E - THEORY/OPERATION

1993 Mitsubishi Montero

1993 ENE PERFORMANCE
Chrysler Corp./Mitsubishi Theory & Operation

Dodge; Colt, Colt 200, Ram-50, Stealth
Eagle; Summit, Summit Wagon
Mitsubishi; Diamante, Eclipse, Expo, Expo LRV, Galant, Mirage, Montero, Pickup, Precis, 3000GT
Plymouth; Colt, Colt Vista, Colt 200

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.

1993 TERMINOLOGY

Due to Federal government requirements, manufacturers may use names and acronyms for systems and components different than those used in previous years. The following table will help eliminate confusion when dealing with these components and systems. Only relevant components and systems whose names have changed from previous Chrysler Corp./Mitsubishi terminology have been listed. See REVISED TERMINOLOGY table.

REVISED TERMINOLOGY CHART

1992 & Earlier	1993
CHECK ENGINE Light	Malfunction Indicator Light (MIL)
Crank Angle Sensor	Crankshaft Position Sensor
Engine Control Unit (ECU)	Engine Control Module (ECM)
Idle Speed Control (ISC Or AIS)	Idle Air Control (IAC)
Self-Diagnostic Connector	Data Link Connector (DLC)

AIR INDUCTION SYSTEM

NON-TURBOCHARGED ENGINES

All Chrysler Corp./Mitsubishi engines with Multi-Point Injection (MPI) use same basic air induction system. Remote air filter (with airflow sensor) is ducted to a plenum-mounted throttle body.

TURBOCHARGED ENGINES

In addition to basic air induction system used on all other models, turbocharging system components include turbocharger(s), air-to-air intercooler(s), air by-pass valve(s), wastegate actuator(s), wastegate control solenoid valve(s) and intake duct.

Wastegate Control Solenoid Valve
Engine Control Module (ECM) energizes solenoid valve, controlling leakage rate of turbocharger pressure to wastegate actuator.

COMPUTERIZED ENGINE CONTROLS

Multi-Point Injection (MPI) is a computerized engine control system, which controls fuel injection, ignition timing, idle speed and emission control systems.

ENGINE CONTROL MODULE (ECM)

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, ECM sends signals to various components, which control fuel injection, ignition timing, idle speed and emission control systems. For ECM location, see ECM LOCATION table.

ECM LOCATION TABLE

Application	Location
Chrysler Corp.	Behind Right Side Of Instrument Panel, Next To Blower Motor
Mitsubishi	
Diamante, Expo, Galant, Mirage, Montero & Pickup	Behind Right Side Of Instrument Panel
Eclipse & 3000GT	Behind Radio Console
Precis	Behind Left Side Of Instrument Panel

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

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 in this section. The following are available input devices.

Air Conditioner Switch

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

Airflow Sensor

Incorporated in airflow sensor assembly, airflow sensor is a Karmen vortex-type sensor which measures intake airflow rate. Intake air flows through tunnel in airflow sensor assembly. Airflow sensor transmits radio frequency signals across direction of incoming airflow, downstream of vortex. Intake air encounters vortex, causing turbulence in tunnel.

Turbulence disrupts radio frequency, causing variations in transmission. Airflow sensor converts frequency transmitted into a proportionate electrical signal, which is sent to ECM.

Airflow Sensor Assembly

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

Atmospheric (Barometric) Pressure Sensor

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

Closed Throttle Position Switch

Closed throttle position switch located in Throttle Position Sensor (TPS), senses whether accelerator pedal is depressed or not. High voltage (open) or low voltage (closed) signal is input to ECM, which then controls IAC motor based on input signal.

Coolant Temperature Sensor

Sensor converts coolant temperature to electrical signal for use by ECM. ECM uses coolant temperature information to control fuel enrichment when engine is cold.

Crankshaft Position & TDC Sensor Assembly

Assembly is located in distributor on SOHC engines. On DOHC engines, which use Direct (or Distributorless) Ignition System (DIS), assembly is a separate unit mounted in place of distributor. Assembly consists of triggering disc (mounted on shaft) and stationary optical sensing unit. Camshaft drives shaft, triggering optical sensing unit. ECM determines crankshaft position and TDC based on signals received from optical sensing unit.

Electrical Load Switch

Electrical load switch inputs on/off state of taillight relay, defogger relay and stoplight relay to ECM. ECM signals IAC to increase or decrease RPM depending on on/off state of relays.

Engine Speed (Tach Signal)

ECM uses ignition coil tach signal to determine engine speed.

Heated Oxygen Sensor (HO2S)

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

Idle Position Switch

On all DOHC engines, idle position switch is a separate switch mounted on throttle body. On all other models, idle position switch is incorporated in IAC motor or throttle position sensor, depending on vehicle application. When throttle valve is closed, switch is activated. When throttle valve is at any other position, switch is deactivated. This input from idle position switch is used by ECM for controlling fuel delivery time during deceleration.

Ignition Timing Adjustment Terminal

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

Inhibitor Switch (Automatic Transmission)

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

Intake Air Temperature Sensor

Sensor is incorporated in airflow sensor assembly. This resistor-based sensor measures temperature of incoming air and supplies air density information to ECM.

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

Motor Position Sensor (MPS)
Sensor is incorporated in IAC motor (or separate unit on some models). MPS senses IAC motor plunger position and sends electrical signal to ECM.

Oxygen (O2) Sensor
O2 sensor is located in exhaust system and generates an output voltage. Output voltage varies with oxygen content of exhaust gas stream. ECM adjusts air/fuel mixture based on signals from O2 sensor.

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

TDC Sensor
See CRANKSHAFT POSITION & TDC SENSOR ASSEMBLY under INPUT DEVICES.

Throttle Position Sensor (TPS)
TPS is a variable resistor mounted on throttle body. ECM uses voltage signal from TPS to determine throttle plate angle.

Vehicle Speed Sensor
Sensor is located in speedometer in instrument cluster, and uses a reed switch to sense speedometer gear revolutions. ECM uses gear revolutions to determine vehicle speed.

OUTPUT SIGNALS

NOTE: Vehicles are equipped with various combinations of computer-controlled components. Not all components listed below are used on every vehicle. For theory and operation on each output component, refer to system indicated after component.

Accelerator Pedal Position Sensor (APPS)
See MISCELLANEOUS CONTROLS.

Data Link Connector
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 Speed Control Servo
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.

Variable Induction Control (VIC) Motor Sensor
See MISCELLANEOUS CONTROLS.

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 Multi-Point Injection (MPI) 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, ECM applies voltage to fuel pressure control solenoid valve for 2 minutes after engine restart. 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). ECM controls amount of fuel metered through injectors based on information received from sensors.

IDLE SPEED

Air Conditioner Relay

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

Idle Air Control (IAC) Motor

Motor controls pintle-type air valve (DOHC engines) or throttle plate angle (SOHC engines) to regulate volume of intake air at idle.

During start mode, ECM controls idle intake air volume according to coolant temperature 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 coolant temperature input.

ECM 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.

Fast Idle Air Control Valve

Some models use a coolant temperature-sensitive fast idle air control valve, located on throttle body, to admit additional intake air volume during engine warm-up. Control valve closes as temperature increases, restricting by-pass airflow rate. At engine warm-up, valve closes completely.

IGNITION SYSTEMS

DIRECT IGNITION SYSTEM (DOHC ENGINES)

Depending on number of cylinders, ignition system is a 2 or 3-coil distributorless ignition system. Crankshaft position and TDC sensor assembly, mounted in place of distributor, are optically controlled.

Power Transistors & Ignition Coils

Based on crankshaft position and TDC sensor inputs, ECM 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.

ELECTRONIC IGNITION SYSTEM (SOHC ENGINES)

Breakerless electronic ignition system uses a disc and optical sensing unit to trigger power transistor.

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. ECM 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 ECM. ECM adjusts timing based on various conditions such as engine temperature, altitude and detonation (turbo).

EMISSION SYSTEMS

EXHAUST GAS RECIRCULATION (EGR) CONTROL

Federal (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 thermovalve 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 & Turbo

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

California models are equipped with an EGR temperature sensor. When EGR malfunction occurs, EGR temperature decreases and ECM illuminates MIL (CHECK ENGINE light).

EGR Control Solenoid Valve

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

Thermovalve

Thermovalve denies or allows vacuum supply to EGR valve based on coolant temperature.

EVAPORATIVE CONTROL

Fuel evaporation system prevents fuel vapor from entering atmosphere. System consists of the following: 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, ECM energizes purge control solenoid valve, allowing vacuum to purge valve.

Canister vapors are then drawn through purge 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.

HIGH ALTITUDE CONTROL (HAC)

HAC system compensates for variations in altitude. When

atmospheric (barometric) pressure sensor determines vehicle is at altitude greater than preset value, ECM compensates by adjusting air/fuel mixture and ignition timing. If HAC system is inoperative, there will be an increase in 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.

MISCELLANEOUS CONTROLS

NOTE: Although not considered true engine performance-related systems, some controlled devices may affect driveability if they malfunction.

ACCELERATOR PEDAL POSITION SENSOR (APPS)

ECM supplies one end of APPS resistor with a 5-volt signal. The other end of resistor is grounded at ECM. Accelerator pedal position sensor converts amount accelerator pedal is depressed into variable voltage input to traction control module for traction control.

VARIABLE INDUCTION CONTROL (VIC) MOTOR SENSOR

ECM controls VIC valve opening or closing. VIC valve controls length of intake air path to intake manifold. VIC valve closes at higher RPM to shorten intake air path and opens at lower RPM to lengthen intake air path. The result is more engine torque in a wider RPM range.

SELF-DIAGNOSTIC SYSTEM

NOTE: ECM 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 ECM is disconnected.

Self-diagnostic system monitors input and output signals through the data link connector. On all models, codes can be read using analog voltmeter. Scan tester can be used to read codes on some models. For additional information, see G - TESTS W/ CODES article in this section.

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, ECM 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 ECM detects malfunction during system operation.