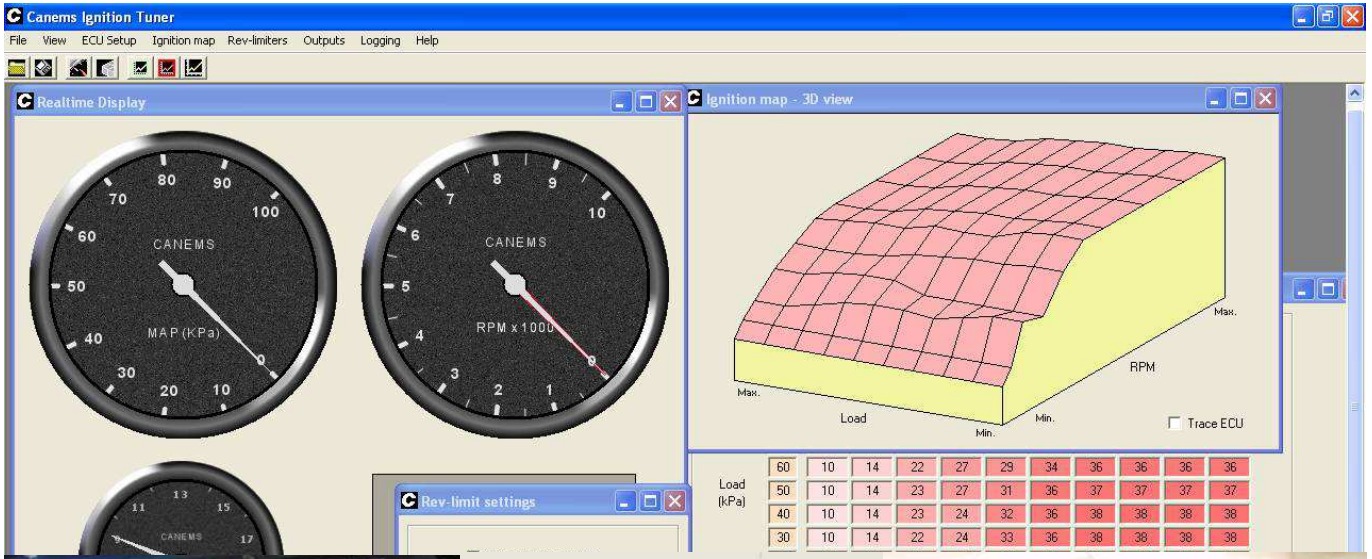
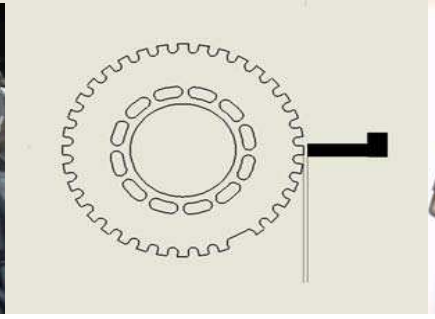
CANEMS – 14CUX ROVER V8 ENGINE MANAGEMENT KIT - INSTALLATION INSTRUCTIONS

Rev. 1.5 – Fuel & Ignition with Custom Loom

Nathan J. Lloyd BA & Daniel R. Lloyd BEng - February 2010





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INTRODUCTION

The Lloyd Specialist Developments Fully Programmable Rover V8 Engine Management kit combines the excellent Canems ECU with all other required components into a simple and affordable package, complete with full installation instructions.

This engine management system is designed to completely replace the original 14CUX fuel injection ECU, its restrictive air-flow meter and the entire distributor-based ignition system, including the distributor and coil. The original stepper-motor idle valve is replaced with a 2-wire idle valve for increased reliability.

The original injectors & OEM sensors are retained.

A crank pulley trigger wheel and VR sensor, along with a coil pack set, ignition leads and ignition sub-loom replace the original distributor unit, coil, and ignition leads. A MAP sensor and air temperature sensor replace the mass air-flow meter.

The Canems ECU supports both MAP (vacuum/boost) and ALPHA-N (throttle position based) load inputs in order to dispense with the restrictive OEM mass airflow meter. This normally liberates some extra performance due to the better induction air-flow.

3D fuel and ignition timing maps can be easily altered in real-time for optimum air/fuel ratio's and ignition timing at ***all*** load/ rpm combinations to ensure maximum performance and efficiency. The crankshaft-triggered ignition results in much more accurate timing control whilst the wasted spark coil-packs provide vastly more ignition energy than the original distributor-based system.

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KIT CONTENTS

Please check you have the following kit contents:

- ✓ Canems ECU;
- ✓ Custom Wiring Loom - Inc. Connectors & Main Relay;
- ✓ Rover V8 Trigger Wheel;
- ✓ Crank VR Sensor;
- ✓ Crank VR Sensor Bracket;
- ✓ Ignition Coil-packs x 2;
- ✓ Coil-pack Bracket;
- ✓ HT Leads x 8;
- ✓ Air Temperature Sensor;
- ✓ 2-Wire PWM Idle Valve;
- ✓ MAP Sensor;
- ✓ 4mm Vacuum Hose – 3m;
- ✓ Serial & USB Adaptor Cables;
- ✓ USB Convertor CD;
- ✓ Canems Injection Software CD;
- ✓ Rover V8 Base-map CD.

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FITTING THE TRIGGER WHEEL KIT

Before starting this work, ensure that you have disconnected the vehicle battery.

■ The first job to tackle is the fitting of the trigger wheel. The majority of 3.5/3.9/4.2/4.6 and all TVR serpentine engines use a 6-hole trigger wheel and this is what we normally supply. However, if you find your engine has a 4-hole pulley we can exchange these for the 4-hole type at no extra cost.

■ The trigger wheel's function is to not only give the ECU an rpm signal, but to provide a very accurate engine timing reference. The 36-1 trigger wheel provides crankshaft position data every 10 degrees of crankshaft rotation. The original 14CUX ECU cannot control ignition timing and simply takes an rpm signal from the negative side of the OEM coil .

■ The trigger wheel is located on the original front damper/ pulley using the existing bolt holes.

■ The trigger wheel kit consists of a 36-1 toothed wheel, 1x crank sensor bracket and 1x crank VR sensor.

■ The exact location of the trigger wheel on the front damper/ pulley is dependent on what type of damper/ front pulley you have fitted. There is a degree of adjustment available on the crank sensor bracket to allow the trigger wheel to be fitted in a number of locations.

■ Damper/ front-pulley specific fitting guidance with pictures are given overleaf.

■ We often find a degree of misalignment between pulleys on serpentine-belt engines, as found in many TVR and later Range Rover/ Discovery engines. In these cases it is often possible to fit the trigger wheel between the front damper assembly and removable drive pulley and correct this misalignment in the process. If this is not possible it will be necessary to modify the trigger wheel.

Please note that whatever method is used, it is necessary to ensure a good fit on the damper/ pulley assembly with a run-out not exceeding 0.25mm. The procedure for doing this is detailed overleaf.

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FITTING THE TRIGGER WHEEL: TYPICAL INSTALL PRE-SERPENTINE ENGINES

Original dowel/ roll pin, note locating hole drilled in trigger wheel

5/16 UNF bolt-holes

Crankshaft damper

Typical trigger wheel install: Pre-Serpentine 3.9/ 4.0 depicted. The 36-1 Trigger wheel is mounted between crankshaft damper & balancing rim on original bolts.

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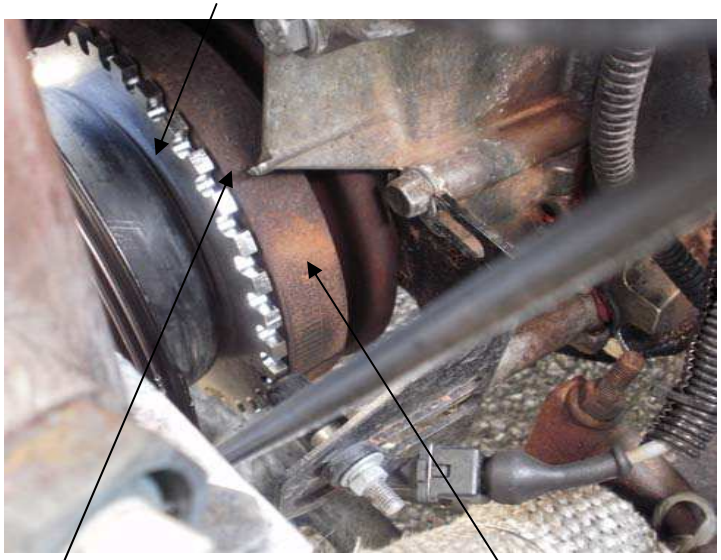
FITTING THE TRIGGER WHEEL: TYPICAL INSTALL SERPENTINE ENGINES

36-1 Trigger wheel mounted between crankshaft damper & pulley rim on original bolts.

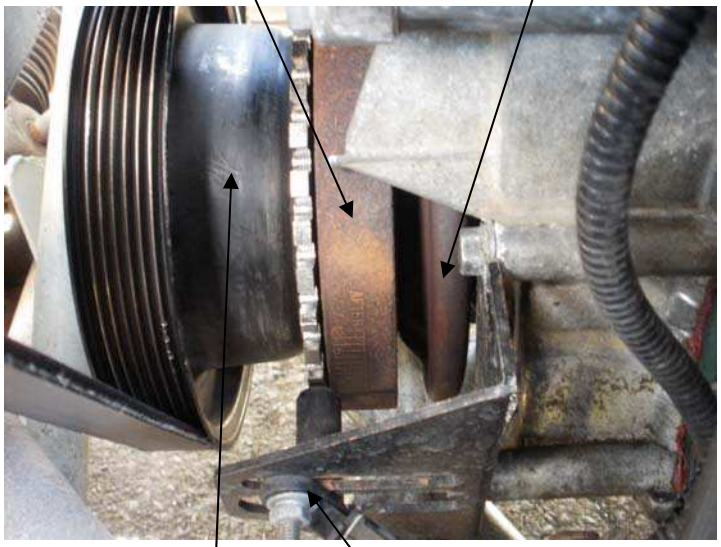


OEM Timing pointer

OEM Timing marks on damper

Crankshaft damper

Crankshaft damper balancing rim



Pulley rim

Crankshaft position (VR) Sensor & bracket

Typical trigger wheel install: 1995 4.0 Rover V8 (serpentine) depicted. Note trigger wheel installation between crankshaft damper and pulley rim. The trigger wheel fitment has effectively moved the pulley rim forward 2.5mm. We often find this actually *improves* belt alignment on serpentine-belt engines

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FITTING THE TRIGGER WHEEL: RECOMMENDED LOCATIONS

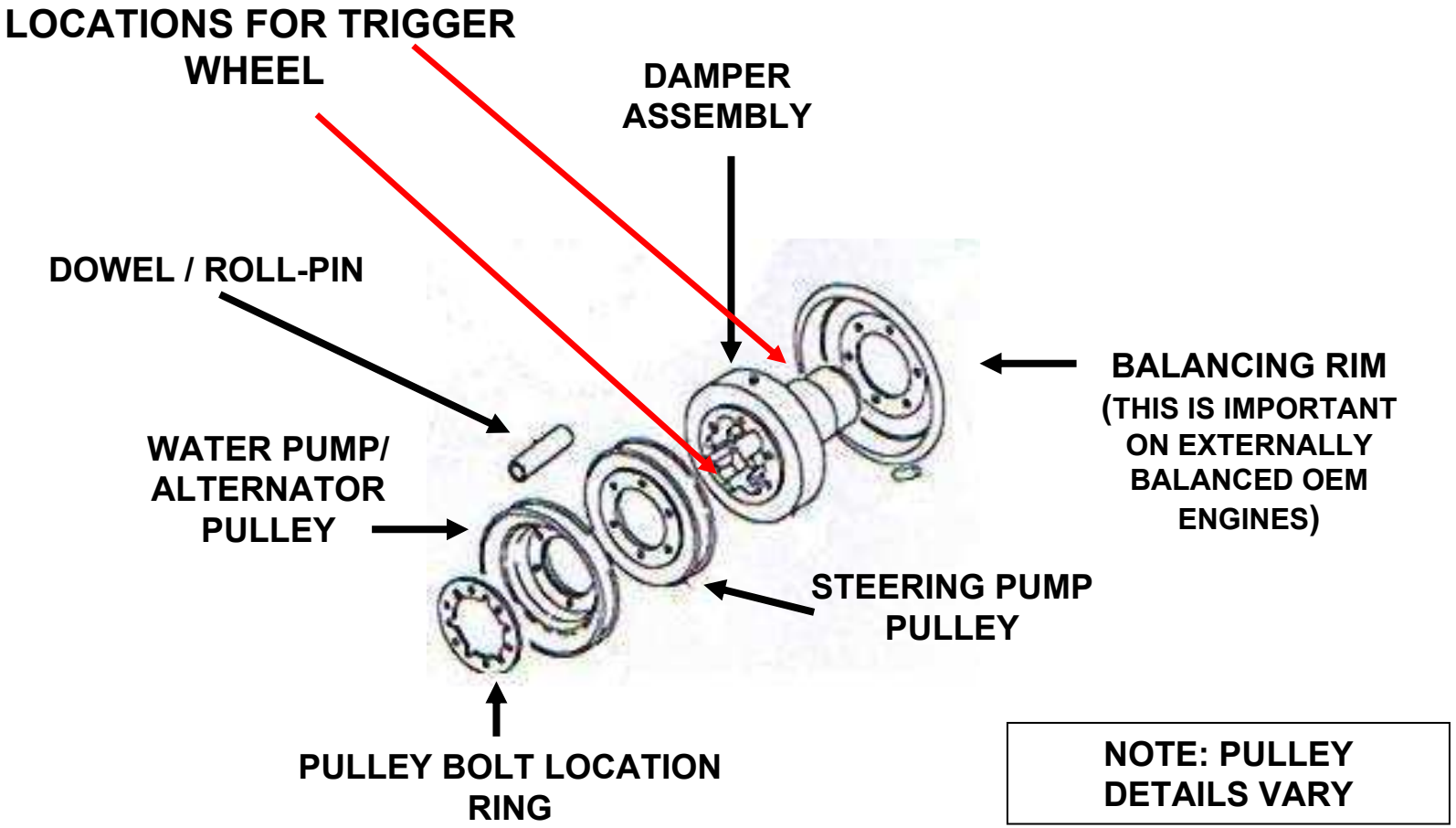

Fig. 1: POLYVEE BELT 6 HOLE DAMPER/ PULLEY ASSEMBLY

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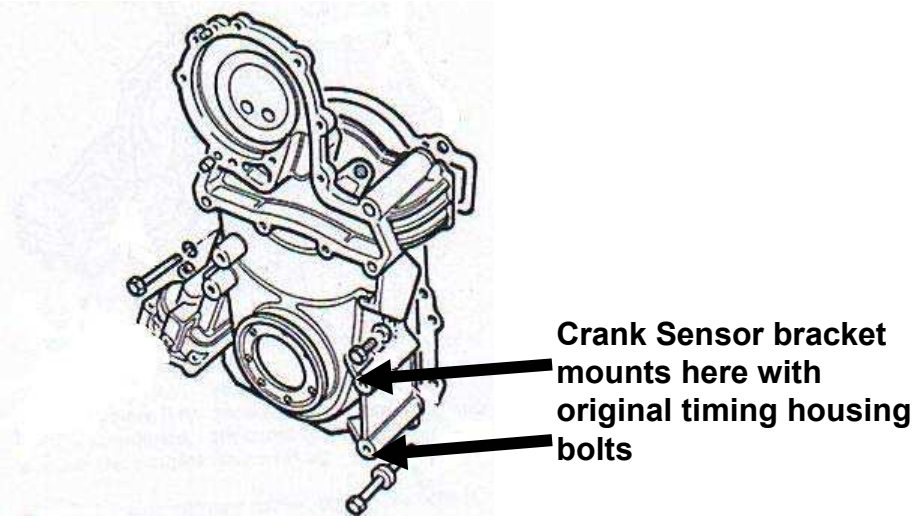

Fig. 2: CRANK SENSOR BRACKET LOCATION

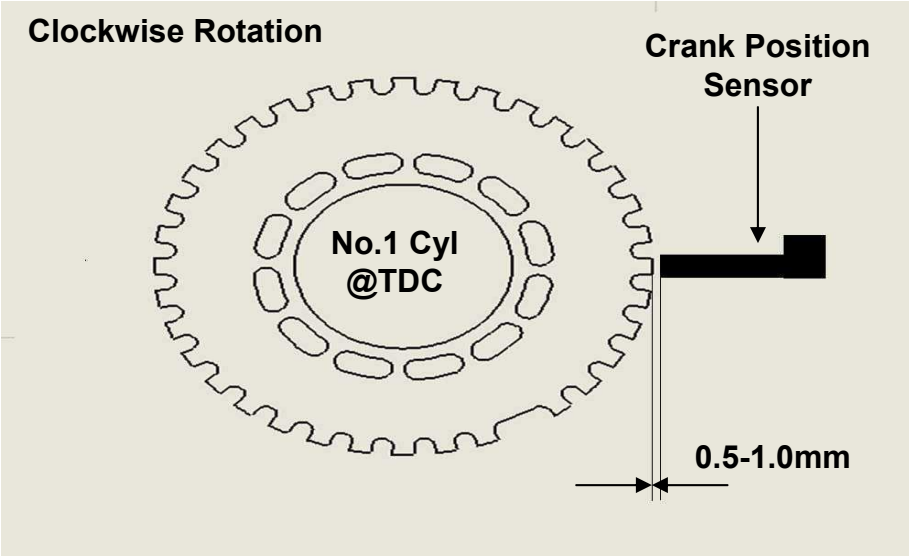

Fig. 3: TRIGGER WHEEL SETUP

SET GAP 6 TEETH AFTER CRANK POSITION SENSOR WITH ENGINE AT TDC

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FITTING THE TRIGGER WHEEL: METHOD 1 (MOST SERPENTINE MODELS)

1. Check the alignment of the ancillary drive belts, it is sometimes possible to fit the trigger wheel *between* the damper assembly and removable pulley. This method has the advantage of not having to remove the damper assembly itself from the engine. We often find this works on interim serpentine engines as fitted to later TVR models. **Caution:** Pulley alignment is critical: do not be tempted to locate here if pulley alignment is impaired as a result. Refer to method 2 overleaf.
2. Slacken the ancillary belt tension adjustment – remove ancillary belts.
3. Remove 6 x 5/16 UNF bolts fixing the pulley rims to the damper assembly & carefully remove pulley rims from the damper assembly.
4. Loosely fit crank sensor bracket & sensor on front timing housing bolts. See fig. 2.
5. Rotate engine to TDC on number 1 cylinder as indicated by OEM timing marks. Check No1 cylinder *is* at TDC carefully with a long probe or screwdriver. Please do check the accuracy of damper rim TDC markings (we have seen them as far as 10 degrees out!)
6. Locate trigger wheel on central spigot on damper assembly ensuring the missing tooth is exactly 60 degrees or 6 teeth *after* the crank sensor centre point (clockwise rotation), Mark this position carefully with a scribe line and remove trigger wheel from damper. See fig. 3.
7. Carefully mark and centre punch the trigger wheel where it contacts against the original dowel/ roll pin.
8. Double check dowel/ roll pin location and position of missing tooth on trigger wheel. Ensure the engine is still located at TDC on No1 cylinder. See fig.3.
9. Drill a small hole through the centre punched mark on the trigger wheel just large enough to clear the dowel/ roll pin located in the crankshaft damper assembly.
10. Locate trigger wheel on the central spigot on damper assembly ensuring the missing tooth is exactly 60 degrees or 6 teeth after the crank sensor centre point (clockwise rotation). The small hole should now locate on the dowel/ roll pin in the damper assembly.

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11. Re-fit pulley rims over trigger wheel/ damper assembly and apply thread locking compound (e.g.: Loctite 572) before loosely fitting the 5/16 UNF bolts through the pulley rims/ trigger wheel/ damper assembly.

12. Rotate engine carefully whilst checking the clearance between the crank sensor and the edge of the trigger wheel teeth. The air gap between sensor and trigger teeth should be less than 0.5mm and run-out should not exceed 0.25mm. See fig. 3.

13. Torque all 5/16 bolts to 28NM.

14. Double check the adjustment of the crank sensor and sensor bracket. The crank sensor centre point should align with the centre of the 6th tooth *after* the missing tooth. (See fig. 3)

FITTING THE TRIGGER WHEEL: METHOD 2

1. With pre-serpentine engines it is often necessary to remove the complete crankshaft damper/pulley assembly.
2. Slacken the ancillary belt tension adjustment – remove ancillary belts.
3. With an assistant to stop crankshaft rotation (in gear, footbrake and handbrake applied), remove crankshaft pulley assembly retaining bolt. **Note:** this bolt is tight and will require a good fitting socket, short extension bar and an air impact wrench, or long breaker bar. If in doubt employ professional help.
4. With the pulley bolt removed the crankshaft damper assembly can usually be pulled off by hand or given a blow on the damper circumference with a soft mallet to remove it. Occasionally it is necessary to use a puller to remove stubborn damper assemblies.
5. Place crankshaft damper assembly on the bench/in a vice, taking care not to damage seal surface or pulley rims. Remove the small round steel seal guard from the rear of the damper assembly by carefully prying it off with two screwdrivers / pry bars.
6. Remove the 6x 5/16 UNF nuts & bolts fixing the pulley rims to the damper assembly. Carefully remove the pulley rims and place to one side.
7. Remove the Crankshaft damper balancing rim from the rear of the crankshaft damper. Place trigger wheel on damper where the balancing rim was originally located and temporarily locate with 5/16 UNF nuts and bolts. Note that the trigger wheel will not sit flat against the damper yet due to a small dowel / roll pin.
8. Rotate engine to TDC on number 1 cylinder as indicated by OEM timing marks. Check No1 cylinder is at TDC carefully with a long probe or screwdriver. Please do check the accuracy of damper rim TDC markings (we have seen them as far as 10 degrees out!)
9. Loosely fit crank sensor bracket & sensor on front timing housing bolts. See fig. 2.

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10. Carefully trial-fit the damper/ trigger wheel/ balancing rim assembly on the crankshaft and adjust the trigger wheel position until the missing tooth on the trigger wheel is exactly 60 degrees or 6 teeth after the crank sensor centre point (clockwise rotation), Mark this position carefully with an accurate scribe line. See fig. 3.

11. Check that the engine is still positioned at TDC on No.1 cylinder and that the missing tooth is positioned 6 teeth after the crank sensor as in fig. 3. Check all scribe lines are correct.

12. Remove damper assembly and place on bench/ in vice.

13. Locate trigger wheel on rear of damper assembly ensuring scribe marks made in step 10 align and the trigger wheel is the same way around as when it was trial fitted (not back to front!). Carefully mark and centre punch the trigger wheel where it contacts against the original dowel/ roll pin.

13. Double check dowel/ roll pin location and position of missing tooth on trigger wheel. Ensure the engine is still located at TDC on No1 cylinder. (See fig.3)

14. Drill a small hole through the centre punched mark on the trigger wheel just large enough to clear the dowel/ roll pin located in the crankshaft damper assembly.

15. Locate trigger wheel on rear of damper assembly ensuring that it locates cleanly on the dowel/ roll pin in the damper assembly. Refit balancing rim on rear of damper, the front pulley rims and six 5/16 UNF bolts. Do not refit the small round steel seal guard (it can come loose causing damage).

16. Torque all 5/16 bolts to 28NM.

17. Carefully refit crankshaft damper assembly to crankshaft, check position of missing tooth/ crank sensor before refitting main pulley/ damper assembly bolt. Torque to 280NM.

18. Double check the adjustment of the crank sensor and sensor bracket. Rotate engine carefully whilst checking the clearance between the crank sensor and the edge of the trigger wheel teeth. The air gap between sensor and trigger teeth should be less than 0.5mm and run-out should not exceed 0.25mm. See fig. 3.

19. Refit ancillary belts and tension.

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AIR-FLOW METER REMOVAL, AIR TEMP. & MAP SENSOR HOSE FITMENT

1. Un-plug the air-flow meter multi-plug, two jubilee clips and retaining bolts, where fitted.
2. Remove the air-flow meter.
3. Replace air-flow meter with suitable diameter intake tubing.
4. Choose where you wish to locate your air temp. sensor, it can be located in the intake tubing or in the plenum / throttle housing. Anywhere that sees intake airflow will work although we do not want to place the sensor in a location that will become heat soaked (e.g. near exhaust manifolds). Drill and tap the M12 x 1.5 thread and screw the sensor into place.
5. Fit the MAP sensor 4mm tubing to the intake plenum via the vacuum take-off on the left hand side of the manifold base. Alternatively cut the vacuum pipe between the plenum and the fuel pressure regulator, and fit a 4mm t-piece. Connect the MAP sensor tubing to this t-piece. Pass the remainder of the hose through the bulkhead to the chosen MAP sensor location.

OEM fuel pressure regulator vacuum pipe take-off located on the rear of the plenum, at the bottom of the stepper motor housing.

OEM fuel pressure regulator vacuum pipe

Cut into original vacuum piping here and insert 4mm t-piece.

New 4mm vacuum pipe (supplied) connects between T-piece and MAP sensor.

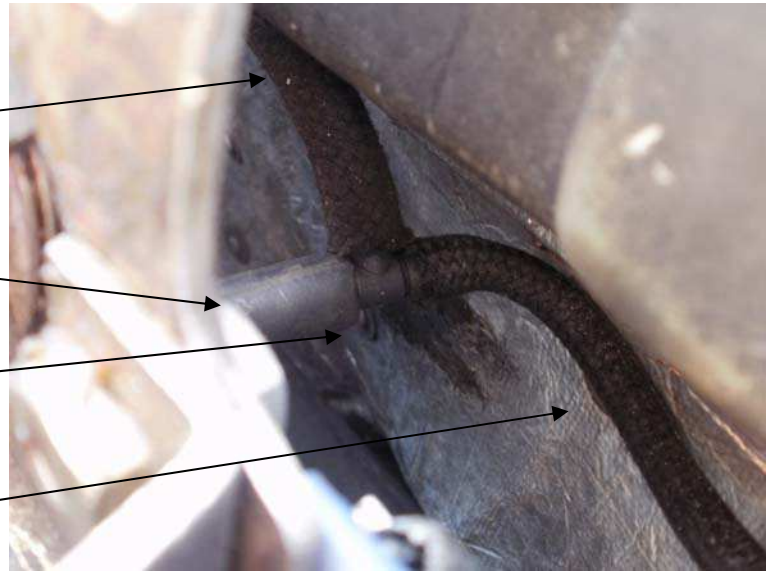

Fig. 4

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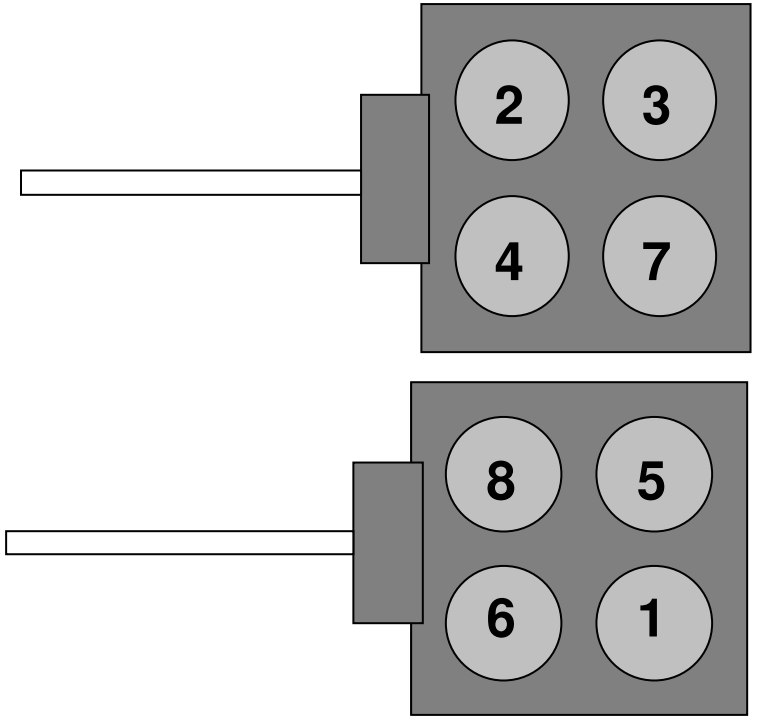
FITTING THE COIL-PACKS

1. Remove distributor leads. Remove single coil and wiring making a note of the connections. The standard tachometer wire is often connected to the coil -ve connection. Locate and identify the tachometer to coil connection.
2. Bolt the two coil-packs to the coil-pack bracket.
3. Offer up coil-pack bracket noting the two existing bolts that line up with the holes in the bracket, remove these bolts.
4. Locate coil-packs/ bracket with the original bolts and tighten to 28NM.
5. Fit the HT-leads provided in the order shown below.



Ignition output 1 = cylinders 1 & 6

Ignition output 2 = cylinders 5 & 8

Ignition output 3 = cylinders 4 & 7

Ignition output 4 = cylinders 2 & 3

Fig. 5

FRONT OF ENGINE

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FITTING THE WIRING LOOM

1. Lay the complete wiring harness alongside the vehicle's engine or engine bay and make a note of the correct orientation of the loom. All connections are clearly labelled. The crankshaft position sensor (VR) two pin plug should be at the front L/H side of the engine. The ECU end of the loom should face to the rear of the engine bay / bulkhead. Note the position of the various connections and main relay location. The custom Canems-14CUX Rover V8 loom supplied in this kit is 3.1 metres. This is more than enough length for most standard applications, although we can supply a longer harness if necessary.

2. The widest connector is located on the ECU end of the loom. You may wish to begin inside the vehicle so you do not have to feed the larger connector through any holes or wiring grommets.

3. Carefully feed the ignition loom into place. Typical wiring routing would begin inside the vehicle at the ECU and main relay. The smaller engine bay connectors and loom are fed through a suitable grommet & hole in the bulkhead/ firewall on the L/H side. All connectors are plugged into their respective positions beginning with the Crank VR Sensor.

4. In the engine bay, check correct connections have been made to the following components:

1: Crank Sensor (VR) = 2-pin connector – sensor located low on left-hand rear of engine;

2: Throttle Position Sensor (TPS) = 3-pin connector – sensor located on plenum throttle body;

3: Idle Valve (2-wire PWM) = 2-pin connector – Idle Valve should be plumbed in and located between pre- and post throttle plate positions. Note that the original IAC stepper can be replaced with a M20 x1.5 blanking plug.

4: Air Temperature Sensor = 2-pin connector – sensor located in the intake ducting to the throttle body.

5: Left-Hand Injector Bank = 4x 2-pin connectors – the connectors are led in the correct orientation for cylinders 1, 3, 5 & 7.

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6: Coolant Temperature Sensor = 2-pin connector – sensor located at front of left-hand injector bank.

7: Right-Hand Injector Bank = 4x 2-pin connectors – the connectors are led in the correct orientation for cylinders 2, 4, 6 & 8.

8: Ignition Coil-Packs = 6-pin connector – coil-packs located at rear of intake plenum, just in front of the bulkhead.

9: Tacho. Signal = Single spade connector - Connect this to your Tachometer, if fitted. This gives a standard 8-cylinder tachometer output.

5. Once you have fitted your ECU, mount the main relay and MAP sensor in a suitable location. Then make the following connections:

1: Fuel Pump 12V Feed = un-terminated White wire – this provides 12V direct to the fuel pump. Please note that we recommend the fitment of an inertia switch between this wire and the fuel pump.

2: 12V Ignition Live = un-terminated White wire – connect this to a suitable 12V Ignition Live.

3: ECU Multi-plug Connection = Connect to ECU. ¼" socket required.

4: 12V Battery Connection = Red wire with ring-type terminal – connect this to battery-positive lead.

5: Battery Earth Connection = Black wire with ring-type terminal – connect this to the battery-earth lead.

6: MAP Sensor Connection = 3-pin Connector, connect to MAP Sensor. Also connect 4mm vacuum hose at MAP sensor.

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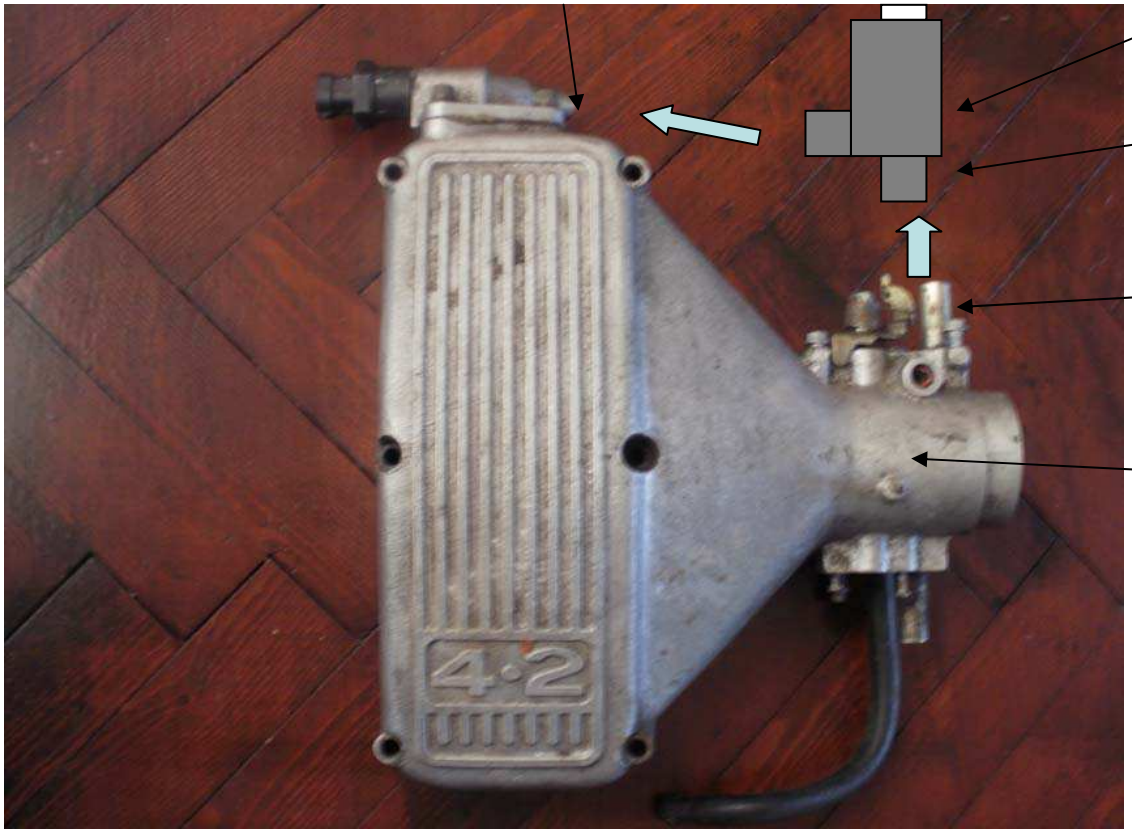
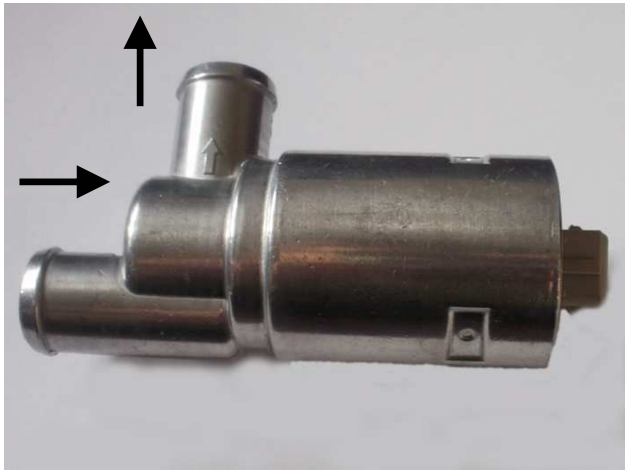
FITTING BOSCH 2-WIRE IDLE VALVE



FITTING BOSCH 2-WIRE IDLE VALVE

- The purpose of the Idle Valve is to regulate the amount of air that can bypass the throttle plate at idle. More air bypass results in a faster idle / less air bypass results in a slower idle.
- Idle too fast? Simply lower the idle duty cycle at the relevant temperature in the Idle valve warm-up map.
- Idle to slow? Simply increase the idle duty cycle in the idle valve warm-up map.
- The higher the duty cycle = more air bypass and faster idle. Less duty cycle = less air bypass and slower idle. .
- When the engine is cold, it will require extra air to increase idle speed and support combustion of the extra fuel that is injected during cold start enrichment.
- The 2-wire PWM system is generally regarded as more reliable and is much simpler to set-up correctly than the OEM 4-wire stepper valve setup.
- The Idle Valve must be plumbed before and after the throttle plate. One connection draws clean, filtered air from before the throttle plate and allows it to bypass the throttle plate via a second connection in the intake plenum.



FITTING BOSCH 2-WIRE IDLE VALVE

• The 2 wire Bosch PWM Idle Valve we supply has two hose connections with a directional arrow on one connection. The Idle Valve needs to be plumbed into the intake system before and after the throttle plate with 22mm rubber or silicon tubing and 22mm – 16mm reducers to mate up to the existing 16mm idle valve connections.

• The first hose connection, identified by an arrow, should be made to the original stepper motor housing pipe (16mm) on the rear of the plenum cover via a 22mm -16mm reducer.

• The second hose should be connected to the original stepper motor air feed pipe that is located ***before*** the throttle plate with a 22mm-16mm reducer.

• Carefully remove the existing Stepper Idle Control Valve and thread in a M20 X 1.5 bung (supplied)

• Ensure the 2-Wire PWM Idle Valve is securely mounted and plug in the two pin connector labelled “Idle Valve” if you are using one of our custom wiring looms.

STARTING THE ENGINE

1. Check all wiring connections have been made correctly. Carefully check the order of the HT ignition leads and ensure each coil output is connected to the correct cylinder as illustrated in fig. 5. Note that the 4 individual coil outputs line up with the pair of cylinders that coil output controls.
2. Re-connect battery.
3. Open the ECU software and connect to the ECU. Check all gauges for air temp, coolant temp. and load are displaying realistic figures. The coolant temp. and air temp. are typically close to ambient from a totally cold start whilst the load would be expected to be around atmospheric pressure (typically 101kpa) with the ignition on but engine off.
4. With the engine running it is recommended that you double-check the trigger-wheel/ crank-sensor alignment. Even with the most careful measurement, trigger-wheel alignment and therefore ignition timing can be a few degrees out. It is therefore advised that you check or get the ignition timing checked as soon as possible after installation.

This ECU has been supplied with a Base Map only, the Fuel Map and Idle settings will need to be checked and mapped by a knowledgeable tuner with a minimum of a wide-band AFR gauge.

- Full Load fuel mixtures should be in the range 11.8 – 13.0 AFR;

- Cruise mixtures should be in the range 13.5 – 15.5 AFR;

- Idle mixtures should be set for smoothest idle / highest vacuum, regardless of fuel mixture.

STATIC TIMING CHECK / CORRECTION PROCEDURE

1. The mechanical method of checking the timing is no different to the original timing checking procedure of connecting a stroboscopic timing light to no.1 cylinder and checking which timing marks coincide on the pulley and timing pointer .

2. Start the engine and set idle to approx 800 rpm (+ or - 50 rpm) and make a note of the ignition timing as indicated by the timing light.

3. Ignition timing should match the idle advance figure of ___ degrees BTDC. Adjust trigger wheel rotation to advance/ retard timing or refer to the simple software correction procedure.

4. Note: This check assumes that there are no vacuum leaks and the MAP sensor is connected correctly. Faulty MAP readings can alter the base idle timing by fooling the ECU into believing the engine is under load.

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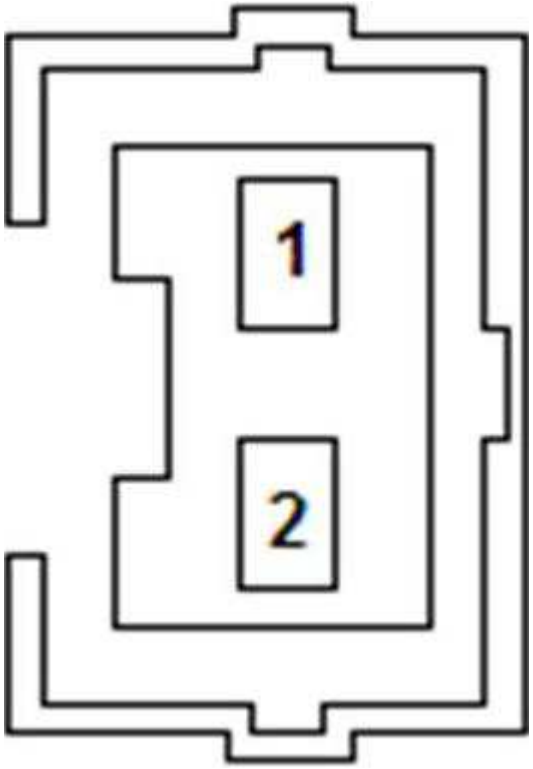
VR CRANK POSITION SENSOR

If you have no crank signal check for continuity between the following pins:

PIN 1 = VR / CRANK POSITION SIGNAL (CHECK FOR CONTINUITY WITH PIN 3D ON ECU)

PIN 2 = VR / CRANK POSITION EARTH – (CHECK FOR CONTINUITY WITH PIN 3C ON ECU)

TWO PIN JUNIOR TIMER VIEWED AS UNPLUGGED FROM SENSOR AND FACING YOU.



PIN 3D

NOTE: All VR CABLES ARE FULLY SHIELDED AGAINST INTERFERENCE

PIN 3C

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Canems – 14CUX Wiring Loom Pin-out

Canems Pin No.	Canems Colour	Function	Component Connection
1A	BLACK	EARTH	Battery Earth
1B	BLACK/ BLUE	INJECTOR BANK 1	Injector 1&6 Signal
1C	BLACK/ GREY	INJECTOR BANK 2	Injector 5&8 Signal
1D	BLACK/ GREEN	INJECTOR BANK 3	Injector 4&7 Signal
1E	BLACK/ RED	INJECTOR BANK 4	Injector 2&3 Signal
1F	GREY/ RED	IGNITION OUTPUT 4	Coil-pack Signal 4 - Cyl. 2&3
1G	GREY/ ORANGE	IGNITION OUTPUT 3	Coil-pack Signal 3 - Cyl. 4&7
1H	GREY/ GREEN	IGNITION OUTPUT 2	Coil-pack Signal 2 - Cyl. 5&8
1J	GREY/ BLACK	IGNITION OUTPUT 1	Coil-pack Signal 1 - Cyl. 1&6
1K	BLACK	IGNITION EARTH	Battery Earth
2A	YELLOW	MAP SWITCHING INPUT	Un-terminated Wire
2B	BLUE/ RED	AIR TEMP SIGNAL	Air Temp. Connector Pin 1
2C	BLUE/ YELLOW	COOLANT TEMP SIG	Coolant Temp. Connector Pin 1
2D	BLUE/ PINK	TPS SIGNAL	Throttle Position Signal
2E	BLUE/ WHITE	MAP SENSOR INPUT	MAP Sensor Connector Pin B
2F	YELLOW/ BROWN	LAMBDA/ 02 SENSOR 1	Un-terminated Wire
2G	YELLOW/ BLACK	LAMBDA/ 02 SENSOR 2	Un-terminated Wire
2H	ORANGE	5V REF	TPS 5V REF. / MAP Sensor Connector Pin C
2J	PINK	MAIN RELAY OUTPUT	Main Relay Pin 85
2K	PURPLE/ GREEN	OUTPUT 2 (PWM ENABLE)	2-Wire Idle Valve Connector Pin 1
3A	BLACK	ECU EARTH	Battery Earth
3B	WHITE	12V IGN FEED	Main Relay Pin 86
3C	BLUE (BRAIDED)	VR SENSOR EARTH+SHIELD	Crank VR Pin 2
3D	RED	VR SENSOR SIGNAL	Crank VR Pin 1
3E		CAM/ ROAD SPEED SIGNAL	-
3F	GREEN/ YELLOW	SERIAL GROUND	-
3G	BLUE	SERIAL RECEIVE	-
3H	BROWN	SERIAL TRANSMIT	-
3J	PURPLE/ YELLOW	OUTPUT 1	Un-terminated Wire
3K	PURPLE	TACHOMETER	Spade Connection
Main Relay			
85	PINK	MAIN RELAY OUTPUT	ECU Pin 2J
86	WHITE	IGNITION LIVE	Ignition Live Wire
87	WHITE	IGN.LIVE - FUEL PUMP 12V, ETC	Fuel Pump 12V Wire / Coil-pack Pin 2 x2 / Injector Live x8 / Idle Valve Pin 2
30	RED	12V PERMANENT LIVE	Battery Live

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