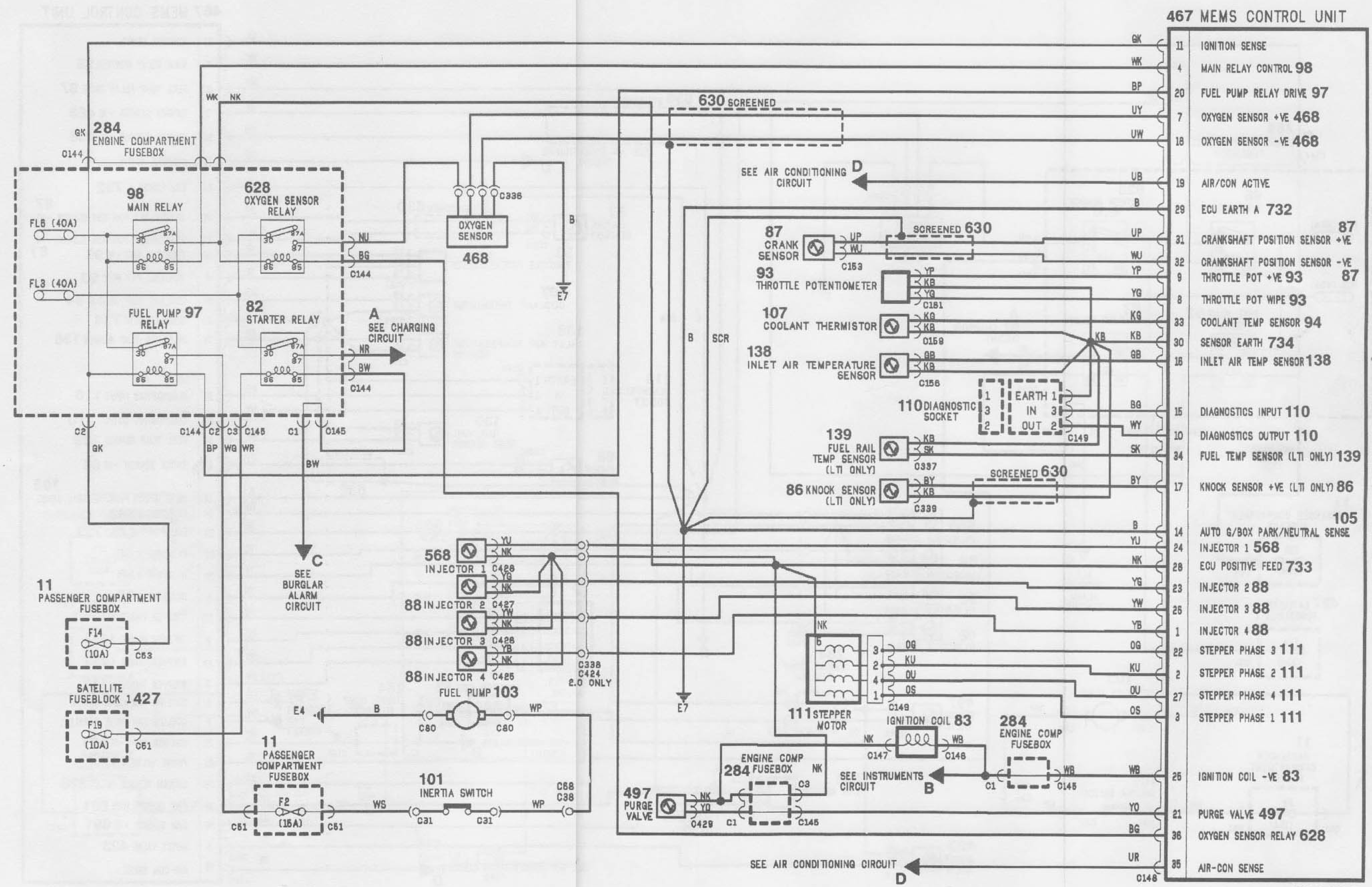
MODULAR ENGINE MANAGEMENT SYSTEM

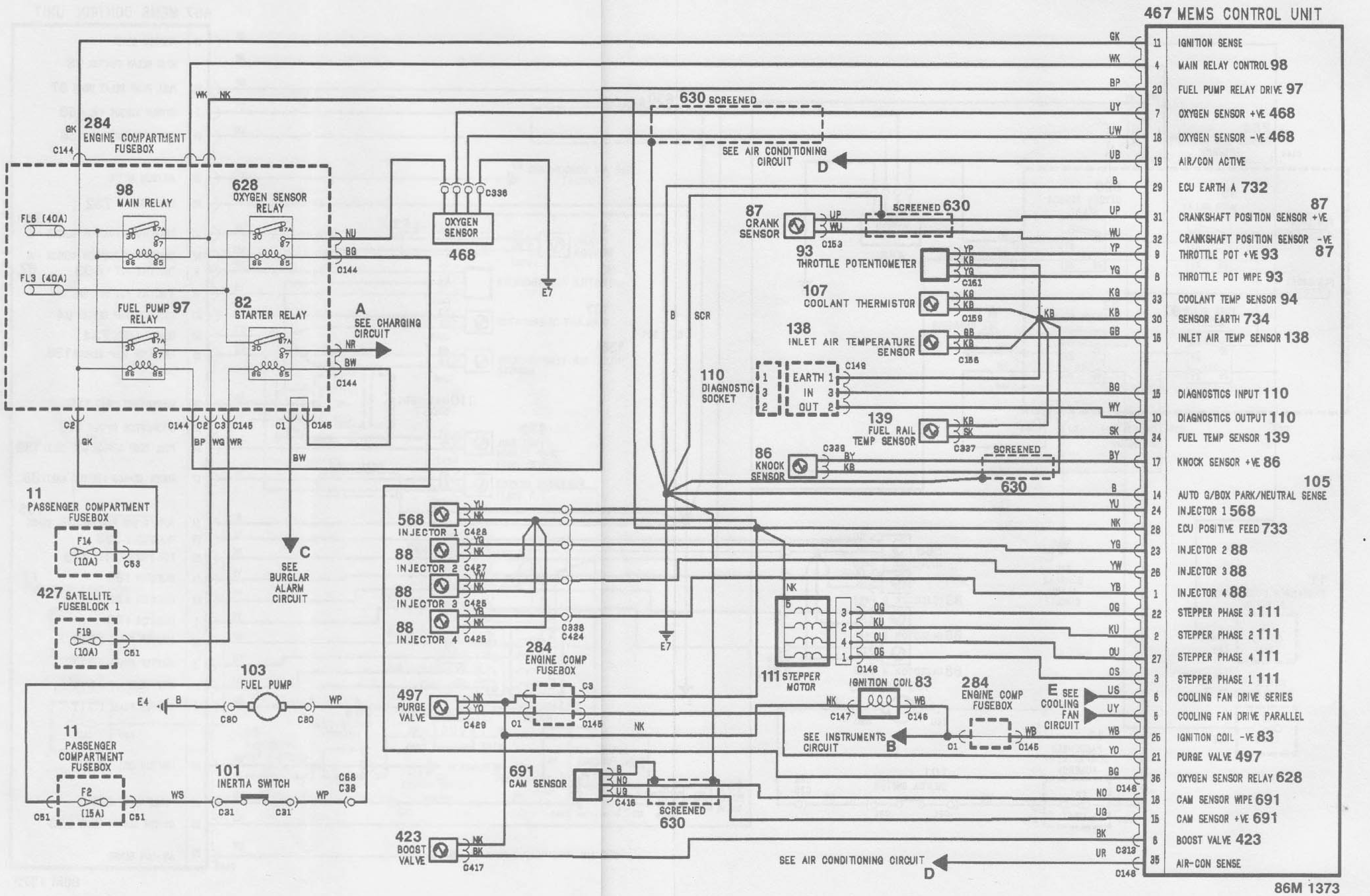
CONTENTS

Circuit Diagram - 1.4 and 2.0 Naturally aspirated engine



86M 1372

Circuit Diagram - 2.0 Turbo engine



MODULAR ENGINE MANAGEMENT SYSTEM (MEMS)

The MEMS system is controlled by the ECU which is located in the engine compartment on the L.H. wing valance next to the rear of the battery.

The ECU is an adaptive unit, this means that, over a period of time, it can 'learn' the load and wear characteristics of the engine. Because no two engine's have identical characteristics, this information is needed by the ECU to determine the amount of stepper motor movement required to achieve the specified idle speed.

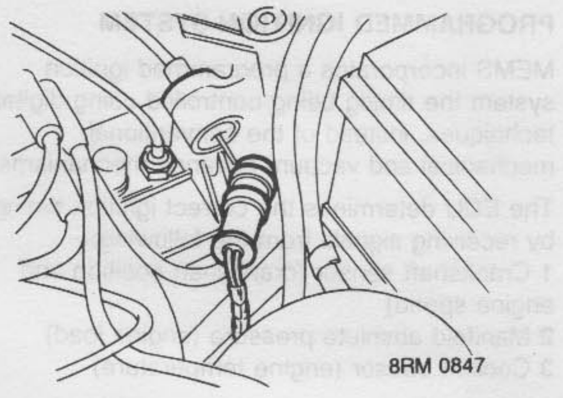
The features of MEMS are:-

1 One common ECU is utilised, incorporating a programmed ignition system and fuel injection system.

Diagnostic connector position

2 A separate diagnostic connector allows diagnosis to be carried out and engine tuning either using "Microtune, Microcheck or Cobest". This facility enables diagnosis to be carried out on the system without disconnecting the ECU harness connector.

3 The ECU incorporates short circuit protection and has more powerful diagnostic capabilities with the ability to store intermittent faults on certain inputs, these capabilities are made full use of by the programmable "Microcheck" hand held tester and Cobest.



4 The ignition system is used to improve the idle speed response by advancing or retarding the ignition when load is placed on, or removed from the engine.

5 If certain system inputs fail the ECU implements a back-up facility enabling the system to carry on functioning, although at a reduced level of performance.

Inputs and Outputs

The ECU receives signals from various inputs and then controls the ignition coil, injector(s), stepper motor, fuel pump relay, main relay, oxygen sensor relay, purge valve and diagnostic output.

INPUTS

- Crankshaft sensor
- Manifold absolute pressure
- Coolant temperature sensor
- Inlet air temperature sensor
- Throttle potentiometer
- Fuel rail temperature sensor
- Battery supply
- Ignition supply
- Diagnostic input
- Power ground
- Sensor ground
- Oxygen sensor

MEMS ECU

OUTPUTS

- Ignition coil
- Injector(s)
- Stepper Motor
- Fuel pump relay
- P.T.C. relay
- Main relay
- Diagnostic output
- Purge control solenoid
- Oxygen sensor relay

PROGRAMMED IGNITION SYSTEM

MEMS incorporates a programmed ignition system the timing being controlled using digital techniques, instead of the conventional mechanical and vacuum advance mechanisms.

The ECU determines the correct ignition timing by receiving signals from the following:-

1 Crankshaft sensor (crankshaft position and engine speed)
2 Manifold absolute pressure (engine load)
3 Coolant sensor (engine temperature)

There is no distributor utilised in this system, timing is controlled by the ECU and spark distribution is accomplished, by means of a rotor arm and distributor cap mounted at the N°4 cylinder end of the inlet camshaft.

Crankshaft sensor

The crankshaft sensor incorporates an armature which projects through the engine adapter plate. The armature is situated adjacent to a reluctor disc containing poles. Every time a pole passes the sensor armature the ECU receives a signal.

The reluctor disc contains 34 poles spaces at 10° intervals. Two missing poles, 180° apart, identify the engine T.D.C. positions, while the remaining poles provide a continual update of crankshaft position and engine speed.

Knock sensor - 2.0 MPi models

The knock sensor is located in the cylinder block between No. 2 and No. 3 cylinders. The sensor monitors noise and vibration in the engine and passes this information to the ECU The ECU is able to identify the characteristics of knock and make the necessary corrections to ignition timing of the individual cylinder(s).

Manifold absolute pressure sensor

The LOAD signal is detected by a manifold absolute pressure sensor located in the ECU which detects manifold pressure via a pipe connected to the inlet manifold. This sensor converts the pressure signal into an electrical signal used by the ECU to determine engine load.

Coolant Temperature Sensor

The coolant temperature sensor is a temperature dependent resistor (thermistor) the Resistance of the thermistor decreases as the coolant temperature increases.

Coolant Temperature Correction

The ECU supplies approx. 5 volts on a K/G wire to the coolant temperature sensor, and by measuring the amount of current in this wire the ECU can the adjust the length of injector opening time required. The ECU supplies the coolant temperature sensor its earth path on a K/B wire.

Idle Speed Control

When the engine is at idle, the ECU implements an idle ignition setting.

Note: *Due to the sensitivity of this system the ignition timing at idle is continually changing.*

FUEL INJECTION

Multi point injection

MEMS multi point fuel injection system incorporates four fuel injectors fitted between the pressurised fuel rail and the inlet manifold. Each injector comprises of a solenoid operated needle valve and a specially designed nozzle to ensure good fuel atomisation.

The amount of fuel injected is determined by how long the injector(s) is held open (known as the injector pulse width). To achieve the required air fuel ratio the ECU receives signals from the following inputs.

1 Crankshaft sensor (engine speed)
2 Manifold absolute pressure (Engine load)
3 Inlet air temperature sensor (Inlet air temperature)
4 Coolant temperature sensor (engine temperature)
5 Throttle potentiometer (rate of throttle opening)
6 Battery voltage (state of battery charge)
7 Oxygen sensor (oxygen content of exhaust gases)

To further refine the air fuel ratio the ECU continually updates the air fuel ratio using the following inputs:-

Battery Voltage Correction

The ECU senses battery voltage and applies adjustments to injector pulse width. These compensate for the effects of any fluctuations in injector pulse width due to variations in battery voltage.

Over-speed Fuel Cut-off

Above 7000 rev/min, the ECU inhibits the earth path from the injectors. When the engine speed drops to 6990 rev/min, fuel is reinstated to ensure driveability is not impaired.

Hot start enrichment - 2.0 MPi

Whenever the ignition is switched on, the ECU compares fuel rail temperature with the temperature recorded when the ignition was last switched off. If the temperature is higher, hot start enrichment is provided. The ECU achieves this by increasing the injector pulse widths and then decaying them at a fixed rate.

Idle Air Fuel Ratio

During idle conditions the ECU implements an idle air fuel ratio map. The ECU implements this map when the engine speed is below an idle speed set point.

Note: *The idle C.O. is adjustable via the serial port using Microcheck or Cobest.*

Cranking Enrichment

During cranking when the engine speed is below a preset threshold speed of approximately 400 rev/min the ECU increases the injector pulse width to aid starting. The amount of increase varies depending upon coolant temperature. To prevent flooding the cranking pulses are intermittent (30 pulses on 16 pulses off).

After Start Enrichment

Additional enrichment is provided following cranking at all temperatures. The amount of additional fuel supplied is controlled by the ECU and will decay at a rate depending upon coolant temperature

To implement after start enrichment, the ECU increases the injector pulse width.

Acceleration Enrichment

During acceleration, additional fuel is required to ensure response is smooth. This enrichment is applied by the ECU which receives an output voltage (rising) from the throttle potentiometer and a rise in manifold absolute pressure. This additional fuel is provided by increasing the injector pulse width and instigating additional pulses.

Over-run Fuel Cut-off

Over-run fuel cut-off is implemented by the ECU when the following conditions exist:

Coolant temperature is above 80°C approx.
Throttle Pedal off - switch contacts closed.
Engine speed above approximately 2200 rev/min.

Back Up Facility

In the event of certain input failures the ECU will implement a back- up air fuel ratio to maintain driveability. A back-up value is provided for the coolant sensor, inlet air sensor and manifold absolute pressure sensor.

Back Up Values :-

Coolant sensor 60°C
Inlet air sensor 35°C
Manifold absolute pressure. The ECU implements air fuel ratio relating to engine speed and throttle position.

Throttle Potentiometer

The throttle potentiometer is a potential divider which is connected to the throttle disc spindle. The ECU provides a 5 volts supply to the throttle potentiometer and an earth return. A third wire is connected to the potentiometer and transmits a voltage output signal back to the ECU indicating the rate of throttle opening.

Exhaust emission control (closed loop)

The ECU uses a signal from the oxygen sensor to control exhaust emissions. This system control the air/fuel ratio to 14.7 : 1 at idle and cruise conditions.

Stepper Motor

This is contained within the throttle body and through a reduction gear operates a cam and push rod. The push rod is in direct contact with the throttle disc spindle lever and allows idle and fast idle speeds to be controlled by the ECU The stepper motor maximum movement is 3.75 revolutions accomplished by 180 steps of 7.5 degrees, a reduction gear reduces this to 150° cam movement.

Stepper Motor Operation

To determine the required amount of stepper motor movement the ECU receives signals from:-

1 Crankshaft sensor (engine speed)
2 Manifold absolute pressure sensor (engine load)
3 Coolant temperature sensor (engine temperature)
5 Battery voltage (state of battery charge)
6 Ignition supply (ignition switched off)

With the aid of these inputs the ECU can index the stepper to compensate for all prevailing conditions.

Coolant Temperature Compensation

During cold running conditions the ECU controls the stepper motor to provide a fast idle condition (elevated idle). The ECU determines the amount of fast idle required by sensing engine coolant temperature via a coolant sensor located in the thermostat housing.

Idle Speed Control

Once the engine has reached normal operating temperature, the idle speed is controlled by the ECU When the idle drops below the specified idle speed (due to increased mechanical or electrical loads), the ECU indexes the stepper motor to restore the correct idle speed.

Idle speed control will only occur when:

The engine speed is below a predetermined set point.

On return to idle, the ECU initially implements a slightly higher idle speed. This prevents the engine stalling when the throttle is closed.

Cranking Position

During cranking, the ECU indexes the stepper to a position for a "throttle off" start. This position is dependent upon coolant temperature.

Over-run Control

During over-run conditions, the ECU indexes the stepper motor, opening the throttle disc. This increases the air flow into the engine reducing hydrocarbon emissions.

Low Battery Voltage Compensation

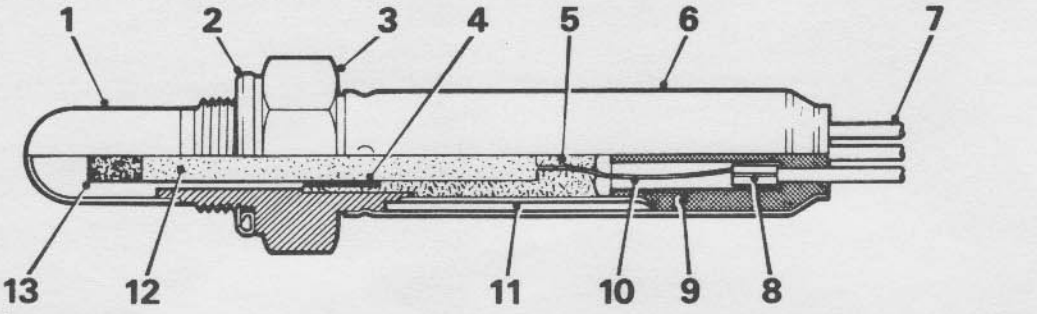
When the battery voltage drops below a preset value, the ECU indexes the stepper motor increasing the idle speed, consequently increasing alternator output.

Ignition Off Position

When the ignition is switched off, the ECU keeps the main relay energised for 30 seconds. During this time the stepper motor is indexed to 180 steps (fully open).

The MEMS idle control is an adaptive system and the ECU learns the engine load and wear characteristics over a period of time. The amount of stepper motor steps required to maintain the specified idle consequently will differ from model to model. In the event of a new ECU or an ECU from another vehicle being fitted, it will take a short period of normal driving for the ECU to learn the load and wear characteristics of that engine.

Catalytic Converter System



Oxygen sensor

1. Protective tube
2. Gasket
3. Sensor body
4. Internal gasket
5. Glass seal
6. Outer body
7. Lead wires
8. Connecting terminals
9. Grommet
10. Metal element
11. Support tube
12. Ceramic filler
13. Alumina coated substrate

Oxygen sensor - Used with Closed-loop Catalytic Converter System

The oxygen sensor is mounted in the exhaust front pipe close to the manifold. It is formed by three insulated platinum coated elements inside a protective tube. The elements are brought together at the sensing tip and form an electrode sensitive to Oxygen.

A 12v feed is supplied from the oxygen sensor relay on a NY wire, to the input element of the sensor which supplies the heater coil and the sensing tip. The heater coil surrounds the sensing tip to ensure an efficient operating temperature is quickly reached from cold. The heater coil operates continually and is earthed through the B wire.

In weak air/fuel mixtures, oxygen content in the exhaust gas increases and the build up of oxygen reduces the resistance of the sensing tip. This allows current to flow across the tip, to the 3rd element and on to the electronic fuel control unit. As the air/fuel mixture becomes richer so oxygen content decreases, resistance of the sensing tip is increased and so current flow decreases.

This forms a signal voltage on the LGS and S wires which is used by the Fuel ECU to determine what correction to fuel delivery is necessary.

CAUTION: *An oxygen sensor will not operate if its power supply is removed, if it has been dropped or subjected to any impact or if cleaning materials are used on it.*

Purge Valve

The ECU controls the operation of the purge valve on the YO wire. The valve remains closed when the engine is cold and at idling speed to protect engine tune and catalyst performance. When the coolant is above 70°C, the purge valve solenoid will be modulated ON and OFF whenever the engine speed is above 1500 rev/min and the manifold absolute pressure is below 30kpa. When the purge valve is open, fuel vapour from the charcoal canister is drawn into the throttle housing for combustion.