Effect Power (+5V) Or Hall Effect Crank Sensor Power (+5V)
29	Data Logger Start Switch
30	Not used
31	Not used
32	CAM VR Sensor +ve
33	CAM VR Sensor –ve
34	Idle Valve Relay Drive
35	Fan Relay Drive
36	Fuel Pump Relay Drive

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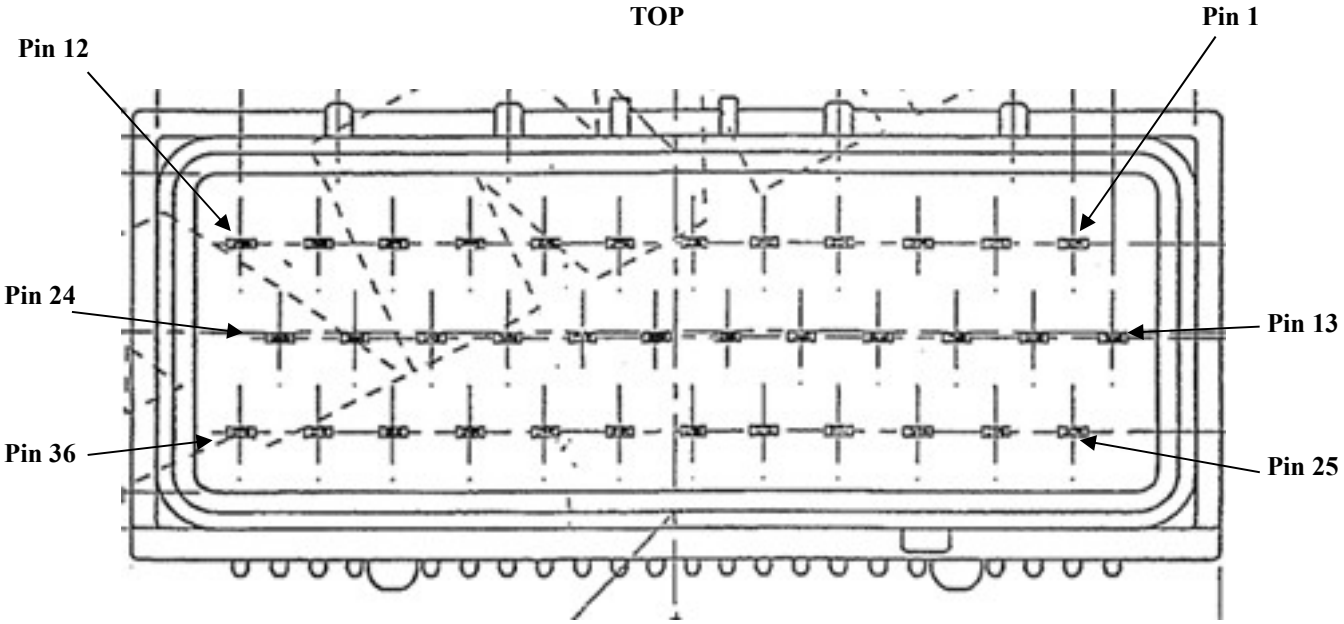
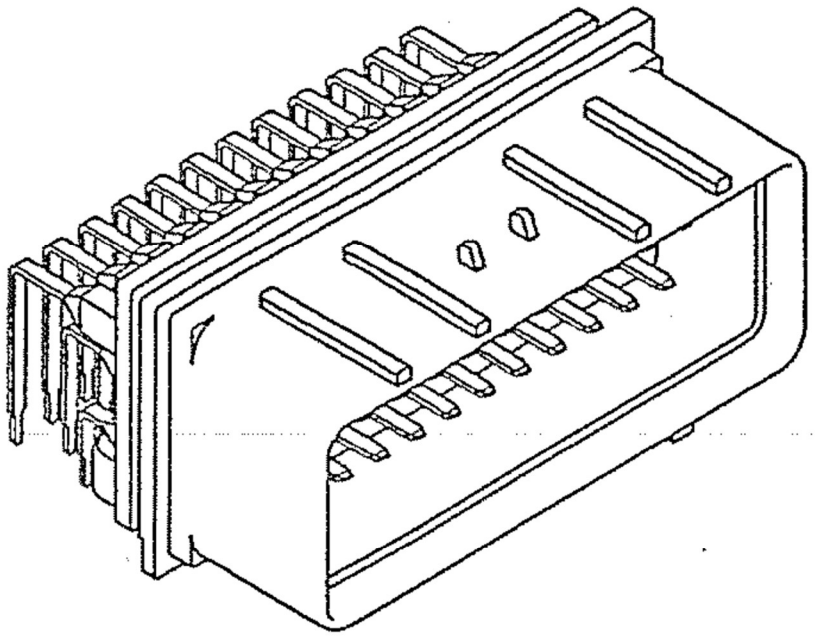


The above diagram indicates the pin numbering looking into the connector on the end of the ECU.



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