E - THEORY/OPERATION

1998 Mitsubishi Galant

1998 ENGINE PERFORMANCE
Mitsubishi - Theory & Operation

Diamante, Eclipse, Galant, Mirage, Montero, Montero Sport, 3000GT

INTRODUCTION

This article covers basic description and operation of engine performance-related systems and components. Read this article before diagnosing vehicles or systems with which you are not completely familiar.

AIR INDUCTION SYSTEM

NON-TURBOCHARGED ENGINES

Mirage equipped with 1.5L engine uses a Manifold Absolute Pressure (MAP) sensor instead of a Volume Airflow (VAF) sensor. Filtered air is ducted to a plenum-mounted throttle body.

All other models use same basic air induction system using a remote air filter (with VAF sensor) connected to a plenum-mounted throttle body.

TURBOCHARGED ENGINES

In addition to basic air induction system, turbocharging system components include turbocharger(s), charge air cooler(s), air by-pass valve(s), wastegate actuator(s), wastegate control solenoid valve(s) and intake duct(s).

Wastegate Control Solenoid Valve(s)

Powertrain Control Module (PCM) energizes solenoid valve(s), controlling bleed-off rate of turbocharger pressure by wastegate actuator(s).

COMPUTERIZED ENGINE CONTROLS

Sequential Fuel Injection (SFI) is a computerized engine control system, which controls fuel injection, ignition timing, idle speed and emission control systems.

POWERTRAIN CONTROL MODULE (PCM)

PCM, also known as Engine Control Module (ECM), receives and processes signals from input devices. Operating conditions such as cold starting, altitude, acceleration and deceleration affect input device signals. Based on signals received, PCM sends signals to various components, which control fuel injection, ignition timing, idle speed and emission control systems. For PCM location, see PCM LOCATION table.

PCM LOCATION TABLE

Application	Location
Eclipse 2.0L Non-Turbo	In Front of Left Front Strut Tower

Mirage & Montero Sport	Behind Right Side Of Instrument Panel (Glove Box)
Montero	Right Front Kick Panel
All Others	Behind Center Console

NOTE: Components are grouped into 2 categories. The first category covers INPUT DEVICES, which control or produce voltage signals monitored by Powertrain Control Module (PCM). The second category covers OUTPUT SIGNALS, which are components controlled by PCM.

INPUT DEVICES

Vehicles are equipped with different combinations of input devices. Not all input devices are used on all models. To determine input device usage on specific models, see appropriate wiring diagram in L - WIRING DIAGRAMS article. The following are available input devices.

Air Conditioning Switch

When A/C is turned on, signal is sent to PCM. With engine at idle, PCM increases idle speed through Idle Air Control (IAC) motor.

Airflow Sensor Assembly

Assembly is mounted inside air cleaner, and incorporates barometric pressure sensor, intake air temperature sensor and volume airflow sensor.

Barometric (BARO) Pressure Sensor

Sensor is incorporated into airflow sensor assembly. Sensor converts barometric pressure to electrical signal, which is sent to PCM. PCM adjusts air/fuel ratio and ignition timing according to altitude.

Camshaft Position (CMP) Sensor

On SOHC engines equipped with a distributor, CMP sensor is located in distributor. On Eclipse (Turbo) and DOHC V6 engines, sensor is located beside camshaft, in front of engine. On all other engines, CMP sensor is a separate unit mounted in place of distributor. PCM determines TDC based on pulse signals received from sensor, and then controls MFI timing.

Closed Throttle Position (CTP) Switch

CTP switch is located in the Throttle Position (TP) sensor. PCM senses whether accelerator pedal is depressed or not. High voltage (open) or low voltage (closed) signal is input to PCM, which then controls Idle Air Control (IAC) motor based on input signal.

Crankshaft Position (CKP) Sensor

CKP sensor is located in distributor on SOHC engines, except 1.5L 4-cylinder with California emissions. On DOHC 4-cylinder, DOHC V6 and 1.5L 4-cylinder engines with California emissions, CKP sensor is located beside crankshaft, in front of engine. PCM determines crankshaft position on pulse signals received from sensor, and then controls MFI timing and ignition timing.

Engine Coolant Temperature (ECT) Sensor

ECT sensor converts coolant temperature to electrical signal for use by PCM. PCM uses coolant temperature information to control fuel enrichment when engine is cold.

Heated Oxygen Sensor (HO2S)

HO2S detects oxygen content in exhaust gas and sends this information to PCM. PCM uses input signals from HO2S to vary duration of fuel injection. HO2S heater stabilizes sensor temperature regardless of exhaust gas temperature to allow for more accurate exhaust oxygen content readings.

Idle Air Control (IAC) Valve Position Sensor

Sensor is incorporated in IAC motor. Sensor senses IAC motor plunger position and sends electrical signal to PCM.

Ignition Timing Adjustment Terminal

Used for adjusting base ignition timing. When terminal is grounded, PCM timing control function is by-passed, allowing base timing to be adjusted.

Intake Air Temperature (IAT) Sensor

IAT sensor is incorporated into airflow sensor assembly. This resistor-based sensor measures temperature of incoming air and supplies air density information to PCM.

Knock Sensor (KS)

KS is located in cylinder block and senses engine vibration during detonation (knock). KS converts vibration into electrical signal. PCM retards ignition timing based on this signal.

Manifold Differential Pressure (MDP) Sensor

MDP sensor converts negative air pressure in intake manifold plenum into voltage signals sent to PCM. PCM monitors Exhaust Gas Recirculation (EGR) system using these signals.

Park/Neutral Position (PNP) Switch (Automatic Transmission)

PNP switch senses position of transmission select lever, indicating engine load due to automatic transmission engagement. Based on this signal, PCM commands IAC motor to increase throttle angle, maintaining optimum idle speed.

Power Steering Oil Pressure Switch

Switch detects increase in power steering oil pressure. When power steering oil pressure increases, switch contacts close, signaling PCM. PCM commands IAC motor, raising idle speed to compensate for drop in engine RPM due to power steering load.

Throttle Position (TP) Sensor

TP sensor is a variable resistor mounted on throttle body. PCM uses voltage signal from TP sensor to determine throttle plate angle.

Vehicle Speed Sensor (VSS)

Mounted on transaxle/transmission, VSS sends a pulsing signal to PCM for vehicle speed calculation. PCM uses this calculation for cruise control and fuel cut-off.

Volume Airflow (VAF) Sensor

Incorporated into airflow sensor assembly, VAF sensor measures intake airflow rate. Intake air flows through tunnel in airflow sensor assembly. VAF sensor sends frequency signal to PCM. PCM uses signal to adjust fuel injection rate.

OUTPUT SIGNALS

NOTE: Vehicles are equipped with various combinations of computer-controlled components. Not all components listed below are used on every vehicle. To determine component

usage on specific models, see appropriate wiring diagram in L - WIRING DIAGRAMS article. For theory and operation on each output component, refer to system indicated after component.

Data Link Connector (DLC)
See SELF-DIAGNOSTIC SYSTEM.

EGR Control Solenoid Valve
See EXHAUST GAS RECIRCULATION (EGR) CONTROL under EMISSION SYSTEMS.

Fuel Injectors
See FUEL CONTROL under FUEL SYSTEM.

Fuel Pressure Control Solenoid Valve (Turbo)
See FUEL DELIVERY under FUEL SYSTEM.

Fuel Pressure Regulator
See FUEL DELIVERY under FUEL SYSTEM.

Idle Air Control (IAC) Motor
See IDLE SPEED under FUEL SYSTEM.

Malfunction Indicator Light
See SELF-DIAGNOSTIC SYSTEM.

Power Transistor(s) & Ignition Coils
See IGNITION SYSTEMS.

Purge Control Solenoid Valve
See EVAPORATIVE CONTROL under EMISSION SYSTEMS.

Wastegate Control Solenoid Valve
See TURBOCHARGED ENGINES under AIR INDUCTION SYSTEM.

FUEL SYSTEM

FUEL DELIVERY

Electric fuel pump, located in gas tank, feeds fuel through in-tank fuel filter, external fuel filter (located in engine compartment) and fuel injector rail.

Fuel Pump
Fuel pump consists of a motor-driven impeller. Pump has an internal check valve to maintain system pressure, and a relief valve to protect fuel pressure circuit. Pump receives voltage supply from MFI control relay.

Fuel Pressure Control Solenoid Valve (Turbo)
Valve prevents rough idle due to fuel percolation. On engine restart, if engine coolant or intake air temperature reaches a preset value, PCM applies voltage to fuel pressure control solenoid valve for 2 minutes after enginerestart. Valve will open, allowing atmospheric pressure to be applied to fuel pressure regulator diaphragm. This allows maximum available fuel pressure at injectors, enriching fuel mixture and maintaining stable idle at high engine temperatures.

Fuel Pressure Regulator
Located on fuel injector rail, this diaphragm-operated relief valve adjusts fuel pressure according to engine manifold vacuum.
As engine manifold vacuum increases (closed throttle), fuel

pressure regulator diaphragm opens relief valve, allowing pressure to bleed off through fuel return line, reducing fuel pressure.

As engine manifold vacuum decreases (open throttle), fuel pressure regulator diaphragm closes valve, preventing pressure from bleeding off through fuel return line, increasing fuel pressure.

FUEL CONTROL

Fuel Injectors

Fuel is supplied to engine through electronically pulsed (timed) injector valves located on fuel rail(s). PCM controls amount of fuel metered through injectors based on information received from sensors.

IDLE SPEED

Air Conditioning (A/C) Relay

When A/C is turned on with engine at idle, PCM signals IAC motor to increase idle speed. To prevent A/C compressor from switching on before idle speed has increased, PCM momentarily opens A/C relay circuit.

Idle Air Control (IAC) Motor

Motor controls pintle-type air valve to regulate volume of intake air at idle.

During start mode, PCM controls idle intake air volume according to Engine Coolant Temperature (ECT) sensor input. After starting, with idle position switch activated (throttle closed), fast idle speed is controlled by IAC motor and fast idle air control valve (if equipped).

When idle switch is deactivated (throttle open), IAC motor moves to a preset position in accordance with ECT sensor input.

PCM signals IAC motor to increase engine RPM in the following situations: A/T (if applicable) is shifted from Neutral to Drive, A/C is turned on, or power steering pressure reaches a preset value.

IGNITION SYSTEMS

DIRECT IGNITION SYSTEM (DIS)

Depending on number of cylinders, ignition system is a 2 or 3-coil, distributorless ignition system. On Eclipse (Turbo) and DOHC V6 engines, Camshaft Position (CMP) sensor is located beside camshaft, in front of engine. On all other engines equipped with DIS, CMP sensor is a separate unit mounted in place of distributor. On DOHC 4-cylinder, DOHC V6 and 1.8L 4-cylinder engines with California emissions, Crankshaft Position (CKP) sensor is located beside crankshaft, in front of engine. PCM determines TDC based on pulse signals received from sensors and then controls MFI and ignition timing.

Power Transistors & Ignition Coils

Based on crankshaft position and CMP sensor inputs, PCM controls timing and directly activates each power transistor to fire coils. On 4-cylinder engines, power transistor "A" controls primary current of ignition coil "A" to fire spark plugs on cylinders No. 1 and No. 4 at the same time. Power transistor "B" controls primary current of ignition coil "B" to fire spark plugs on cylinders No. 2 and No. 3 at the same time. On V6 engines, companion cylinders No. 1 and 4, 2 and 5, and 3 and 6 are fired together.

On all models, although each coil fires 2 plugs at the same time, ignition takes place in only one cylinder, since the other

cylinder is on its exhaust stroke when plug fires.

HALL EFFECT IGNITION SYSTEM

This system is equipped with a Hall Effect distributor. Shutter(s) attached to distributor shaft rotate through distributor Hall Effect switch, also referred to as a Camshaft Position (CMP) sensor, which contains a distributor pick-up (a Hall Effect device and magnet). As shutter blade(s) pass through pick-up, magnetic field is interrupted and voltage is toggled between high and low. PCM uses this data along with Crankshaft Position (CKP) sensor data to control ignition timing and injector pulse width to maintain optimum driveability.

Power Transistor & Ignition Coil

Power transistor is mounted inside distributor with disc and optical sensing unit. When ignition is on, ignition coil primary circuit is energized. As distributor shaft rotates, disc rotates, triggering optical sensing unit. PCM receives signals from optical sensing unit. Signals are converted and sent to power transistor, interrupting primary current flow and inducing secondary voltage.

IGNITION TIMING CONTROL SYSTEM

Ignition timing is controlled by PCM. PCM adjusts timing based on various conditions such as engine temperature, altitude and detonation.

EMISSION SYSTEMS

EXHAUST GAS RECIRCULATION (EGR) CONTROL

Federal Emissions (Non-Turbo)

To lower oxides of nitrogen (NOx) exhaust emissions, a non-computer controlled exhaust gas recirculation system is used. EGR operation is controlled by throttle body ported vacuum. Vacuum is routed through vacuum control valve to prevent EGR operation at low engine temperatures.

Spring pressure holds EGR valve closed during low vacuum conditions (engine idling or wide open throttle). When vacuum pressure increases and overcomes EGR spring pressure, EGR valve is lifted to allow exhaust gases to flow into intake manifold for combustion.

California Emissions & Turbo

PCM controls EGR operation by activating EGR control solenoid valve according to engine load. When engine is cold, PCM signals EGR control solenoid valve to deactivate EGR.

EGR Control Solenoid Valve

Valve denies or allows vacuum supply to EGR valve based on PCM commands.

EVAPORATIVE CONTROL

Fuel evaporation system prevents fuel vapor from entering atmosphere. System consists of special fuel tank with vapor separator tanks (if equipped), vacuum relief filler cap, overfill limiter (2-way valve), fuel check valve, thermovalve (if equipped), charcoal canister, purge control valve, purge control solenoid valve, and connecting lines and hoses.

Purge Control Solenoid Valve

When engine is off, fuel vapors are vented into charcoal canister. When engine is warmed to normal operating temperature and running at speeds greater than idle, PCM energizes purge control solenoid valve, allowing vacuum to purge valve.

Canister vapors are then drawn through solenoid valve into intake manifold for burning. Purge control solenoid valve remains closed during idle and engine warm-up to reduce HC (hydrocarbons) and CO (carbon monoxide) emissions.

POSITIVE CRANKCASE VENTILATION (PCV) VALVE

PCV valve operates in closed crankcase ventilation system. Closed crankcase ventilation system consists of PCV valve, oil separator, breather and ventilation hoses.

PCV valve is a one-way check valve located in valve cover. When engine is running, manifold vacuum pulls PCV valve open, allowing crankcase fumes to enter intake manifold. If engine backfires through intake manifold, PCV valve closes to prevent crankcase combustion.

SELF-DIAGNOSTIC SYSTEM

NOTE: PCM diagnostic memory is retained by direct power supply from battery. Memory is not erased by turning off ignition, but it will be erased if battery or PCM is disconnected.

Self-diagnostic system monitors input and output signals through the Data Link Connector (DLC). Diagnostic Trouble Codes (DTCs) can only be read using a scan tester. For additional information, see G - TESTS W/CODES article.

Malfunction Indicator Light (MIL)

MIL (CHECK ENGINE light) comes on when ignition is turned on. MIL remains on for several seconds after engine has started. If an abnormal input signal occurs, MIL comes on and code is stored in memory. If an abnormal input signal returns to normal, PCM turns MIL off, but code remains stored in memory until it is cleared. If ignition is turned on again, MIL will not come on until PCM detects malfunction during system operation.