Chapter 14
Rover MEMS - MPi/SPi

Contents

Specifications

Vehicle	Year	idle speed	CO%
Rover MEMS MPi			
114 1.4 GTi 16V cat	1991 to 1994	850 ± 50	0.75 max
214 1.4 DOHC 16V cat	1992 to 1996	875 ± 50	0.5 max
220 2.0 DOHC 16V cat	1991 to 1994	850 ± 50	0.5 to 2.0
220 2.0 DOHC 16V cat	1992 to 1996	850 ± 50	0.5 to 2.0
220 2.0 DOHC 16V turbo cat	1992 to 1996	850 ± 50	0.5 to 2.0
414 1.4 DOHC 16V cat	1992 to 1996	875 ± 50	0.5 max
414 1.4 DOHC 16V	1995 to 1996	875 ± 50	0.5 max
416 1.6 DOHC 16V	1995 to 1996	875 ± 50	0.5 max
420 2.0 DOHC 16V cat	1991 to 1994	850 ± 50	0.5 to 2.0
420 2.0 DOHC 16V cat	1992 to 1996	850 ± 50	0.5 to 2.0
420 2.0 DOHC 16V turbo cat	1992 to 1996	850 ± 50	0.5 to 2.0
620 2.0 DOHC 16V turbo	1994 to 1996	800 ± 50	0.3 max
820i 2.0 DOHC 16V cat	1991 to 1996	850 ± 50	0.5 to 2.0
820 2.0 DOHC 16V turbo cat	1992 to 1996	850 ± 50	0.5 to 2.0
Metro 1.4 GTi DOHC 16V cat	1991 to 1994	850 ± 50	0.5 to 2.0
MGF 1.8 DOHC 16V	1995 to 1996	875 ± 50	0.3 max
MGF 1.8 VVC DOHC 16V	1995 to 1996	875 ± 50	0.3 max
Montego 2.0 EFi	1989 to 1992	750 ± 50	2.0 to 2.5
Montego 2.0 EFi AT	1989 to 1992	750 ± 50	2.0 to 2.5
Rover MEMS SPi			
Metro 1.4 16V	1990 to 1992	850 ± 50	0.5 to 2.0
Metro 1.4 16V cat	1990 to 1992	850 ± 50	0.5 to 2.0
Metro 1.4 16V cat	1993 to 1997	850 ± 50	0.5 to 2.0
Mini Cooper 1.3i MT	1991 to 1992	850 ± 50	0.5 to 2.0
Mini Cooper 1.3i AT	1991 to 1992	850 ± 50	0.5 to 2.0
Mini Cooper 1.3i Cabriolet	1993 to 1997	850 ± 50	0.5 to 2.0
Mini 1.3	1996 to 1997	850 ± 50	0.4 max
111	1995 to 1997	850 ± 50	0.4 max
114	1995 to 1997	875 ± 50	0.4 max
114 1.4i & Cabrio cat	1991 to 1994	875 ± 50	0.75 max
114 1.4i 16V cat	1991 to 1993	875 ± 50	0.75 max
214/414 non cat	1989 to 1992	850 ± 50	0.5 to 2.0
214/414 cat	1990 to 1992	850 ± 50	0.5 to 2.0
214 1.4 16V cat	1992 to 1996	850 ± 50	0.5 to 2.0
414 1.4 16V cat	1992 to 1996	850 ± 50	0.5 to 2.0
414 1.4 16V	1995 to 1996	850 ± 50	0.5 to 2.0

Overview of system operation

1 Introduction

Please read this overview of Rover MEMS operation in conjunction with Chapter 2, which describes some of the functions in more detail.

The Rover MEMS (Modular Engine Management System) was developed jointly by Rover and Motorola, and first appeared in 1989 on Montego 2.0 carburettor and then MPi vehicles. MEMS is a fully-integrated system that controls primary ignition, fuelling and idle control from within the same ECM **(see illustration 14.1)**. When fitted to carburetted engines, it is known as the ERIC system.

MEMS was designed as a modular system that was capable of controlling a wide range of engines equipped with either MPi or SPi. Additionally, the ECM is designed for a harsh environment. It is robustly built, and incorporates short-circuit protection in consideration of its location in the engine compartment.

Prior to 1994, there were three main production versions of MEMS. These are labelled versions 1.2, 1.3 and 1.6. From mid-1994, version 1.8 was fitted.

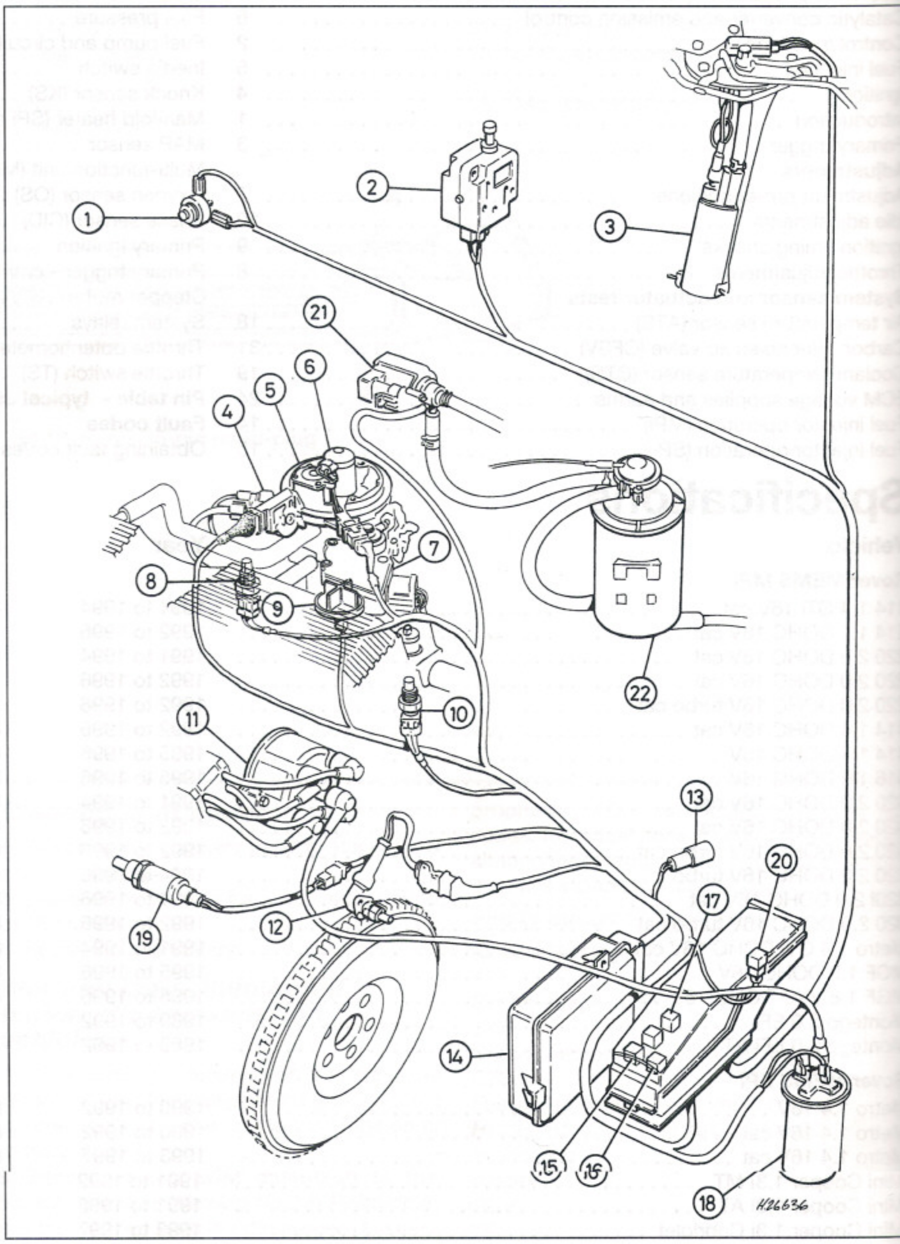
The differences between the versions are as follows:

a) *Version 1.2 (the first production version) was designed for non-catalyst engines. Although a catalyst could be fitted to the exhaust system of vehicles with v1.2, the catalyst would be of the non-regulated type. Version 1.2 is identified by a single 36-pin multi-plug connector to the ECM.*

b) *Version 1.3 is a fully-regulated catalyst version with ECM control of emission controls. Version 1.3 is identified by two multi-plug connectors (36-pin and 18-pin) to the ECM.*

Improvements in internal organisation released vital areas of MEMS, and allowed the return of a single 36-pin multi-plug connector to the ECM. However, turbocharged vehicles retain the twin multi-plug connectors.

From mid-1994, MEMS version 1.8 has been in production. Main changes are fitment of a plastic inlet manifold and a new stepper motor. The new stepper motor no longer acts upon the linkage to the throttle plate, but uses the motor to actuate a valve mounted within the inlet manifold. Very late versions fitted to KR6 and MGF vehicles utilise wasted spark DIS and variable valve control (VVC).



14.1 Rover MEMS (Rover 214 SPi). Multi-point systems are very similar

1 Throttle pedal switch
2 Inertia switch
3 Fuel pump
4 TPS
5 Fuel pressure regulator
6 Fuel injector
7 Stepper motor
8 ATS
9 Throttle body heater (inlet manifold)
10 CTS
11 Distributor
12 CAS
13 SD connector plug
14 ECM
15 Main relay
16 Fuel pump relay
17 Throttle body heater (inlet manifold) relay
18 Ignition coil
19 OS
20 OS relay
21 CFSV
22 Charcoal canister

2 Control functions

Signal processing

The MEMS ECM is designed with three main areas of control. These are the ignition, fuel system and idle speed. The correct ignition dwell and timing for all engine operating conditions are calculated from data provided by the CAS (crankshaft position and speed), and the MAP sensor (engine load).

Basic ignition timing is stored in a three-dimensional map, and the engine load and speed signals determine the ignition timing. The main engine load sensor is the MAP sensor, and engine speed is determined from the CAS signal.

Correction factors are then applied for starting, idle, deceleration, and part- and full-load operation. The main correction factor is engine temperature (CTS). Minor corrections to timing and AFR are made with reference to the air temperature sensor (ATS) and throttle potentiometer sensor (TPS) signals.

The basic AFR is also stored in a three-dimensional map, and the engine load and speed signals determine the basic injection pulse value. Using the speed/density method, MEMS calculates the AFR from the pressure in the inlet manifold (MAP) and the speed of the engine (CAS).

This method relies on the theory that the engine will draw in a fixed volume of air per revolution. The AFR and the pulse duration are then corrected on reference to ATS, CTS, battery voltage and rate of throttle opening (TPS). Other controlling factors are determined by operating conditions such as cold start and warm-up, idle condition, acceleration and deceleration. During acceleration, additional injection pulses are provided at 80° crankshaft intervals.

MEMS accesses a different map for idle running conditions, and this map is implemented whenever the idle switch is closed and the engine speed is at idle. Idle speed during all warm-up and normal hot running conditions is maintained by the idle speed stepper motor. However, MEMS makes small adjustments to the idle speed by advancing or retarding the timing, and this results in an ignition timing that is forever changing during engine idle.

Basic ECM operation

Once the ignition is switched on, a voltage supply to ECM pin 11 is made from the ignition switch. This causes the ECM to connect pin 4 to earth, so actuating the main fuel injection relay. A relay switched voltage supply is thus made to ECM pin 28, from terminal 87 of the main fuel injection relay. Depending on model, the coil is supplied with voltage from either the main relay or from the ignition switch direct.

The majority of sensors (other than those that generate a voltage such the CAS, KS and CID sensor), are now provided with a 5.0-volt reference supply from a relevant pin on the ECM. When the engine is cranked or run, a speed signal from the CAS causes the ECM to earth pin 20 so that the fuel pump will run. Ignition and injection functions are also activated. All actuators (Injectors, ISCV, FTVV etc), are supplied with nbv from the main relay, and the ECM completes the circuit by pulsing the relevant actuator wire to earth.

Self-diagnostic function

MEMS provides a serial port for diagnostic and system tuning purposes. The port allows two-way communication, so that certain parameters can be changed (ie CO value) and actuation of various output components.

In addition, a self-test capability regularly examines signals from the engine sensors, and internally logs a code in the event of a fault being present. This code can be extracted from the MEMS serial port by a suitable FCR. If the fault clears, the code will remain logged until the FCR is used to erase it from memory.

LOS (limp-home mode)

MEMS has a limited operating strategy (LOS) or limp-home facility, and in the event of a serious fault in one or more of the sensors, the EMS will substitute a fixed default value in place of the defective sensor.

For example, in limp-home mode the coolant temperature sensor (CTS) value is set to 60°C, the ATS is set to 35°C, and engine load is based on rpm. The engine may actually run quite well with failure of one or more minor sensors. However, since the substituted values are those of a hot engine, cold starting and running during the warm-up period are likely to be less than satisfactory. Also, failure of a major sensor, ie the MAP sensor, will lead to a considerable reduction in performance.

Adaptive and non-volatile memory

Over a period of time, the ECM will learn the best idle position for a particular engine - irrespective of age, engine condition and load, so that the correct idle speed is always maintained. The adaptive idle settings are stored in non-volatile memory. Consequently, a replacement ECM will need some time to re-learn the system parameters before proper idle control is restored. A tune-up with a suitable FCR is recommended whenever a new ECM is fitted.

Faults identified by the self-diagnostic function will also be stored in non-volatile memory, and will remain there until erased by a suitable FCR. This allows the self-diagnostic function to retain data of an intermittent nature.

Adaptive idle measurements and fault codes retained in non-volatile memory cannot be lost - even if the vehicle battery is removed. If the ECM from one vehicle is transferred to another vehicle, the contents of non-volatile memory will also be transferred, unless a FCR is used to erase the codes and tune the engine to the new set-up.

Reference voltage

Voltage supply from the ECM to the engine sensors is made at a 5.0-volt reference level. This ensures a stable working voltage, unaffected by variations in system voltage.

The earth return connection for most engine sensors is made through ECM pin number 30, and this pin is not directly connected to earth. The ECM internally connects pin number 30 to earth via the ECM earth pin that is directly connected to earth.

Signal shielding

To reduce interference (RFI), a number of sensors (eg the crank angle sensor, knock sensor and oxygen sensor) use a shielded cable. The shielded cable is connected to the main ECM earth wire at terminal 29 to reduce interference to a minimum.

3 Primary trigger

Crank angle sensor (CAS)

The primary signal to initiate both ignition and fuelling emanates from a CAS mounted next to the flywheel. The CAS consists of an inductive magnet that radiates a magnetic field. The flywheel incorporates a reluctor disk containing 34 steel pins set at 10° intervals. As the flywheel spins, and the pins are rotated in the magnetic field, an AC voltage signal is generated to indicate speed of rotation. The two missing pins (set at 180° intervals) are a reference to TDC, and indicate crankshaft position by varying the signal as the flywheel spins. One missing pin indicates TDC for cylinders 1 and 4, and the other missing pin indicates TDC for cylinders 2 and 3.

The peak-to-peak voltage of the speed signal can vary from 5 volts at idle to over 100 volts at 6000 rpm. The ECM microprocessor contains an analogue-to-digital converter to transform the AC pulse into a digital signal.

4 Ignition

Data on engine load (MAP) and engine speed (CAS) are collected by the ECM, which then refers to a three-dimensional digital ignition map stored within its microprocessor. This map contains an advance angle for basic load and speed operating conditions. The advance angle is corrected after reference to engine temperature (CTS), so that the best ignition advance angle for a particular operating condition can be determined.

Amplifier

The MEMS amplifier contains the circuitry for switching the coil negative terminal at the correct moment to instigate ignition. The signal received by the amplifier from the CAS trigger is of an insufficient level to complete the necessary coil switching. The signal is thus amplified to a level capable of switching the coil negative terminal.

The amplifier circuitry is contained within the ECM itself, and the microprocessor controls the ignition dwell period for each condition of engine speed and battery voltage.

Dwell operation in MEMS is based upon the principle of the 'constant-energy current-limiting' system. This means that the dwell period remains constant at about 3.0 to 3.5 ms, at virtually all engine running speeds. However, the dwell duty cycle, when measured in percent or degrees, will vary as the engine speed varies.

Ignition coil

The ignition coil utilises low primary resistance in order to increase primary current and primary energy. The amplifier limits the primary current to around 8 amps, and this permits a reserve of energy to maintain the required spark burn time (duration). In DIS systems, the coils are double-ended, and fire two spark plugs together. The KR6 utilises three DIS coils, and the MGF two DIS coils.

Distributor

In the MEMS system, the distributor only serves to distribute the HT current from the coil secondary terminal to each spark plug in firing order. The distributor is located on the inlet camshaft at the cylinder No 4 end. The distributor contains a rotor arm, and also has a deflector plate and oil drain to prevent oil seal leakage from contaminating the distributor cap and rotor arm.

Distributorless ignition system (DIS)

Vehicles with the KR6 V6 engine, and those with the four-cylinder MGF VVC engine utilise wasted spark DIS ignition. The MGF without VVC is equipped with a distributor. Refer to Chapter 2 for a detailed description of wasted spark and DIS.

Knock sensor (some MPi vehicles)

The optimal ignition timing (at engine speeds greater than idle) for a given high-compression engine is quite close to the point of onset of knock. However, running so close to the point of knock occurrence means that knock will certainly occur on one or more cylinders at certain times during the engine operating cycle.

Since knock may occur at a different moment in each individual cylinder, MEMS employs a knock control processor (KCP) built into the ECM to pinpoint the actual cylinder or cylinders that are knocking. The knock sensor is mounted on the engine block, and consists of a piezo-ceramic measuring element that responds to engine noise oscillations. This signal is converted to a voltage signal that is proportional to the level of knock, and returned to the ECM for evaluation and action.

The ECM will analyse the noise from each individual cylinder, and uses a sophisticated technique to recognise knock as distinct to general engine noise.

Initially, timing will occur at its optimal ignition point. Once knock is identified, the microprocessor retards the ignition timing for that cylinder in steps of 0.625° until either knock ceases or a maximum retard of 10° is reached. The timing is then advanced in 0.65° increments until the reference timing value is achieved or knock occurs again, when the processor will retard the timing once more. This procedure continually occurs so that all cylinders will consistently run at their optimum timing.

If a fault exists in the KCP, knock control sensor or wiring, an appropriate code will be logged in the self-diagnostic unit, and the ignition timing retarded by 10.5° by the LOS program.

5 Fuel injection

Rover has adopted three distinct methods for providing fuel to the engines equipped with MEMS. The methods are simultaneous multi-point injection (MPi), sequential multi-point injection (MPi) and single-point injection (SPi).

Because of the modularity of MEMS, very little difference exists between the implementation of each system on the various engines. First, a description of common features and a description of each type follows.

The injector(s) are switched using two circuits. Operation depends on the principle that more current is required to open an injector than to keep it open. This kind of system is often termed 'current-controlled'. Once the injector is open, a second circuit rapidly pulses the injector to earth. The switching is so rapid that the injector is effectively held open, and less current is required during the operation. Advantages of this arrangement include a reduction in injector operating temperature, and immediate injector closure once the holding circuit is switched off.

The MEMS ECM contains a fuel map with an injector opening time for basic conditions of speed and load. Information is then gathered from engine sensors such as the MAP sensor, CAS, CTS, ATS and TPS. As a result of this information, the ECM will look up the correct injector pulse duration right across the engine rpm, load and temperature range.

The fuel injector is a magnetically-operated solenoid valve that is actuated by the ECM. Voltage to the injectors is applied from the fuel pump relay, and the earth path is completed by the ECM for a period of time (called pulse duration) of between 1.5 and 10 milliseconds. The pulse duration is very much dependent upon engine temperature, load, speed and operating conditions. When the magnetic solenoid closes, a back-EMF voltage of up to 60 volts is initiated.

The amount of fuel delivered by the injector(s) is determined by the fuel pressure and the injector opening time - otherwise known as the pulse duration. The ECM controls the period of time that the injector is held open, and this is determined by the signals from the various sensor inputs. During engine start-up from cold, the pulse duration and number of pulses (frequency) are increased to provide a richer air/fuel mixture.

Over-speed fuel cut-off (rev limiter)

To prevent over-high engine speeds, which might otherwise lead to engine damage, above 6250 rpm (MPi) and 6860 rpm (SPi), MEMS inhibits the injector earth path. As the engine speed drops below 6150 rpm and 6820 rpm respectively, fuel injection is reinstated.

Deceleration fuel cut-off

A deceleration fuel cut-off is implemented during engine over-run conditions, to improve economy and reduce emissions. The conditions for over-run to be implemented are:

a) Throttle closed (throttle pedal contacts closed).
b) Engine speed above 2600 rpm (MPi) or 1500 rpm (SPi).
c) Coolant temperature above 80°C.
d) Once the engine speed drops below 2600 rpm or 1500 rpm respectively, fuel injection is reinstated.

Multi-point injection (MPi - simultaneous)

The MPi system consists of one injector for each cylinder, mounted in the inlet port, so that a finely-atomised fuel spray is directed onto the back of each valve. The injectors are all pulsed simultaneously, twice per engine cycle. Half of the required fuel per engine cycle is injected at each engine revolution.

Fuel will briefly rest upon the back of a valve before being drawn into a cylinder. Unlike other simultaneous systems, the injectors are all connected to the ECM via separate wires to separate ECM driver pins.

Multi-point injection (MPi - sequential)

The sequential system functions in a similar manner to the simultaneous system. However, with reference to the signal from the cylinder identification (CID) sensor (only present in sequential systems), each injector is actuated as its inlet valve opens, in firing order.

Single-point fuel injection (SPi)

The SPi system consists of a single injector mounted in the throttle body. The amount of fuel delivered by the injector is determined by the fuel pressure and the injector opening time - otherwise known as the pulse duration.

In SPi engines, fuel is injected into the inlet manifold, where it mixes with air. The depression produced by a descending piston causes the resulting air/fuel mixture to be drawn into each cylinder. Otherwise, operation of the injector is very similar to operation of the injector fitted to the MPi systems.

Cylinder identification sensor (sequential injection only)

In simultaneous MPi systems, the ECM does not have to recognise No 1 cylinder, or indeed even the firing order. When the crankshaft or distributor provides a timing signal, the correct cylinder is identified by the mechanical position of the crankshaft, camshaft, valves and ignition rotor.

On models fitted with sequential injection, the ECM must determine which cylinder is on its firing stroke, and the CID sensor provides the appropriate signal. The CID sensor operates on the inductive principle, and is a permanent magnet device mounted adjacent to the camshaft. A reluctor is attached to the camshaft, divided into four equal quadrants. Each quadrant contains a unique number of teeth, numbering from one to four. Because the AC-generated signal from each quadrant is unique, the ECM is able to determine the camshaft position and cylinder sequence.

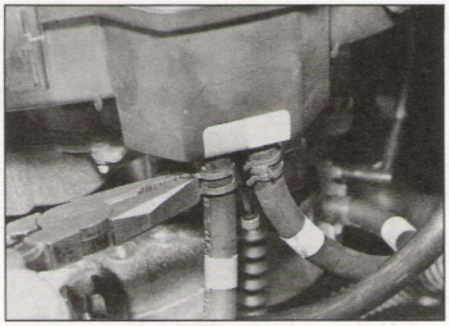
The reluctor should be handled with extreme care, due to the fragile sintered material used in its construction. Any impact may cause cracking or a stress fracture.

MAP sensor

The main engine load sensor is the MAP sensor. A vacuum hose connects the MAP sensor (located within the ECM) and the inlet manifold **(see illustration 14.2)**. Manifold vacuum acts upon the MAP sensor diaphragm, and the ECM converts the pressure into an electrical signal. MAP is calculated from the formula: Atmospheric Pressure less Manifold Pressure = Manifold Absolute Pressure.

Using the speed/density method, MEMS calculates the AFR from the MAP signal and the speed of the engine (CAS). This method relies on the theory that the engine will draw in a fixed volume of air per revolution.

The inlet manifold on the MPi models is a 'dry' manifold. Since fuel does not enter the manifold - due to injection being made onto the back of the inlet valve, there is no risk of fuel being drawn into the MAP sensor to contaminate the diaphragm, and a fuel trap is not used. However, on Rover 820 models



14.2 SPi: The MAP sensor vacuum hose connections to the fuel trap at the air filter. The hoses are colour coded to ensure correct refitting

under certain operating conditions, fumes are drawn from the rocker box into the MAP sensor vacuum hose and then to the ECM, where contamination can occur. This can be prevented by fitting the fuel trap used on SPi models.

The inlet manifold on the SPi models is a 'wet' manifold. Fuel is injected into the inlet manifold, and there is a risk of fuel being drawn into the MAP sensor to contaminate the diaphragm. This is prevented by running the vacuum hose upward to the air filter, through a fuel trap and then to the ECM (which contains the MAP sensor).

Air temperature sensor (ATS)

The ATS is mounted in the air inlet casing (MPi) or air filter casing (SPi), and measures the air temperature before it enters the inlet manifold. Because the density of air varies in inverse proportion to the temperature, the ATS signal allows more accurate assessment of the volume of air entering the engine.

The open-circuit supply to the sensor is at a 5.0-volt reference level, and the earth path is through the sensor return. The ATS operates on the NTC principle. A variable voltage signal is returned to the ECM based upon the air temperature. This signal is approximately 2.0 to 3.0 volts at an ambient temperature of 20°C, and reduces to about 1.5 volt as the temperature rises to around 40°C.

Although the air filter casing used on SPi models contains a thermal valve system, the thermal valve has no bearing on the AFR, and the air temperature is calculated solely by reference to the ATS.

CO adjustment

The CO value at idle speeds can only be adjusted through the medium of a FCR attached to the serial port. It is not possible to make this adjustment by any other means. On catalyst-equipped models, the CO is non-adjustable.

Coolant temperature sensor (CTS)

The CTS is incorporated in the cooling system, and contains a variable resistance that operates on the NTC principle. When the engine is cold, the resistance is quite high. Once the engine is started and begins to warm-up, the coolant becomes hotter, and this causes a change in the CTS resistance. As the CTS becomes hotter, the resistance of the CTS reduces (NTC principle), and this returns a variable voltage signal to the ECM based upon the coolant temperature.

The open-circuit supply to the sensor is at a 5.0-volt reference level, and this voltage reduces to a value that depends upon the CTS resistance. Normal operating temperature is usually from 80° to 100° C. The ECM uses the CTS signal as a main correction factor when calculating ignition timing and injection duration.

Throttle potentiometer sensor (TPS)

A TPS is provided to inform the ECM of rate of acceleration. The TPS is a potentiometer with three wires. A 5.0-volt reference voltage is supplied to a resistance track, with the other end connected to earth. The third wire is connected to an arm which wipes along the resistance track, and so varies the resistance and voltage of the signal returned to the ECM.

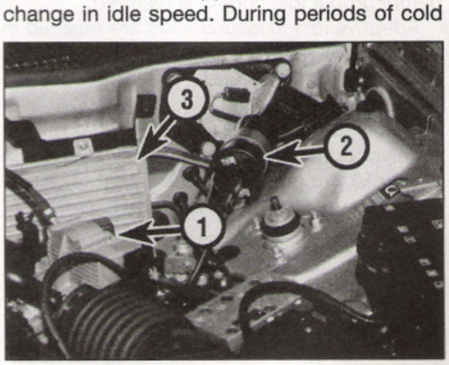
From the voltage returned, the ECM is able to calculate just how quickly the throttle is opened. From model year 1993 onwards, the TPS also informs the ECM of idle position with a voltage of approximately 0.6 volts.

Throttle pedal switch

Until the 1993 model year, the throttle pedal switch indicated a closed throttle to the ECM. The ECM was then able to recognise the idle speed condition and also deceleration. From 1993 models year, MEMS recognised the closed throttle condition with reference to the TPS signal.

Stepper motor

The stepper motor is an actuator that the ECM uses to automatically control idle speed during normal idle and during engine warm-up **(see illustration 14.3)**. When electrical loads, such as headlights or heater fan etc are switched on, the idle speed would tend to drop. In this event, the ECM advances the ignition timing to make a small speed change, and indexes the stepper motor for a greater change in idle speed. During periods of cold



14.3 Rover 820 stepper motor
1 Stepper motor 2 Ignition coil 3 ECM

running, the stepper motor will open the throttle so that the engine rpm will be set to a suitable fast idle speed. Also, on sensing low battery voltage, the ECM will increase the idle speed to allow greater alternator output.

The stepper motor is a DC motor, provided with a voltage supply from the system relay. The motor windings are earthed through four earth wires. By earthing various combinations of the four wires, the ECM is able to index the motor to its correct position. The ECM controls idle speed by using the stepper motor in one of two diverse ways.

Throttle plate actuator

The stepper motor controls a cam and pushrod through a reduction gear. The pushrod contacts the throttle lever, which actuates the throttle plate and so maintains the correct idle speed. Maximum movement of the stepper motor is 3.75 revolutions, and this is accomplished by 180 steps of 7.5°. The reduction gear reduces the actual cam movement to 150°.

Inlet manifold air valve

The air valve stepper motor is an actuator that the ECM uses to automatically control idle speed during normal idle and during engine warm-up. When the throttle is closed, the throttle valve is locked in a position where very little air passes by. The throttle position then, will have no effect upon the idle speed.

A by-pass port to the throttle plate is located in the inlet manifold. A valve is positioned in the port. As the valve moves, the volume of air passing through the port will vary, and this directly affects the idle speed. The idle speed then, depends upon the position of the stepper air valve in the by-pass port. This method of idle control is fitted to some models (principally those with the plastic inlet manifold) from the middle of 1994.

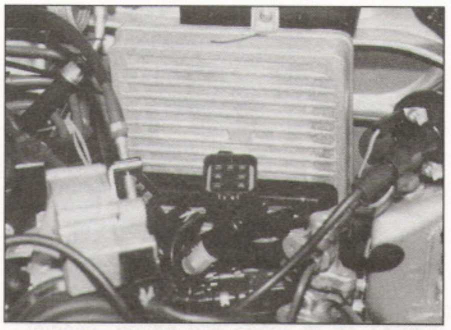
Adaptive idle control

Since the idle control is adaptive, over a period of time, the ECM will learn the best position for a particular engine - irrespective of age, engine condition and load, so that the correct idle speed is always maintained. Consequently, a replacement ECM will need some time to re-learn the system parameters before proper idle control is restored.

Adaptive idle measurements are retained in non-volatile memory and cannot be lost - even if the vehicle battery is removed. On models prior to 1993, idle position was determined by an idle switch located on the accelerator pedal. From 1993, this switch has been discontinued, and the idle position is now determined by the TPS.

Manifold heater (SPi)

The ECM controls the manifold heater through a relay. This heater works on the PTC principle, and allows a greater current to quickly heat the inlet manifold during the warm-up period. This allows better driveability during engine warm-up. Once a preset temperature of



14.4 Rover 820 MEMS multi-function unit (MFU)
MFU multi-plug disconnected

approximately 75° C is reached, the ECM turns off the relay. If the ignition is switched to the 'on' position and the engine is not cranked, the ECM will turn off the manifold heater after a few seconds. The manifold heater will also be turned off to prevent battery overload during engine cranking.

MEMS relays and MFU

The MEMS electrical system is controlled by a number of relays. The relays utilised in some vehicles are conventional in construction and operation. However, some models are equipped with an MFU (multi-function unit).

Main and fuel pump relays (Rover 214, 414, 220 and 420 models)

A permanent voltage supply is made to main relay terminals 30 and 86, and fuel pump relay terminal 30, from the battery positive terminal. When the ignition is switched on, the ECM earths terminal 85 through ECM terminal number 4, which energises the relay winding. This causes the main relay contacts to close, and terminal 30 is connected to the output circuit at terminal 87. A voltage supply is thus output at terminal 87. Terminal 87 supplies voltage to the injector(s), ECM terminal 28, the ignition coil terminal 15 (some models) and the stepper motor. In addition, voltage is supplied to the manifold heater relay terminal 86 on SPi vehicles.

When the ignition is switched on, a voltage supply is made to fuel pump relay terminal 86, and the ECM briefly earths relay contact 85 at ECM terminal 20, which energises the fuel pump relay winding. This causes the fuel pump relay contacts to close, and connects voltage from terminal 30 to terminal 87. Voltage is thereby output to the fuel pump circuit. After approximately one second, the ECM opens the circuit and the pump stops. This brief running of the fuel pump allows pressure to build within the fuel pressure lines, and provides for an easier start.

The fuel pump circuit will then remain open until the engine is cranked or run. Once the ECM receives a speed signal from the CAS, the fuel pump winding will again be energised by the ECM, and the fuel pump will run until the engine is stopped.

Multi-function unit (MFU) main and fuel pump relays (all Rover models other than 214, 414, 220, and 420)

The MFU is a sealed box that contains four sets of relay contacts. The two relays always used are a main and fuel pump relay, and the other two will be chosen from the starter, OS or manifold heater relays **(see illustration 14.4)**.

If any one of the relays fails, the whole MFU must be replaced. However, the relay contacts are heavy-duty, and failure is a fairly rare occurrence.

Two multi-plugs of 8-pin and 6-pin configuration connect the MFU with MEMS wiring. The multi-plug terminal designations are identified by the prefix 8 or 6 for the multi-plug, and the suffix 1 to 8 or 1 to 6 for the actual terminal. So 8/1 would identify the terminal as number one terminal in the eight 8-pin multi-plug. There follows a typical description, but be warned that wiring of some MFU's may differ.

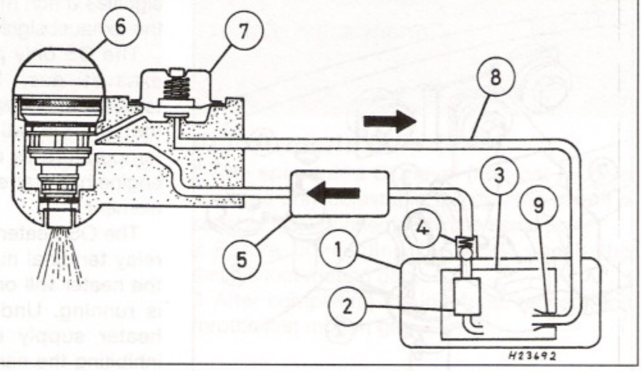
A permanent voltage supply is made to the MFU main relay terminals 8/6 and 8/7 from the battery positive terminal. When the ignition is switched on, the ECM earths terminal 6/3 through ECM terminal number 4, which energises the relay winding. This causes the main relay contacts to close, and output voltage is available at MFU terminal 8/1, 8/3 and 8/8. These output terminals supply voltage to the injector(s), ECM terminal 28, the ignition coil terminal 15 models) and the stepper motor. Connections to individual components vary according to vehicle. In addition, voltage is internally supplied to the manifold heater relay inside the MFU on SPi vehicles.

When the ignition is switched on, a voltage supply is made to MFU terminal 6/2, and the ECM briefly earths MFU contact 6/1 at ECM terminal 20. This energises the fuel pump relay, and causes the fuel pump relay contacts to close. Terminal 8/6 is thus connected to terminal 8/4, and voltage is thereby output to the fuel pump circuit. After approximately one second, the ECM opens the circuit, and the pump stops. This brief running of the fuel pump allows pressure to build within the fuel pressure lines, and provides for an easier start.

The fuel pump circuit will then remain open until the engine is cranked or run. Once the ECM receives a speed signal from the CAS, the fuel pump winding will again be energised by the ECM, and the fuel pump will run until the engine is stopped.

Engine shut down

On switching off the engine, the ECM keeps the relay (or MFU) earth energised for up to 30 seconds. This holds the voltage supply to the ECM, which then actuates the stepper motor to its fully closed position (thus preventing engine run-on). After a few seconds more, the ECM actuates the stepper motor to a position where it slightly opens the throttle plate, ready for the next engine start.



14.5 Fuel delivery circuit for SPi engines
1 *Fuel tank*
2 *Fuel pump*
3 *Swirl pot*
4 *Non-return valve*
5 *Fuel filter*
6 *Fuel injector*
7 *Fuel pressure regulator*
8 *Fuel return line*
9 *Venturi*

Fuel pressure system

Note: *Uniquely, the Montego utilises a roller-type fuel pump mounted outside the fuel tank. Voltage to the fuel pump is applied through a 1.0 ohm ballast resistor. This reduces the voltage and current applied to the fuel pump, and ensures cooler running. During cranking, when a higher voltage level is required, voltage is applied directly to the pump from the starter solenoid and the resistor is by-passed. Full nbv is thus applied to the fuel pump.*

The fuel system includes a fuel tank, with swirl pot and a submerged fuel pump. The fuel pump draws fuel from the tank and pumps it to the fuel rail via a fuel filter **(see illustration 14.5)**.

Switching the ignition key on causes the ECM to energise the fuel pump relay for approximately one second so that the fuel system is pressurised. The fuel pump relay is then switched off, to await a cranking or running signal. The swirl pot prevents air from entering the fuel supply line, by ensuring that the pick-up strainer is always immersed in fuel when the fuel level is low - even during fuel movement due to centrifugal forces acting upon the vehicle.

The pump is of the 'wet' variety, in that fuel actually flows through the pump and the electric motor. There is no actual fire risk, because the fuel drawn through the pump is not in a combustible condition. The fuel pump assembly comprises an outer and inner gear assembly, termed a 'gerotor'. Once the pump motor becomes energised, the gerotor rotates, and as the fuel passes through the individual teeth of the gerotor, a pressure differential is created. Fuel is drawn through the pump inlet, to be pressurised between the rotating gerotor teeth, and discharged from the pump outlet into the fuel supply line.

To reduce the effect of fluctuations in fuel pressure, a pulsation damper is provided in the pump outlet, thereby preventing hydraulic knock. The pump is protected from over-pressurising by a relief valve mounted in the inlet side of the pump. Once the engine is running, fuel is fed through a non-return valve and fuel filter to the multi-point injector rail or the single throttle body injector.

To prevent pressure loss in the supply system, a non-return valve is provided in the fuel pump outlet. When the ignition is switched off, and the fuel pump ceases operation, pressure is thus maintained for some time. Temperature in the fuel rail is monitored by a fuel rail temperature sensor (FRTS) in manual transmission models; a fuel restrictor and fuel temperature sensor (FTS) is used in automatic transmission models.

Fuel pressure regulator (MPi)

Fuel pressure in the fuel rail is maintained at a constant 2.5 bar by a fuel pressure regulator fitted on the outlet side of the fuel rail. The fuel pump normally provides much more fuel than is required, and surplus fuel is thus returned to the fuel tank via a return pipe. In fact, a maximum fuel pressure in excess of 5 bar is possible in this system.

The pressure regulator consists of two chambers, separated by a diaphragm. The upper chamber contains a spring, which exerts pressure upon the lower chamber and closes off the outlet diaphragm. Pressurised fuel flows into the lower chamber, and this exerts pressure upon the diaphragm. Once the pressure exceeds 2.5 bar, the outlet diaphragm is opened, and excess fuel flows back to the fuel tank via a return line.

A vacuum hose connects the upper chamber to the inlet manifold, so that variations in inlet manifold pressure will not affect the amount of fuel injected. This means that the pressure in the rail is always at a constant pressure above the pressure in the inlet manifold. The quantity of injected fuel thus depends solely on injector opening time, as determined by the ECM, and not on a variable fuel pressure.

At idle speed with the vacuum pipe disconnected, or with the engine stopped and the pump running, or at full-throttle, the system fuel pressure will be around 2.5 bar. At idle speed (vacuum pipe connected), the fuel pressure will be approximately 0.5 bar under the system pressure.

Fuel pressure regulator (SPi)

Fuel pressure of approximately one bar is controlled by the pressure regulator, which is located within the throttle body next to the injector. As the pressure rises over the pre-determined level, excess fuel is returned to the fuel tank via a return pipe.

Fuel rail temperature sensor (FRTS) - some MPi models with manual transmission

The FRTS senses the temperature of the fuel in the fuel rail, and the value is logged by the ECM at the time that the engine is shut down. When the engine is restarted, the ECM compares the start-time temperature with the temperature recorded at shut-down. If the new temperature is higher, the injection pulse is lengthened during the cranking operation to provide hot start enrichment. This enrichment decays at a fixed rate.

Fuel temperature sensor (FTS) and fuel restrictor solenoid (FRS) - MPi models with automatic transmission)

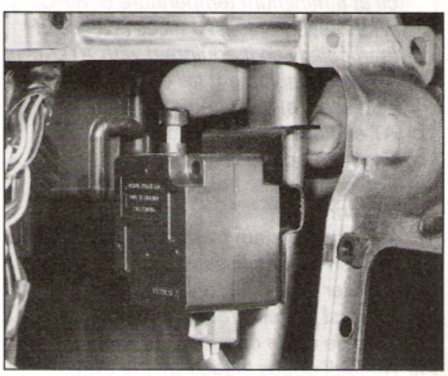
In vehicles with automatic transmission, the FRTS is replaced with a fixed resistance so that after-start enrichment will never be implemented. When the fuel rail temperature exceeds 90°C, the FTS closes to complete the earth circuit to the FRS. The FRS is energised to cause a restriction in the fuel return line. The increased fuel pressure thereby improves starting.

Inertia switch

The inertia switch is a safety cut-out switch, used to isolate the fuel pump in the event of a very sharp deceleration - eg a collision. Once the switch has been activated, the electrical supply to the fuel pump remains open-circuit until the inertia switch has been reset by raising the button **(see illustration 14.6)**.

Temperature gauge (Montego only)

The engine coolant temperature gauge on the instrument panel is connected to earth through the ECM. MEMS actuates the gauge and warning lamp by rapidly pulsing the ECM connection to earth. This produces a square waveform of variable frequency and duty cycle. The frequency increases as the engine temperature increases, and the hotter the engine, the lower will the average voltage become. In addition, the duty cycle will also change.



14.6 Reset inertia switch by depressing plunger

14

Turbocharger

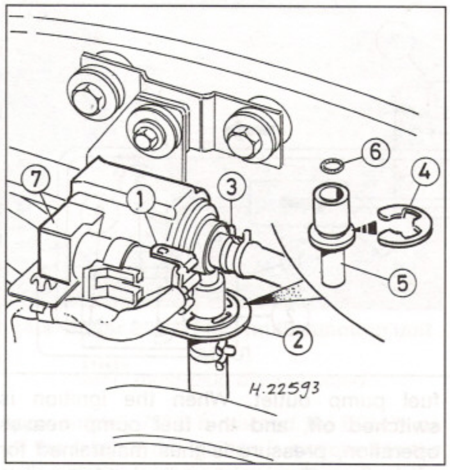
Refer to Chapter 2 for a detailed description of turbocharger operation. An intercooler, which is a kind of air radiator, for cooling is used in Rover turbo models. Boost control is controlled by the ECM so that maximum use is made of the turbo during appropriate operating conditions.

Air by-pass (turbo models)

Turbo lag is reduced on Rover turbo models by use of an air by-pass valve. A sensing pipe connects the by-pass valve with the inlet manifold. When the turbine supplies compressed air to the manifold, the compressed air pushes upon the air by-pass valve, and it remains shut. During deceleration or light load when the turbo is inactive, the manifold contains depressed air (a vacuum) and the depression will open the air by-pass valve. Air pressure from the impeller wheel is circulated throughout the turbocharger housing, and prevents a back pressure forming. The turbine slows very little, and turbo lag is much reduced when the accelerator is re-applied.

6 Catalytic converter and emission control

From January 1993, all new cars in the UK are fitted with a catalyst as standard equipment.



14.7 Carbon filter solenoid valve (CFSV)

1 *Wiring connector*
2 *Inlet hose, charcoal canister to CFSV*
3 *Outlet hose, CFSV to throttle body*
4 *C-clip*
5 *Inlet hose, connector*
6 *O ring*
7 *CFSV*

The MEMS injection system fitted to catalyst vehicles implements a closed-loop control system, so that exhaust emissions may be reduced. Closed-loop systems are fitted with an oxygen sensor (OS) which monitors the exhaust gas for its oxygen content. A low oxygen level in the exhaust signifies a rich mixture. A high oxygen level in the exhaust signifies a weak mixture.

The OS only produces a signal when the exhaust gas, has reached a minimum temperature of approximately 300°C. In order that the OS will reach optimum operating temperature as quickly as possible after the engine has started, the OS contains a heating element.

The OS heater supply is made from the OS relay terminal number 87. This ensures that the heater will only operate whilst the engine is running. Under full-load conditions, the heater supply is cut-off by the ECM by inhibiting the earth path of the OS relay. The KR6 engine utilises twin oxygen sensors, one for each bank.

Carbon filter solenoid valve (CFSV)

A CFSV and activated carbon canister will also be employed to aid evaporative emission control **(see illustration 14.7)**. The carbon canister stores fuel vapours until the CFSV is actuated by MEMS. CFSV actuation occurs when the engine temperature is above 70°C, the engine speed above 1500 rpm and the MAP sensor returns less than 30 kPa.

When the CFSV is actuated by MEMS, the valve is modulated on and off, and fuel vapours are drawn into the inlet manifold to be burnt by the engine during normal combustion. So that engine performance will not be affected, the CFSV remains closed during cold engine operation and also during engine idle.

Adjustments

7 Adjustment pre-conditions

1 Ensure that all of these conditions are met before attempting to make adjustments:

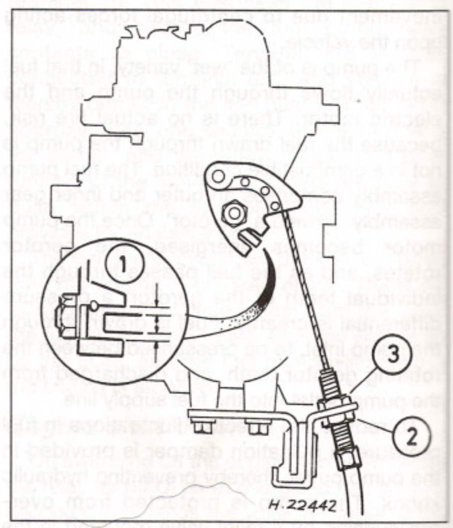
a) *Engine at operating temperature. Engine oil at a minimum temperature of 80°C. A journey of at least 4 miles is advised (particularly so if equipped with AT).*
b) *Ancillary equipment (all engine loads and accessories) switched off.*
c) *AT engines: Transmission in N or P.*
d) *Engine mechanically sound.*
e) *Engine breather hoses and breather system in satisfactory condition.*
f) *Induction system free from vacuum leaks.*
g) *Ignition system in satisfactory condition.*
h) *Air filter in satisfactory condition.*
i) *Exhaust system free from leaks.*
j) *Throttle cable correctly adjusted.*
k) *No fault codes logged by the ECM.*
l) *OS operating satisfactorily (catalyst vehicles with closed-loop control).*

2 In addition, before checking the idle speed and CO value stabilise the engine as follows.

a) *Stabilise the engine. Raise the engine speed to 3000 rpm for a minimum of 30 seconds, and then let the engine idle.*
b) *If the cooling fan operates during adjustment, wait until it stops, re-stabilise the engine, and then restart the adjustment procedure.*
c) *Allow the CO and idle speed to settle.*
d) *Make all checks and adjustments within 30 seconds. If this time is exceeded, re-stabilise the engine and recheck.*

8 Throttle adjustments

1 Clean the throttle valve and surrounding areas with carburettor cleaner. Blow-by from the breather system often causes sticking problems here **(see illustration 14.8)**.
2 The throttle valve position is critical, and must not be disturbed.
3 The TPS in not adjustable for this range of engines.



14.8 Adjust the throttle lost motion gap - see text

1 *The clearance should be equal on both sides*
2 *Adjustment nut*
3 *Locknut*

9 Ignition timing checks

1 The ignition timing is not adjustable on these models, and timing marks are not provided.

10 Idle adjustments

Adjustments (idle tune)

1 Idle speed and CO level (non-cat models only) are only adjustable through the use of a suitable FCR connected to the serial port.
2 Before connecting the FCR, check the throttle lost motion gap.
3 After completing the idle tune, recheck the throttle lost motion gap.

Adjustment of the throttle lost motion gap (typical)

4 Switch the ignition on.
5 From within the engine compartment, use the throttle lever to fully open the throttle valve. The ECM will index the stepper motor to 25 steps.
6 Allow the throttle valve to fully close.
7 Adjust the throttle cable so that an equal gap exists either side of the lost motion lever.
8 Switch off the ignition key. The stepper motor will revert to normal control.

System sensor and actuator tests

Important notes

Please refer to Chapter 4, which describes common test procedures applicable to this system. The routines in Chapter 4 should be read in conjunction with the component notes and wiring diagrams presented in this Chapter. The wiring diagrams and other data presented in this Chapter are necessarily representative of the system depicted. Because of the variations in wiring and other data that often occurs, even between similar vehicles in any particular VM's range, the reader should take great care in identification of ECM pins, and satisfy himself that he has gathered the correct data before failing a particular component.

MEMS ECM terminals

The multi-plug terminals at the MEMS ECM are gold-plated, and care must be taken that the plating is not removed during procedures that involve probing or back-probing. The terminal wires are sealed with a rubber plug, and you should not back-probe through these plugs, or pierce them with a sharp object. If the rubber plug is damaged, it will lose its water-sealant qualities. The following method is strongly recommended to prevent damage to terminal or sealing plug.

First, disconnect the multi-plug and detach the white cover. Carefully insert a small jeweller's-type screwdriver into the recess at the top of the terminal pin. Gently lever out the plastic retainer leg, and gently pull on the wire from behind the multi-plug. Once the clip is disengaged, the terminal should slide easily from its holder. Slide the rubber plug up the wire, and then push the terminal back into the multi-plug. Repeat this procedure for all terminal pins that will be back-probed during a test. After testing is completed, the procedure should be reversed, and all sealant plugs refitted into their original position.

Moulded component multi-plugs

From about 1994, many Rover models are fitted with moulded multi-plugs to the components. This means that it is no longer possible to backprobe the component. Live voltage or oscilloscope tests must therefore be made at the ECM or with the aid of a break-out box (BOB). Component BOB's suitable for this purpose are available from the suppliers of engine test equipment.

11 Primary trigger - crank angle sensor (CAS)

1 Refer to the notes at the start of this Section, and refer to the relevant Section of Chapter 4.
2 The CAS resistance is 1100 to 1700 ohms

12 Primary ignition

1 Refer to the notes at the start of Section 11, and refer to the relevant Section of Chapter 4 **(see illustration 14.9)**.
2 The primary ignition is essentially that of an ECM with internal amplifier.
3 Primary resistance (distributor ignition) is 0.71 to 0.81 ohms. Secondary resistance is 5000 to 15 000 ohms.
4 Primary resistance (DIS ignition) is 0.63 to 0.77 ohms.

13 Knock sensor (KS)

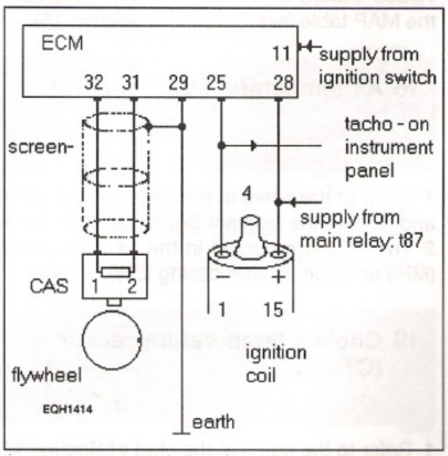
1 Refer to the notes at the start of Section 11, and refer to the relevant Section of Chapter 4.
2 A knock sensor is only used in 2.0 litre engines with MPi.

14 Fuel injector operation (MPi)

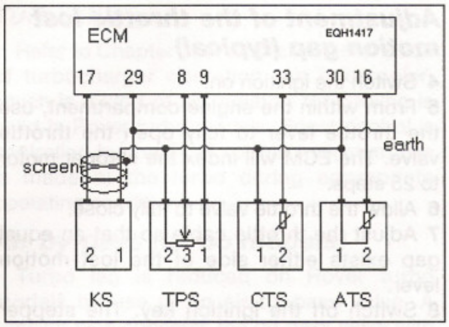
1 Refer to the notes at the start of Section 11, and refer to the relevant Section of Chapter 4.
2 Voltage to the injectors is provided from either the system relay or MFU.
3 MEMS fuel injector operation is current-controlled.
4 Injector operation is either simultaneous or sequential.
5 The injector resistance is normally 15.0 to 17.0 ohms.

15 Fuel injector operation (SPi)

1 Refer to the notes at the start of Section 11, and refer to the relevant Section of Chapter 4.



14.9 Typical local wiring diagram: ignition



14.10 Typical local wiring diagram: sensors

2 Voltage to the injectors is provided from either the system relay or MFU.
3 The SPi system is current-controlled.
4 The injector resistance is normally 1.1 to 1.5 ohms.

16 Phase sensor (CID)

1 Refer to the notes at the start of Section 11, and refer to the relevant Section of Chapter 4.
2 The CID phase sensor is located adjacent to the camshaft.
3 Unfortunately, no data is available for CID resistance, but failure is likely to be indicated by a short- or open-circuit reading.

17 MAP sensor

1 Refer to the notes at the start of Section 11, and refer to the relevant Section of Chapter 4 **(see illustration 14.10)**.
2 The MAP sensor is incorporated into the ECM, and separate voltage tests are not possible.
3 Performance of the MAP sensor can be quickly evaluated by a suitable FCR attached to the serial port. Select Datastream; the values should be similar to those detailed in the MAP table (see Chapter 4, Section 18).

18 Air temperature sensor (ATS)

1 Refer to the notes at the start of Section 11, and refer to the relevant Section of Chapter 4.
2 The ATS is mounted in the air inlet casing (MPi) or in the air filter casing (SPi).

19 Coolant temperature sensor (CTS)

1 Refer to the notes at the start of Section 11, and refer to the relevant Section of Chapter 4.

20 Throttle switch (TS)

1 On pre-1993 models equipped with the throttle pedal-mounted 'idle switch', the engine will gasp, die and fail to respond properly if the engine speed is increased by moving the throttle lever directly from under the bonnet. This is because the ECM links the idle switch closed condition with rpm, and enters fuel deceleration cut-off mode. The engine rpm should only be increased by use of the accelerator pedal from inside the car.
2 However, during testing it is sometimes more convenient to be able to control the engine speed by moving the throttle lever directly. It is possible to by-pass the idle switch by disconnecting one of the wires on the pedal switch. MEMS will assume a fault, and set a default value. The engine will then respond to throttle lever movement.
3 Once testing is complete, the pedal switch wire must be reconnected, and a FCR used to clear the ECM of any logged faults.
4 Check that the terminal pins are pushed home and making good contact with the pedal switch.

Checking pedal switch operation

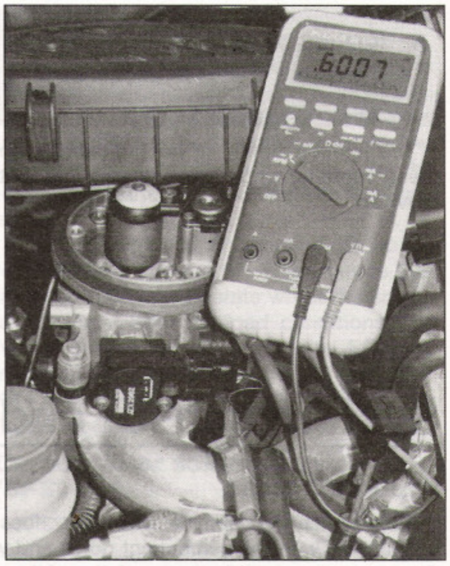
5 The two wires to the pedal switch multi-plug connector are earth and idle signal.
6 With the engine stopped, and ignition on, connect the voltmeter negative probe to an engine earth.
7 Connect the voltmeter positive probe to the wire attached to the pedal switch signal terminal number 2. The meter should indicate zero volts.
8 If zero volts cannot be obtained:
a) Check the pedal switch earth connection.
b) Make the pedal switch resistance tests (below).

9 Crack open the throttle. The voltage should rise to 5.0 volts.
10 If the voltage is low or non-existent:
a) Check that the pedal switch idle terminal is not shorted to earth.
b) Disconnect the pedal switch connections, and check for 5.0 volts at the signal terminal. If there is no voltage, check for continuity of the signal wiring between the pedal switch and the ECM.

11 If the pedal switch wiring is satisfactory, check all voltage supplies and earth connections to the ECM. If the voltage supplies and earth connections are satisfactory, the ECM is suspect.

Pedal switch resistance tests

12 Connect an ohmmeter between the earth terminal 1 and terminal 2.
13 With the pedal switch closed, the ohmmeter should indicate very close to zero ohms.
14 Slowly open the throttle, and as the pedal switch cracks open, the resistance should become open-circuit and remain so - even as the throttle is opened fully.
15 If the pedal switch does not behave as described, and if it is not prevented from opening or closing fully by a binding throttle linkage, the ECM pedal switch is suspect.



14.11 Check the throttle pot voltage output with the aid of a voltmeter

21 Throttle potentiometer sensor (TPS)

1 Refer to the notes at the start of Section 11, and refer to the relevant Section of Chapter 4 **(see illustration 14.11)**.

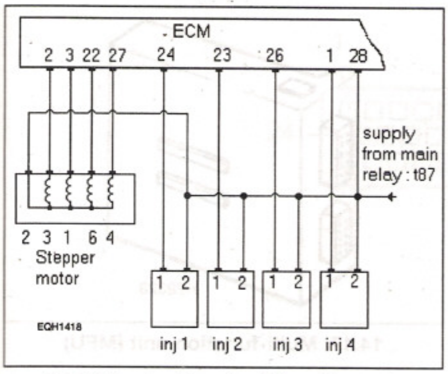
22 Stepper motor

1 Switch the ignition key to the 'on' position.
2 After 5 seconds, switch the ignition key to the 'off' position. The stepper motor plunger should fully retract, and then step to the correct position (according to temperature), ready for the next engine start. After 15 seconds, the main relay will audibly 'click out'. If this operation is completed satisfactorily, it is probable that the stepper motor condition is also satisfactory.

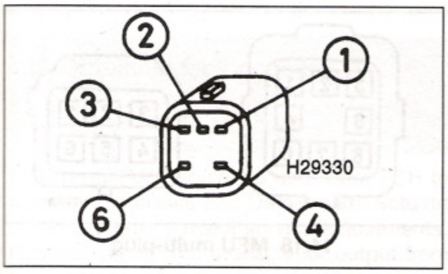
Stepper motor tests

3 Check for nbv to the stepper motor supply.
4 Connect a DC voltmeter to each of the earth pins in turn **(see illustrations 14.12 and 14.13)**.
5 Switch the ignition key on and off. A voltage should be briefly seen as the stepper motor actuates.
6 Disconnect the stepper motor multi-plug, and check the resistance from pin 5 to pins 1, 2, 3 and 4 in turn; 16 ohms should be obtained between pin 5 and each earth pin.

Throttle Pedal Switch wire colours believed to be pink/grey and black/pink



14.12 Typical local wiring diagram: injectors, stepper motor



14.13 Stepper motor multi-plug pin numbers

7 Disconnect the ECM multi-plug (*refer to Warning No 3 in Reference*)

8 Switch the ignition key 'on'.

9 Connect a jumper lead from ECM pin 4 to battery earth (this energises the main relay with the ECM disconnected).

10 Connect a voltmeter between earth and ECM pins 22, 2, 27 and 3 in turn, nbv should be obtained.

11 If nbv is not obtained at one or more of the ECM pins, check the continuity of the wiring between the relevant ECM and stepper motor pins.

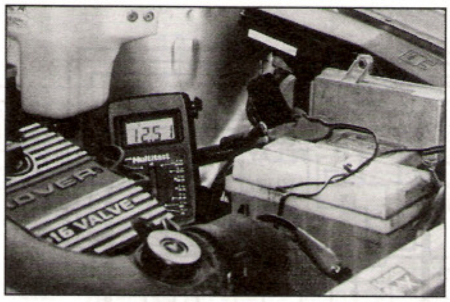
12 If the stepper motor wiring is satisfactory, check all voltage supplies and earth connections to the ECM. If the voltage supplies and earth connections are satisfactory, the ECM is suspect.

23 Manifold heater (SPi engines only)

1 Refer to the notes at the start of Section 11, and refer to the relevant Section of Chapter 4.

2 Make tests when the engine coolant temperature is less than 75°C. **Note:** *If the engine is hot, a variable potentiometer could be connected to the CTS multi-plug so that a cold engine could be simulated.*

3 If a FCR is available, the manifold heater relay can be actuated via the serial port. This would prove the integrity of the relay and associated wiring.



14.14 Probing for nbv at the ECM multi-plug

24 ECM voltage supplies and earths

1 Refer to the notes at the start of Section 11, and refer to the relevant Section of Chapter 4 **(see illustration 14.14).**

2 In addition to relay drivers for the main relay and pump relay, relay drivers may be available for the manifold heater and OS relays.

25 Inertia switch

1 Refer to the notes at the start of Section 11, and refer to the relevant Section of Chapter 4.

2 Montego models only: check the ballast resistor by-pass.

3 The inertia switch may be located behind the radio (early models) or in the engine compartment, close to the bulkhead.

26 System relays

1 Power to the MEMS electrical circuits is provided by either a number of conventional relays or an MFU (multi-function unit).

2 When a conventional set of relays are used, testing also follows conventional lines. In this instance, please refer to Chapter 4, which describes common test procedures applicable to checking standard system relays found in Rover MEMS systems. The routines in Chapter 4 should be read in conjunction with these component notes and the wiring diagrams portrayed in this Chapter **(see illustration 14.15).**

3 In the Rover MEMS system, the OS and manifold heater are also supplied from a relay.

27 Multi-function unit (MFU)

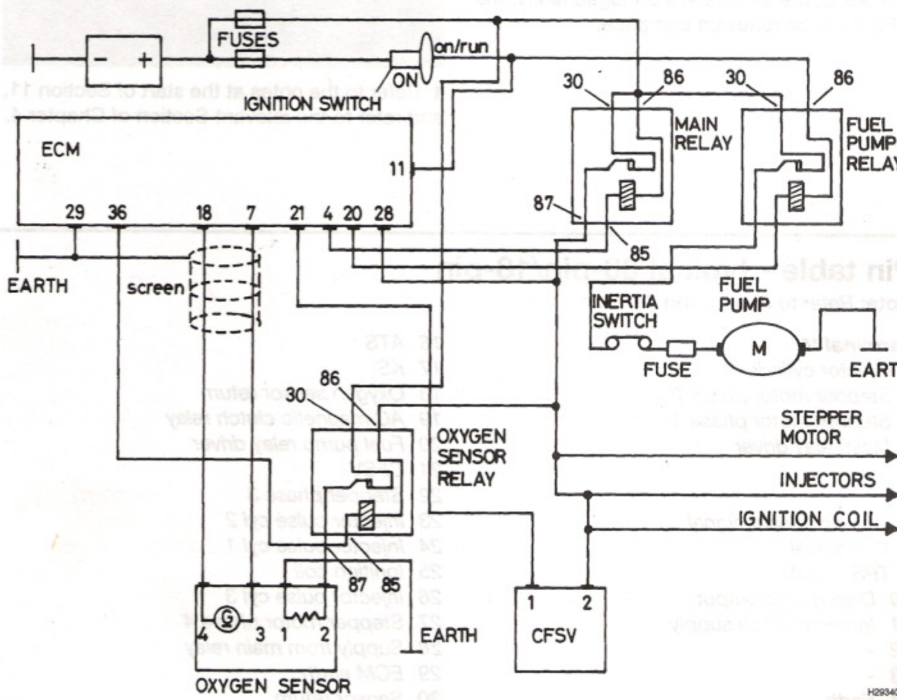
Quick relay test

1 A quick method of determining whether the relay is defective would be:

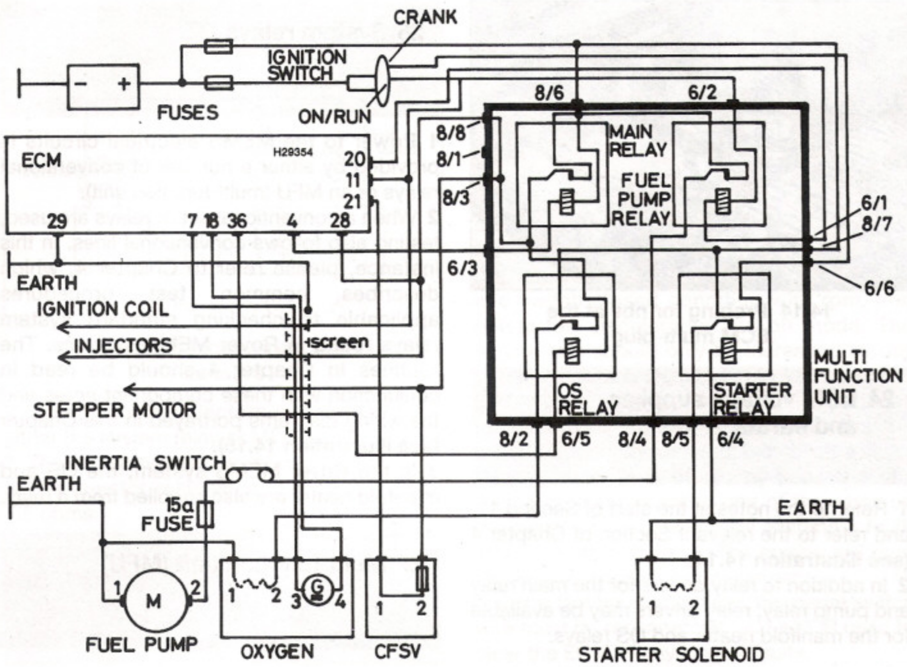
a) *By-pass the MFU and attempt to run the engine.*

b) *Check for voltages at the MFU output terminals or at the components supplied by the relay.*

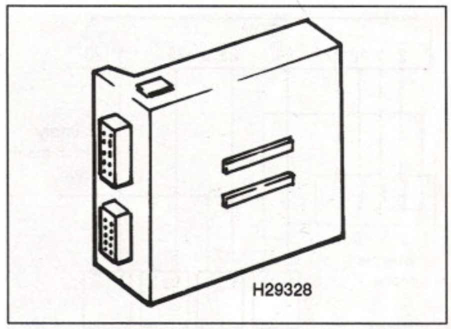
2 If the wiring and MFU operation are satisfactory, yet the ECM fails to operate one or more of the relays, the ECM is suspect.



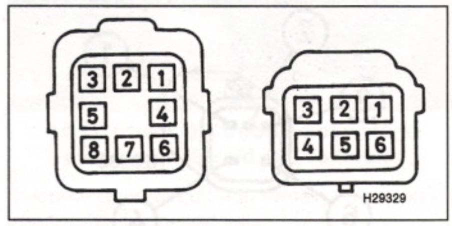
14.15 Typical local wiring diagram: relays and components



14.16 Typical local wiring diagram: relays (MFU) and components



14.17 Multi-function unit (MFU)



14.18 MFU multi-plug

Testing the MFU

3 Ignition key on, relay connected.
4 Backprobe or probe for voltages at components supplied by the relay. If there is no output, backprobe at the appropriate MFU output terminal. If there is still no output, and all supply and earth voltages are satisfactory, the MFU is suspect **(see illustrations 14.16 to 14.18).**
5 If one of the MFU relays is judged faulty, the MFU must be renewed complete.

28 Fuel pump and circuit

1 Refer to the notes at the start of Section 11, and refer to the relevant Section of Chapter 4.

29 Fuel pressure

1 Refer to the notes at the start of Section 11, and refer to the relevant Section of Chapter 4.

30 Oxygen sensor (OS)

1 Refer to the notes at the start of Section 11, and refer to the relevant Section of Chapter 4.
2 The OS found in the majority of Rover MEMS systems is a four-wire sensor with a heater.

31 Carbon filter solenoid valve (CFSV)

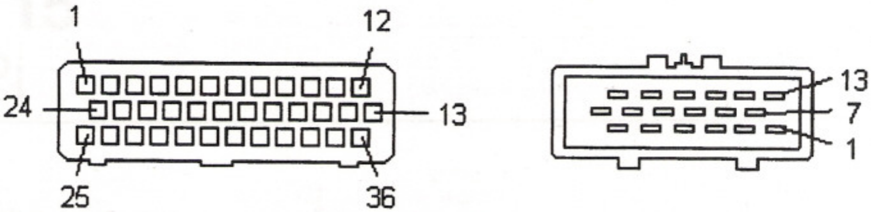
1 Refer to the notes at the start of Section 11, and refer to the relevant Section of Chapter 4.

Pin table - typical 36-pin/18-pin

Note: *Refer to* ***illustration 14.19.***

Terminal 'A'
1 Injector cylinder 4
2 Stepper motor phase 2
3 Stepper motor phase 1
4 Main relay driver
5 -
6 -
7 Oxygen sensor signal
8 TPS signal
9 TPS supply
10 Diagnostics output
11 Ignition switch supply
12 -
13 -
14 Earth
15 Diagnostics input
16 ATS
17 KS
18 Oxygen sensor return
19 AC magnetic clutch relay
20 Fuel pump relay driver
21 CFSV
22 Stepper phase 3
23 Injector pulse cyl 2
24 Injector pulse cyl 1
25 Ignition coil
26 Injector pulse cyl 3
27 Stepper motor phase 4
28 Supply from main relay
29 ECM earth
30 Sensor return
31 CAS +
32 CAS return
33 CTS
34 FRTS
35 AC high press safety sw
36 Oxygen sensor relay driver

Terminal 'B'
3 Alternator
5 OS relay driver
6 Turbo boost valve
8 Turbo air pressure solenoid
13 OS return
14 OS signal
15 Camshaft sensor
18 Camshaft sensor



14.19 Typical 36-pin and 18-pin multi-plugs

Fault codes

32 Obtaining fault codes

1 Rover MEMS requires a dedicated FCR to access fault codes and Datastream, actuate components and make service adjustments. Flash codes are not available for output from this system.

2 MEMS does not provide too many codes, since a programmed test procedure (when using a Rover dedicated tester) will check the sensor and actuator circuits and report on all faults found.

Code	Fault
1	CTS circuit fault
2	ATS circuit fault
10	Fuel pump circuit fault
16	TPS circuit fault
17	TPS supply voltage fault
19	Oxygen sensor heater circuit fault (cat models only)