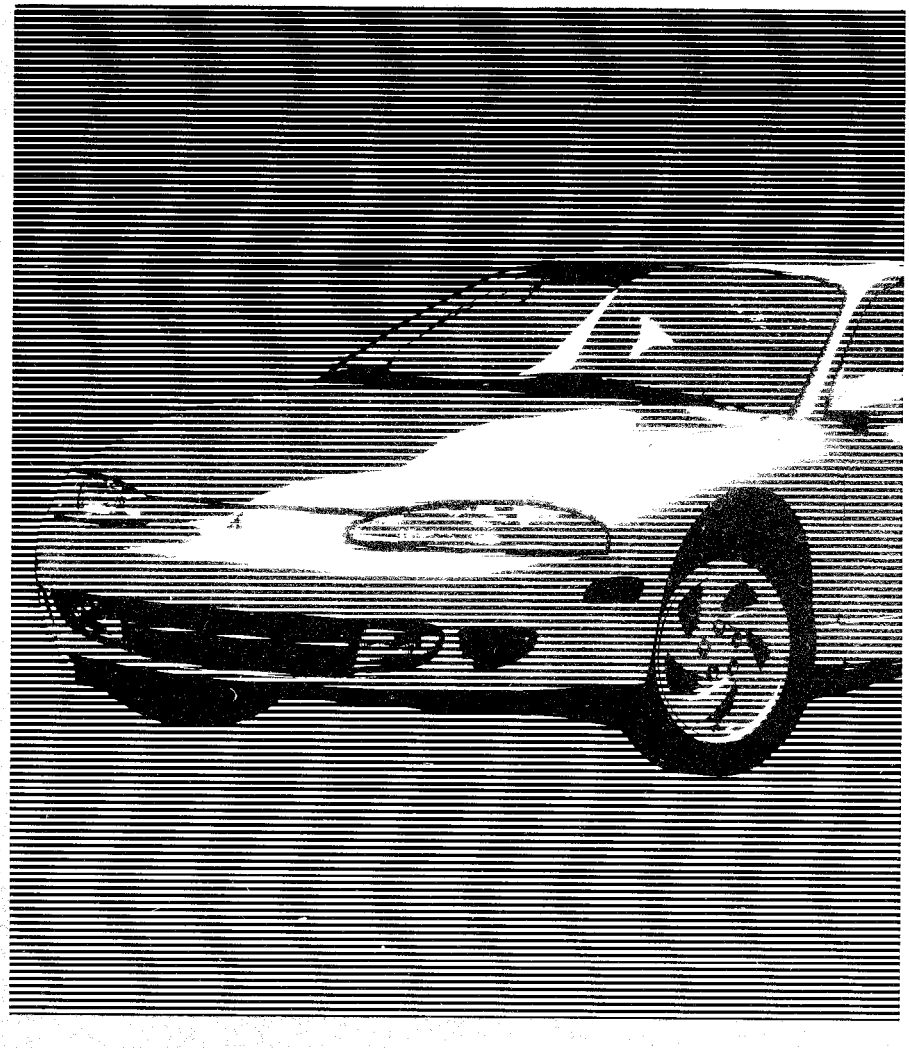
MITSUBISHI MOTORS

Technical Information Manual



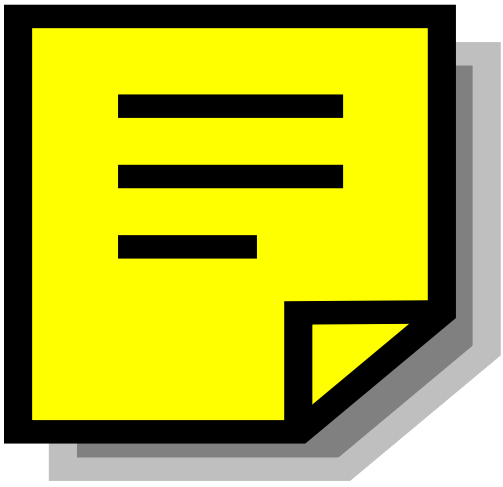
ECLIPSE

ECLIPSE

TECHNICAL INFORMATION MANUAL

FOREWORD

This manual has been prepared as an introduction to the specifications, features, construction and functions of the newly developed ECLIPSE.
Please read this manual carefully as it will be of assistance for service and sales activities.
Please note that the service manuals are also available and should be used in conjunction with this manual.
All information, illustrations and product descriptions contained in this manual are current as at the time of publication. We, however, reserve the right to 'make changes at any time without prior notice or obligation.



MITSUBISHI MOTOR SALES OF AMERICA, Inc.

Mitsubishi Motors Corporation reserves the right to make changes in design or to make additions to or improvements in its products without imposing any obligations upon itself to install them on its products previously manufactured.

0 1994 Mitsubishi Motors Corporation Printed in U.S.A.

GROUP INDEX

GENERAL 0
ENGINE 1
POWER-TRAIN 2
DRIVE-CONTROL COMPONENTS ... 3
BODY 4
EXTERIOR 5
INTERIOR 6
EQUIPMENT 7

MODEL INDICATIONS

N70ZA01AA

The following abbreviations are used in this manual for classification of model types.

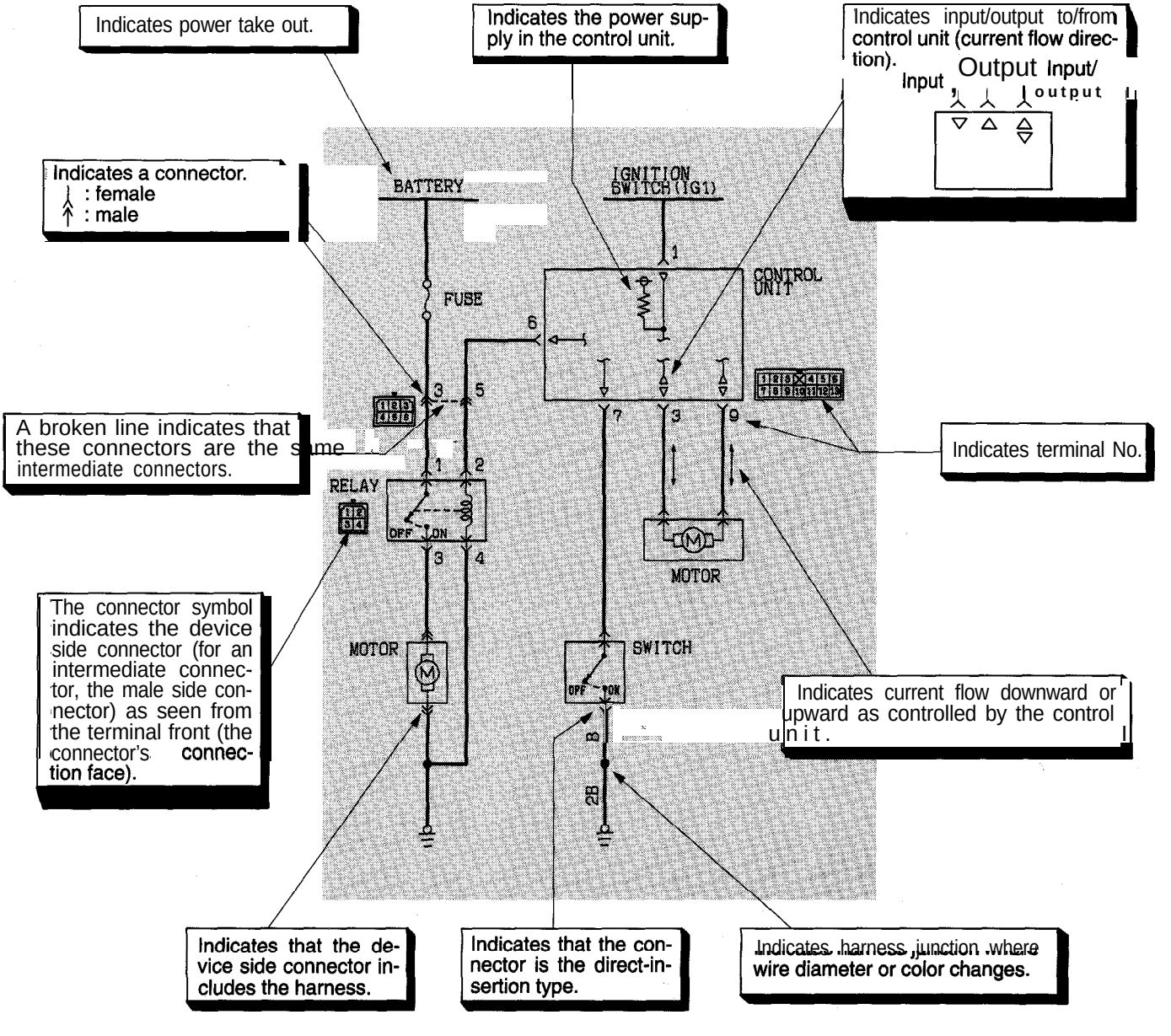
M/T:	Indicates the manual transaxle, or models equipped with the manual transaxle.
A/T:	Indicates the automatic transaxle, or models equipped with the automatic transaxle.
MFI:	Indicates the multiport fuel injection, or engines equipped with the multi-point injection.
DOHC:	Indicates an engine with the double overhead camshaft, or a model equipped with such an engine.
Turbo:	Indicates an engine with turbocharger, or a model equipped with such an engine.
Non-Turbo:	Indicates an engine without turbocharger, or a model equipped with such and engine.
FWD:	Indicates the front wheel-drive vehicles.
AWD:	Indicates the all wheel-drive vehicles.

HOW TO READ A CIRCUIT DIAGRAM

N70ZBOOAA

Circuit diagrams are prepared as follows using these symbols:

NOTE
For specific details concerning the interpretation of circuit diagrams, refer to the separately bound Service Manual.



GENERAL

CONTENTS

N70AA00AA

DESIGN FEATURES 3

GENERAL DATA AND SPECIFICATIONS ... 17

TARGETS OF DEVELOPMENT 2

TECHNICAL FEATURES 4

- Aerodynamic Characteristics 5
- Body Dimensions 4
- Engine ..... .
- Environmental Considerations 12
- Heater and Air Conditioning 12
- Passive Safety 10
- Steering Stability, Ride Comfort and Active Safety 8
- Theft-alarm System 11

VEHICLE IDENTIFICATION 14

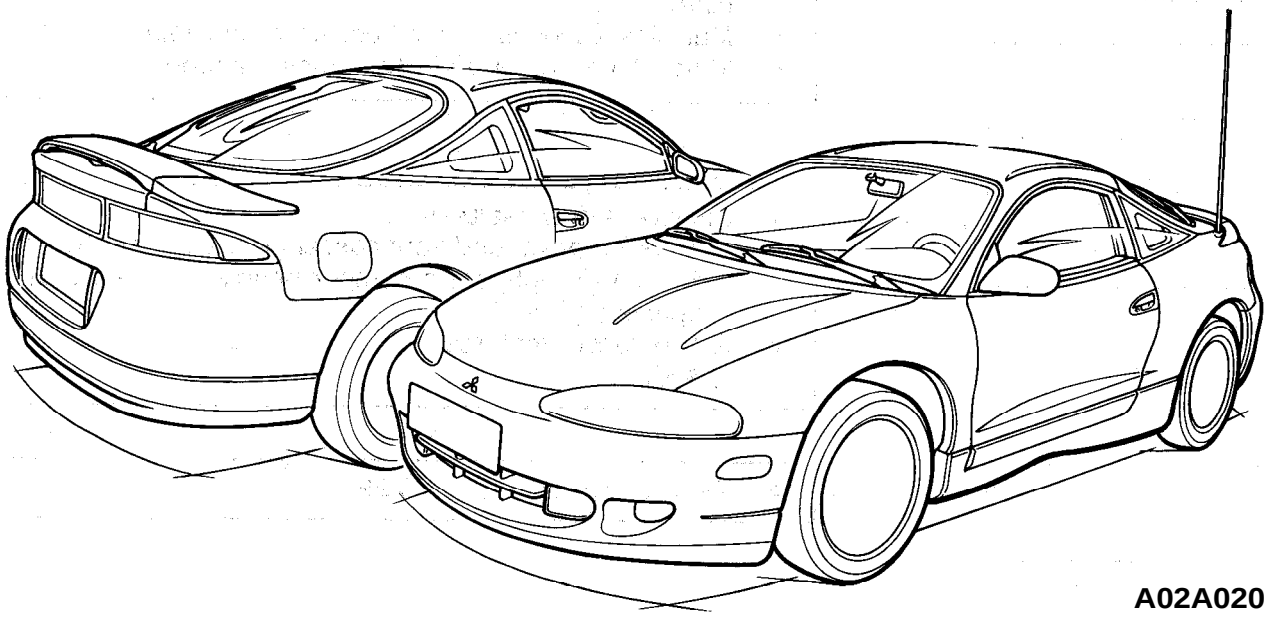
- Engine Model Stamping 16
- Vehicle Identification Code Chart Plate 14
- Vehicle Identification Number List 14
- Vehicle Identification Number Location 14
- Vehicle Information Code Plate 15
- Vehicle Safety Certification Label 15

TARGETS OF DEVELOPMENT

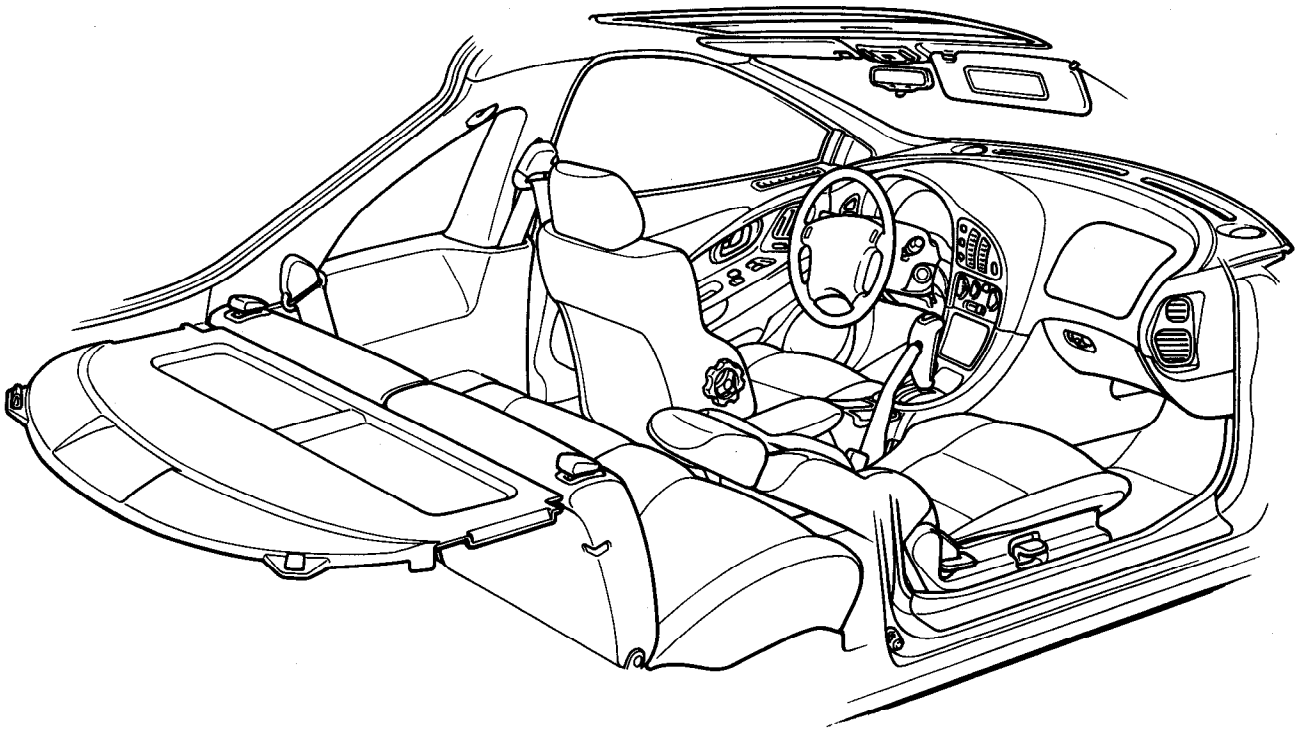
N70ABOOAA

While the ECLIPSE has been finding wide acceptance as a compact sporty vehicle since its introduction early in 1989, Mitsubishi Motors Corporation has introduced further improvements with major accent on the following points to meet the market needs and make the ECLIPSE a top car in its class.

- Styling
  1. Organic and aerodynamic.
  2. Wide and low proportions.
- Fun to drive
  1. Quick acceleration and powerful response (All models equipped with DOHC engine)
  2. Outstanding straight ahead stability and linear steering response (4-wheel multi-link suspension adopted)
  3. Outstanding braking performance
- Value for money
  1. Rich array of features at low price
  2. Low fuel consumption and low repair cost



A02A020



B21B027

DESIGN FEATURES

N70AC00AA

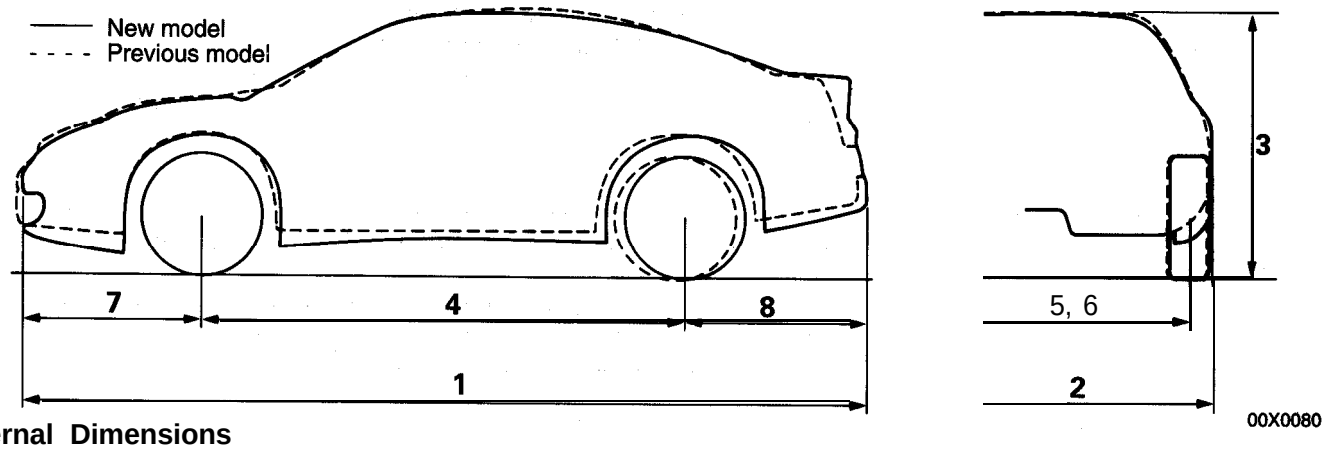
Unique styling	• Forward extended cabin for roomy cabin and sporty styling • Wide and low proportion body • Aerodynamic oriented styling
New techniques	• Chrysler-manufactured 2.0 lit. DOHC engine (420A engine) • Multi-link suspension for both front and rear • Motor-driven outer slide type glass sunroof
Higher safety	• Passive safety features SRS (for driver and front passenger), side door beams, 8 km/h (5 mph) resin bumper beams, flame-retardant upholstery, etc. • Active safety features ABS
Aerodynamic characteristics	• World's top level Cd = 0.29

TECHNICAL FEATURES

BODY DIMENSIONS

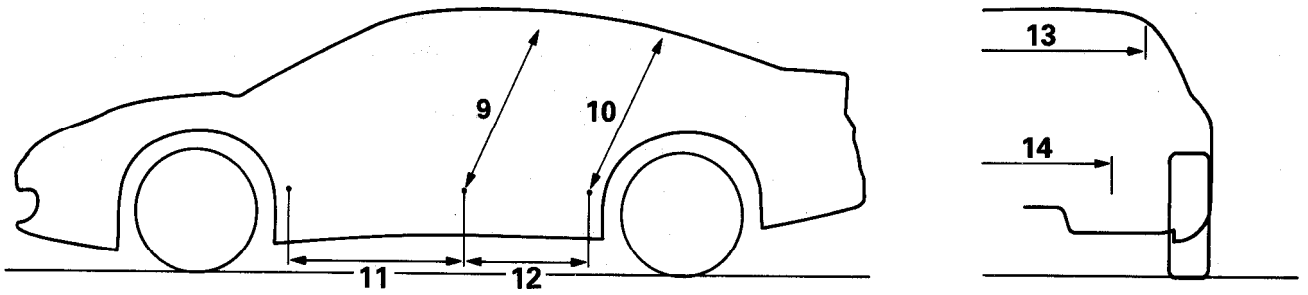
N70ADO2AA

External Dimensions



00X0080

Internal Dimensions



00X0081

mm (in.)

Items		No.	New model	Difference between previous and new models
External dimensions	Overall Length	1	4,375 (172.2)	-15 (-59)
	Overall Width	2	1,735 (68.3) 1,745 (68.7)*'	+40 (+1.57) +50 (+1.97)"'
	Overall Height	3	1,295 (51.0) 1,310 (51 .6)*2	-11 (-.43) -4 (-. 15)*2
	Wheelbase	4	2,510 (98.8)	+40 (+1.57)
	Tread (front)	5	1,515 (59.6)	+50 (+1.97)
	Tread (rear)	8	1,510 (59.4)	+60 (+2.36)
	Overhang (front)	7	930 (36.6)	-45 (-1.77)
	Overhang (rear)	8	935 (38.8)	-10 (-.39)

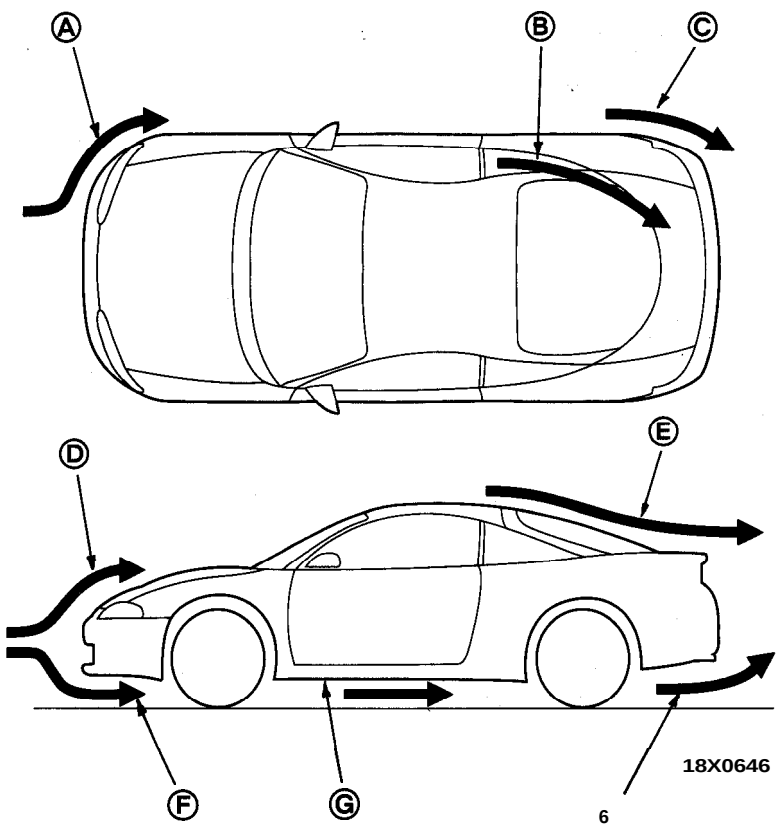
NOTES
*I denotes a vehicles with side air dam.
*2 denotes AWD.

Items		No.	New model	Difference between previous and new models
Internal dimensions	Head Room 8 (front)	9	860 (33.9)	0
	Head Room 8 (rear)	10	785 (30.1)	0
	Brake Pedal Room	11	940 (37.0)	+15 (+.59)
	Hip Point Couple	12	635 (25.0)	0
	Front Hat Room	13	1,080 (41.7)	0
	Front Hip Point Couple	14	714 (28.1)	0

AERODYNAMIC CHARACTERISTICS

N70ADOUA

Many Cd reduction design features, including tapering at body corners, has raised ECLIPSE's aerodynamic characteristics to the top level of the class (Cd = 0.29).



Ⓐ Tapered front side corners
Ⓑ Tapered rear pillar area
Ⓒ Tapered rear side corners
Ⓓ Slanted and rounded engine hood end
Ⓔ Smaller rear window inclination angle for smoother air flow
Ⓕ Venturi skirt
Ⓖ Smoother and more flush underfloor surface
Ⓗ Raised rear floor plane

- Greater contribution to fuel economy during high-speed operation
- Higher directional stability during high-speed operation

ENGINE

N70AEOOAA

Two basic DOHC engines are available.

420A Engine

On non-turbocharged models, the Chrysler-manufactured 2.0 lit. DOHC 16-valve engine increases domestic parts content. The engine and transaxle unit, unlike the conventional MMC engine, is arranged with the engine on the passenger side and the transaxle on the driver's side.

4G63 Engine

N70AEOIAA

On turbocharged models, new techniques and improvements have been embodied in the 4G63 engine to provide better performance and lower fuel consumption.

NEW TECHNIQUES AND IMPROVEMENTS

Items	Aims					
	Smaller size and lighter weight	Higher performance and efficiency	Less noise	Resource and energy saving	Higher dependability and easier maintenance	Tighter exhaust emission control and better driveability
Higher compression ratio		x		x		
Better turbocharger performance		x				
Small-size pressure type Karman air flow sensor adopted	x	x				
Higher intercooler efficiency	x	x				
Cylinder head intake port is tumble-type		x		x		x
2-spray injector adopted		x		x		x
Optimized injector direction and timing		x		x		x
Engine coolant temperature inlet control system		x			x	
48 Kbyte computer adopted		x				x
Resonance type knock sensor adopted		x			x	x
Stainless steel exhaust manifold adopted					x	
Dual oxygen sensor system adopted						x
Oxygen sensor mounted to front exhaust pipe					x	
Piston top land height reduced						x
ECM-controlled EGR adopted						x
ECM-controlled fuel vapor control system adopted						x
Generator control improved		x				

NOTE:
x: Applicable

Items	Aims					
	Smaller size and lighter weight	Higher performance and efficiency	Less noise	Resource and energy saving	Higher dependability and easier maintenance	Tighter exhaust emission control and better driveability
Cooling fan controlled by ECM (Total Control System)		x				
Integrated control of A/T					x	x
Higher accuracy coolant temperature sensor	x			x	x	
Crank angle sensor using Hall IC directly mounted to crankshaft	x	x				
Cylinder block reinforced			x			
Turbocharger piping revised					x	
Small-size and light-weight air cleaner made of resin which allows the air to pass with less resistance	x			x	x	
Dual mode damper			x			
Air bypass valve position optimized			x			
Power steering belt changed to V ribbed style			×			
Oil level gauge grip changed to resin					×	
Scan tool (MUT-II) compatible					×	

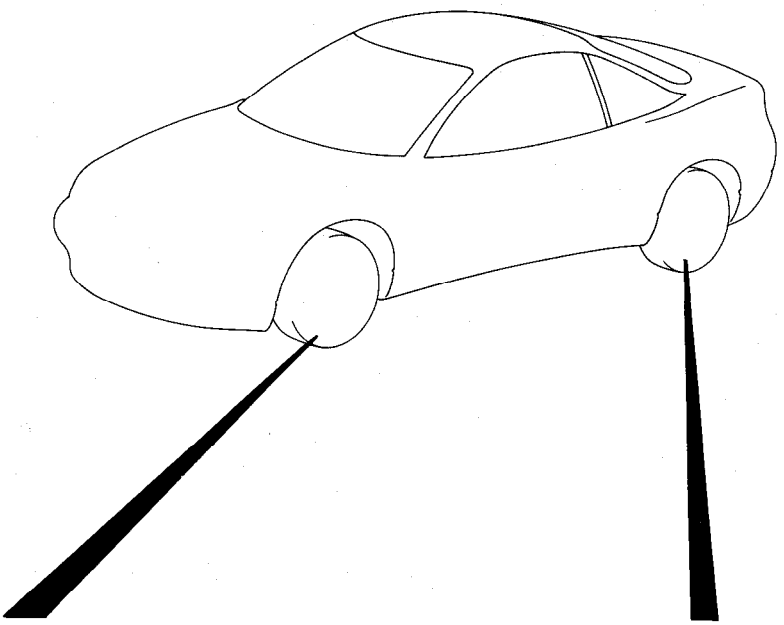
NOTE:
x: Applicable

STEERING STABILITY, RIDE COMFORT AND ACTIVE SAFETY

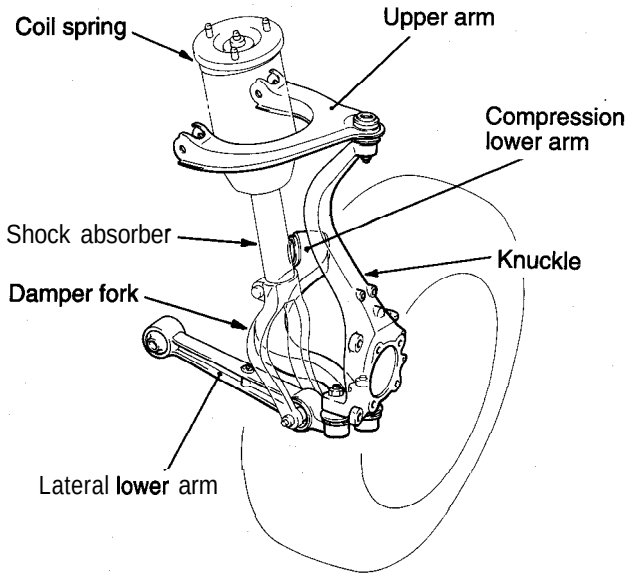
N70AFOOAA

Multi-link Suspension for Four Wheels

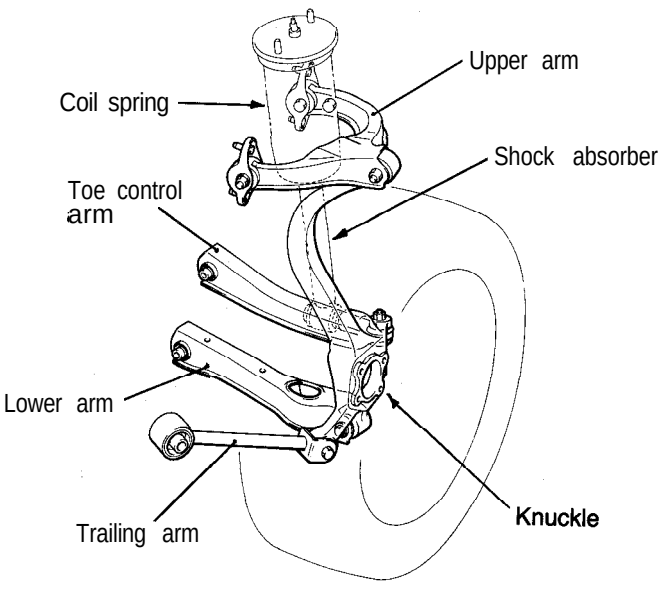
A multi-link suspension similar to the 1994 Galant's, has been adopted for both the front and rear wheels. As a result, the straight line running characteristics and stability have significantly improved, assuring outstanding directional stability without penalty on riding comfort.



18X0621



12X0161



12X0106

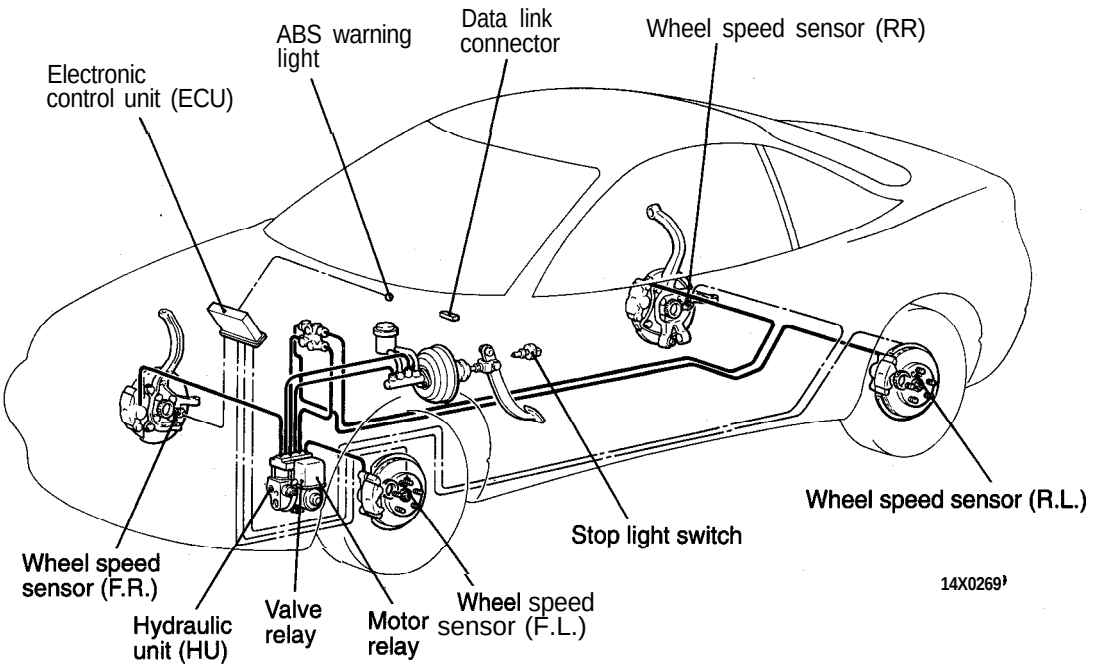
ABS

N7OAFOIAA

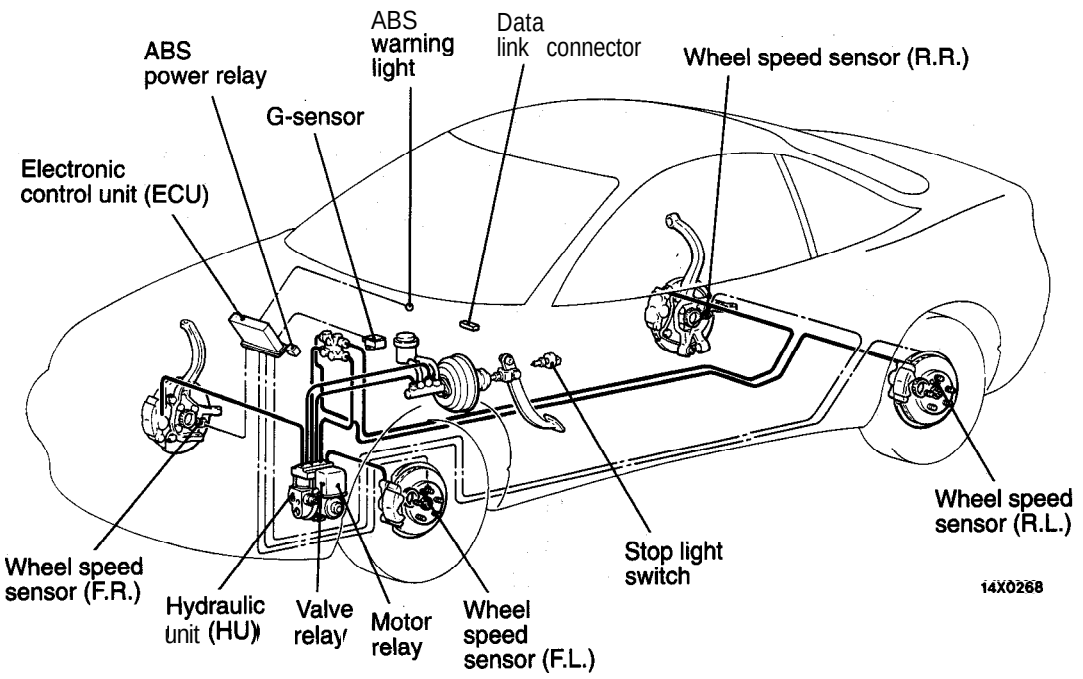
ABS is an option for all models to improve braking stability and safety.

For the FWD vehicles, the 4-sensor, 3-channel configuration is adopted for independent control of the front right and left wheels and integrated control (Select Low control) of the rear wheels. For AWD vehicles, the 4-sensor, 2-channel configuration is adopted for Select Low control of all the front and rear wheels.

<FWD>



<AWD>

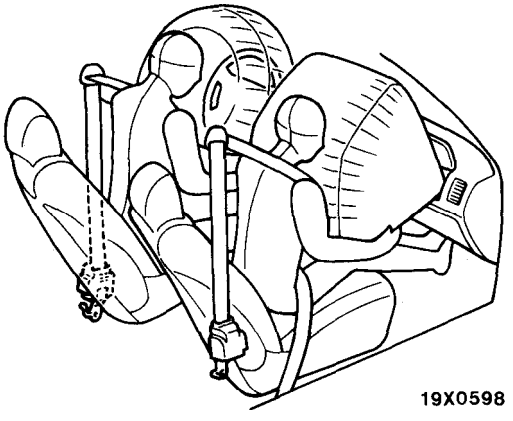


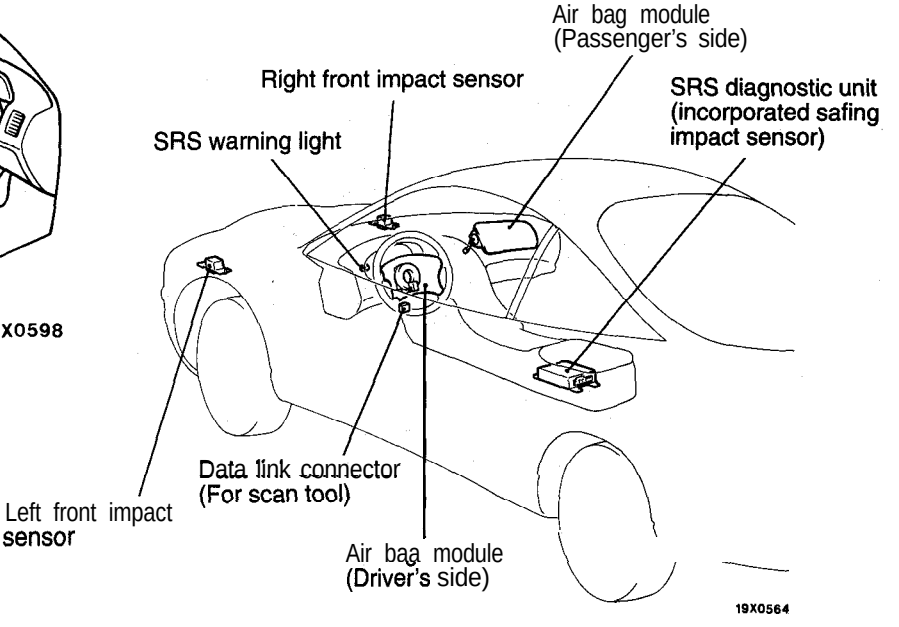
PASSIVE SAFETY

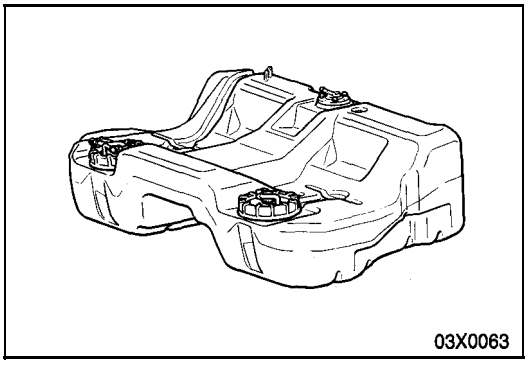
N70AGOOAA

Supplemental Restraint System (SRS)

An airbag module has been provided for both the driver's and front passenger's seats for safety of the driver and front passenger. The driver's seat airbag module is mounted at the center of the steering wheel, whereas the front passenger's seat airbag module is mounted in the instrument panel above the glove compartment. As soon as a frontal collision over a design G-force is detected, the airbags inflate.







Plastic fuel tank

The AWD models are equipped with a plastic fuel tank which is highly resistant to shocks and offers good space efficiency. The fuel tank is installed under the floor for higher safety.

Flame-retardant upholstery

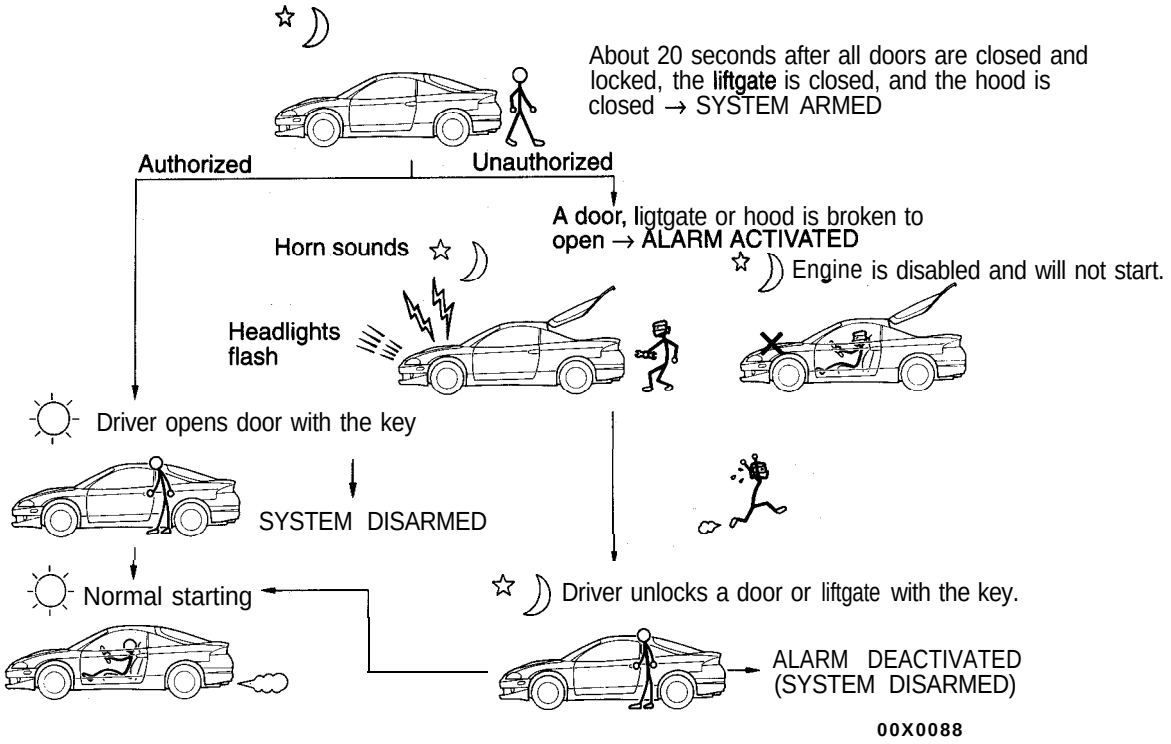
Flame-retardant materials have been used for interior upholstery wherever possible.

THEFT-ALARM SYSTEM

N70AHOOAA

For theft protection, this system is so designed that the headlights go on and off and the horn is sounded intermittently for about three minutes when a locked door, hood or liftgate has been forced open without using a key.

Furthermore, the starter circuit is interrupted so that the engine may not be operated.

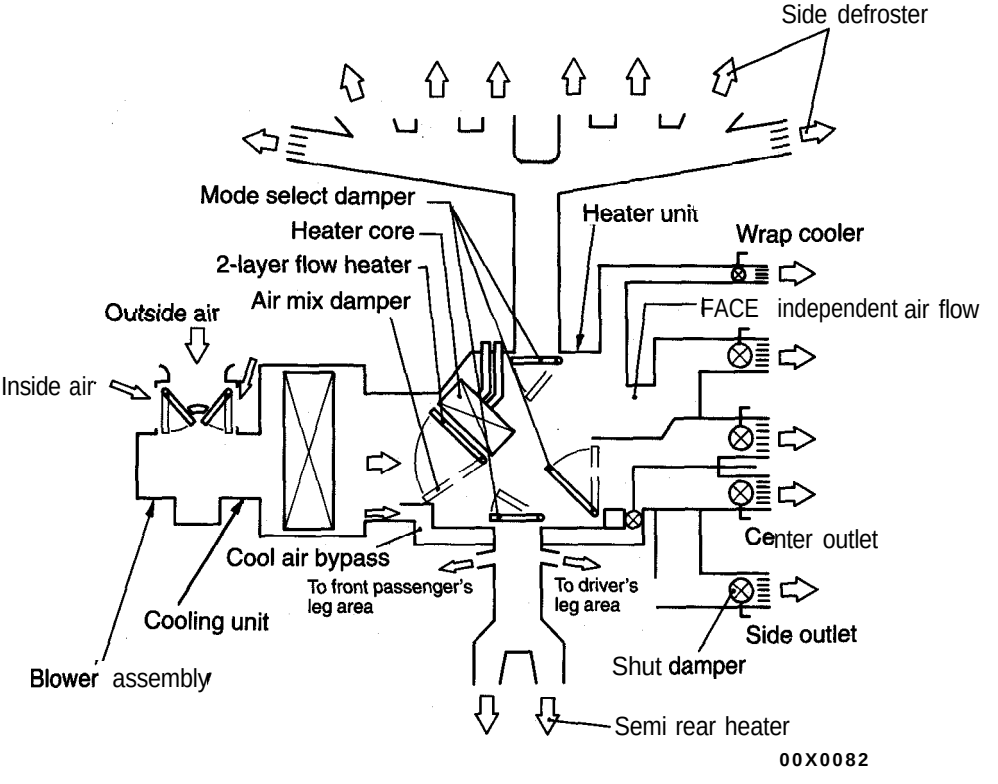


HEATER AND AIR CONDITIONING

N7OAIOOAA

The heater system uses a two-way-flow full-air-mix system that features high performance and low operating noise, and includes an independent face air blowing function and a cool air bypass function.
Side defrosters have been provided in the door section to improve demister performance.
For the rear seat, a semi rear heater duct has been provided for better heating.

The air conditioning system is essentially the same as the conventional one, but it incorporates a new CFC-free refrigerant (R134a) system that uses hydro fluorocarbon (HFC) containing hydrogen atoms as the refrigerant gas to meet the CFC control regulations that call for protection of the ozone layer.



ENVIRONMENTAL CONSIDERATIONS

N70AJ00AA

To meet the growing world-wide demands for saving resources and protecting global environment, special considerations have been incorporated to make the ECLIPSE friendly to driver and passengers and to the earth.

Considerations for recycling

(1) Recyclable thermo-plastic material has been extensively used.
(2) The names of the material have been marked on the plastic parts to facilitate recycling.
(3) Recycled materials (regenerated materials) have been used wherever possible.

Protection of global environment

(1) Use of non-asbestos material for gaskets and pads
(2) Non-Freon parts
- Use of Freon has been limited to the necessary minimum in the processes for manufacture of seats, steering wheels, etc.

(3) Extending material life expectancies for less waste
- Anti-rust steel sheets have been used for about 80% of the outer panels and major members of the body.
- Longer-life brake fluid and coolant additives are used

(4) Better fuel economy by reducing friction and weight in various areas

Use of maintenance-free parts

(1) Auto-lash adjusters have eliminated the need for adjustment of valve clearance.
(2) An auto-tensioner has been adopted to eliminate the need for adjustment of the timing belt tension.
(3) The improved mounting accuracies of the camshaft position sensor and crank angle sensor have eliminated the need for adjustment of ignition timing.
(4) The plastic region angle method has been adopted for tightening the cylinder head bolts.

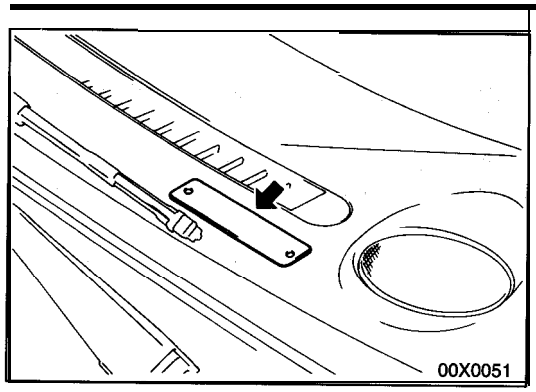
Increased diagnostic items

The diagnostic functions for the following system have been added so that the diagnostic trouble codes and service data for them can be read and actuator tests performed by use of the Scan tool (MUT-II).

- MFI
- *Auto-cruise control
- ELC-4A/T
- ABS
- SRS

Better serviceability and easier handling

(1) The engine oil and ATF level gauge grips have been changed to resin ones for easier handling. The name has been marked on each grip for identification.
(2) The fuel gauge unit and related parts have been made demountable and remountable through the service hole under the rear seat cushion.
(3) Both the front and rear hubs have been bolted to the knuckles for easier demounting and remounting.
(4) When an ABS wheel speed sensor is mounted, there is no need for adjustment of the clearance between the sensor and rotor.
(5) Headlight aiming adjustment can be easily performed from above the light, using a cross-pointed screwdriver.
(6) An electric type speedometer has been adopted for easier demounting and remounting of the speedometer, instrument panel, transaxle, etc.
(7) The luggage compartment floor board can be held raised so that the spare wheel, tools, etc. can be conveniently taken out and stored.



VEHICLE IDENTIFICATION

N00AC00AB

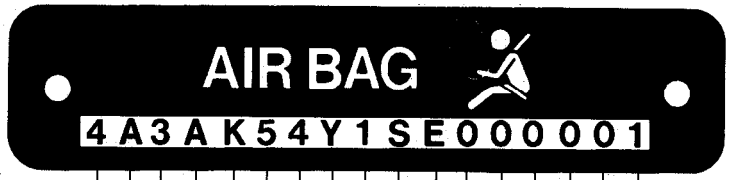
VEHICLE IDENTIFICATION NUMBER LOCATION

The vehicle identification number (V.I.N) is located on a plate attached to the left top side of the instrument panel.

VEHICLE IDENTIFICATION CODE CHART PLATE

N00AC01AB

All vehicle identification numbers contain 17 digits. The vehicle number is a code which tells country, make, vehicle type, erc.



00X0072

1st Digit	2nd Digit	3rd Digit	4th Digit	5th Digit	6th Digit	7th Digit	8th Digit	9th Digit	10th Digit	11th Digit	12th to 17th Digits
Country	Make	Vehicle type	Others	Line	Price class	Body	Engine	'Check digits	Model year	Plant	Serial number
USA	A– Mitsubishi	3– Passenger car	A– Driver and Passenger Air Bags	K– ECLIPSE FWD L– ECLIPSE AWD	3– Medium 4– High 5– Premium	1– 3-door Hatch-back	Y– 2.0 dm³ (122.0 cu.in.) [DOHC-MFI] F– 2.0 dm³ (122.0 cu.in.) [DOHC-MFI-Turbo]	1 2 3 . . . . . . 9 X	S– 1995 Year	E– DSM Plant	000001 to 999999

NOTE

• "Check digit" means a single number or letter X used to verify the accuracy of transcription of vehicle identification number.

VEHICLE IDENTIFICATION NUMBER LIST 4995 MODEL>

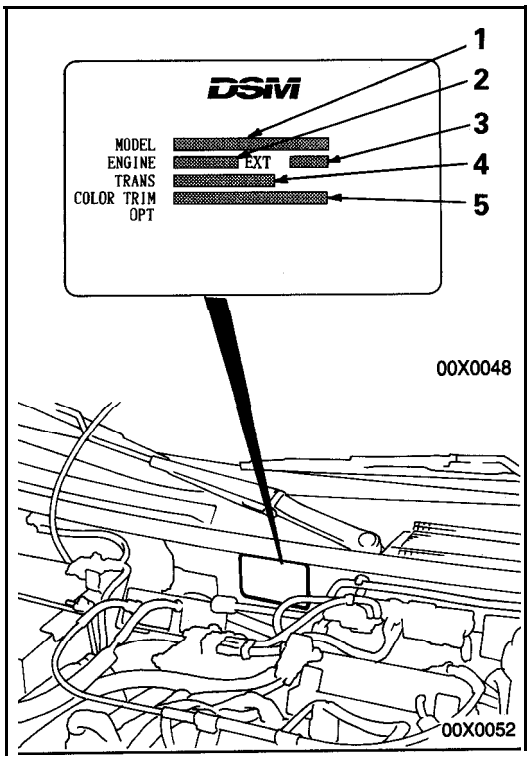
N00AC02A

VEHICLES FOR FEDERAL

V.I.N. (except sequence number)	Brand	Engine Displacement	Model Code
4A3AK34Y□SE	Mitsubishi Eclipse <FWD>	2.0 dm³ (122.0 cu.in.) [DOHC-MFI (420A)]	D31AMNJML4M D31AMRJML4M
4A3AK44Y□SE			D31 AMNHML4M D31AMRHML4M
4A3AK54S□SE	Mitsubishi Eclipse <FWD>	2.0 dm³ (122.0 cu.in.) [DOHC-MFI-Turbo (4G63)]	D32AMNGFL4M D32AMRGFL4M
4A3AL54S□SE	Mitsubishi Eclipse <AWD>		D33AMNGFL4M D33AMRGFL4M

VEHICLES FOR CALIFORNIA

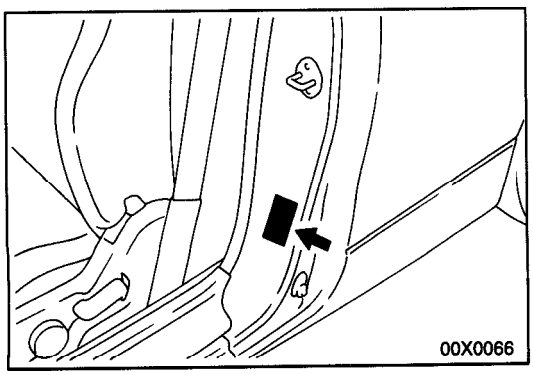
V.I.N. (except sequence number)	Brand	Engine Displacement	Model Code
4A3AK34Y□SE	Mitsubishi Eclipse <FWD>	2.0 dm³ (122.0 cu.in.) [DOHC-MFI (420A)]	D31AMNJML9M D31AMRJML9M
4A3KF44Y□SE			D31AAMNHML9M D31AMRHML9M
4A3AK54S□SE	Mitsubishi Eclipse <FWD>	2.0 dm³ (122.0 cu.in.) [DOHC-MFI-Turbo (4G63)]	D32AMNGFL9M D32AMRGFL9M
4A3AL54S□SE	Mitsubishi Eclipse <AWD>		D33AMNGFL9M D33AMRGFL9M



VEHICLE INFORMATION CODE PLATE N00AC03AB

Vehicle information code plate is riveted onto the bulkhead in the engine compartment.
The place shows model code, engine model, transaxle model, and body color code.

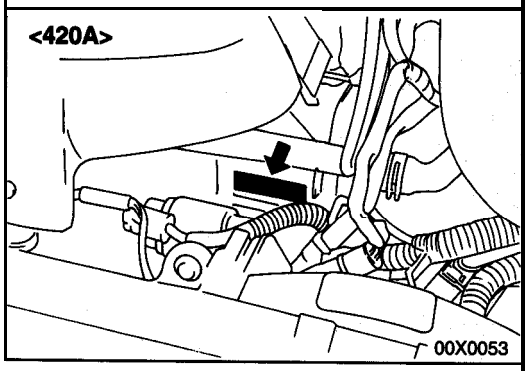
1. MODEL **D32AM RGFL4M**
   - **D32AM** — Vehicle model
   - **RGFL4M** — Model series
2. ENGINE **4G63** — Engine model
3. EXT **CA6A** — Exterior code
4. TRANS **F4A33** — Transaxle model
5. COLOR TRIM OPT R25 **67V 03V**
   - R25 — Body color code
   - **67V** — Interior code
   - **03V** — Equipment code

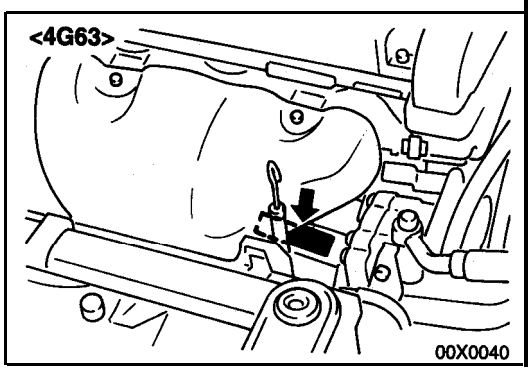


VEHICLE SAFETY CERTIFICATION LABEL

N00ACOSAB

1. The vehicle safety certification label is attached to face of left door pillar.
2. This label indicates Gross Vehicle Weight Rating (G.V.W.R.), Gross Axle Weight Rating (G.A.W.R.) front, rear and Vehicle Identification Number (V.I.N.).





ENGINE MODEL STAMPING

N00AC06AB

1. The engine model number is stamped at the front side on the top edge of the cylinder block as shown in the following.

Engine model	Engine displacement
420A	2.0 dm^3 (122.0 cu.in.)
4G63	2.0 dm^3 (122.0 cu.in.)

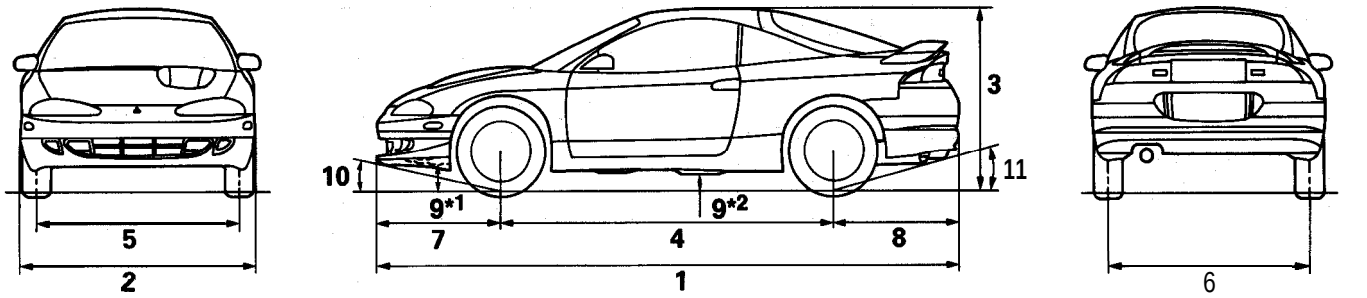
2. The 4G63 engine serial number is stamped near the engine model number, and the serial number cycles, as shown below.

Engine serial number	Number cycling
AA0201 to YY9999	AA0201 - - → AA9999 AB0001 - - → AY9999 BA0001 - - → YY9999

3. The 420A engine serial number and identification number are stamped near the engine model number.

GENERAL DATA AND SPECIFICATIONS

N00AH00AB



GENERAL SPECIFICATIONS

<FWD>

Items \ Model code		D31A				D32A	
		MNJML4M MNJML9M	MRJML4M MRJML9M	MNHML4M MNHML9M	MRHML4M MRHML9M	MNGFL4M MNGFL9M	MNGFL4M MNGFL9M
Vehicle dimensions mm (in.) Overall length	1	4,375 (172.2)					
Overall width	2	1,735 (68.3), 1,745 (68.7)*3				1,745 (68.7)	
Overall height (Unladen)	3	1,295 (51 .0)					
Wheel base	4	2,510 (98.8)					
Tread Front	5	1,515 (59.6)					
Rear	6	1,510 (59.4)					
Overhang Front	7	930 (36.6)					
Rear	8	935 (36.8)					
Minimum running ground clearance	9	145 (5.7)					
Angle of approach degrees	10	11.5					
Angle of departure degrees	11	15.8					
Vehicle weight kg (lbs.) Curb weights		1,235 (2,722)	1,270 (2,800)	1,280 (2,822)	1,315 (2,899)	1,305 (2,877)	1,340 (2,954)
Gross vehicle weight rating		1,690 (3,726)		1,750 (3,858)			
Gross axle weight rating Front		1 ,010 (2,227)				1,025 (2,260)	
Rear		800 (1,764)				775 (1,709)	
Seating capacity		4					
Engine Model No.		420A (DOHC)				4G63 (DOHC)	
Piston displacement cm³ (cu.in.)		1,996 (121.8)				1,997 (121.9)	
Transaxle Model No. Type		F5MC1 5-speed manual	F4AC1 4-speed automatic	F5MC1 5-speed manual	F4AC1 4-speed automatic	F5M33 5-speed manual	F4A33 4-speed automatic
Fuel system Fuel supply system		Electronic control multiport fuel injection					

NOTE
- 3 denotes a vehicles with side air dam.

<AWD>

Items	Model code		D33A	
			MNGFL4M MNGFL9M	MRGFL4M MRGFL9M
Vehicle dimensions	mm (in.)			
Overall length		1	4,375 (172.2)	
Overall width		2	1,745 (68.7)	
Overall height (Unladen)		3	1,310 (51.6)	
Wheel base		4	2,510 (98.8)	
Tread	Front	5	1,515 (59.6)	
	Rear	6	1,510 (59.4)	
Overhang	Front	7	930 (36.6)	
	Rear	8	935 (36.8)	
Minimum running ground clearance		9	145 (5.7)	
Angle of approach	degrees	10	12.2	
Angle of departure	degrees	11	16.2	
Vehicle weight	kg (lbs.)			
Curb weights			1,415 (3,120)	1,450 (3,197)
Gross vehicle weight rating			1,850 (4,079)	
Gross axle weight rating				
Front			1,050 (2,315)	
Rear			850 (1,874)	
Seating capacity			4	
Engine				
Model No.			4G63 (DOHC)	
Piston displacement	cm^3 (cu.in.)		1,997 (121.9)	
Transaxle				
Model No.			W5M33	W4A33
Type			5-speed manual	4-speed automatic
Fuel system				
Fuel supply system			Electronic control multiport fuel injection	

ENGINE

CONTENTS

N71ZA00AA

ENGINE <NON-TURBO> 2
ACCELERATION SYSTEM 62
Accelerator Pedal and Accelerator Cable 62
Auto-cruise Control System 63
BASE ENGINE 3
Automatic Tensioner 5
Camshaft 4
Connecting Rods 4
Crankshaft.. 4
Crankshaft and Camshaft Timing 5
Cylinder Block and Bed-plate 3
Cylinder Head 3
Oil Pan 7
Oil Pump 7
Piston 3
CONTROL SYSTEM 13
Actuators and Control 26
Data Transmission System.. 52
Diagnostic System 31
General Information 13
Sensors 16
COOLING SYSTEM 6
Coolant Flow 8
Specifications 9
EMISSION CONTROL SYSTEM 57
Evaporative Emission Control System 59
Exhaust Gas Recirculation (EGR) System 60
General Information 57
Positive Crankcase Ventilation System 58
Pulsed Secondary Air Injection System 59
ENGINE ELECTRICAL 56
Generator 56
Ignition System 56
Starter Motor 56
FUEL SYSTEM 11
Configuration Diagram 11
Fuel Flow Diagram 11
Fuel Tank 12
GENERAL INFORMATION 2
Lubrication System 2
Major Specifications 2
INTAKE, AND EXHAUST 10
Exhaust Pipe 10
Intake Manifold and Exhaust Manifold 10
MOUNT 61
Features.. 61
ENGINE <TURBO> 64
ACCELERATION SYSTEM 68
Accelerator Pedal and Accelerator Cable 88
Auto-cruise Control System 88
CONTROL SYSTEM 70
Actuators and Control 74
Diagnostic System 78
General Information 70
Main monitors 83
Sensors 73
COOLING SYSTEM 65
Coolant FLOW 5
Specifications 66
EMISSION CONTROL SYSTEM 85
Exhaust Gas Recirculation (EGR) System 86
General Information 85
ENGINE ELECTRICAL 85
FUEL SYSTEM 68
Configuration Diagram 68
Fuel Flow Diagram 68
Fuel Tank 69
GENERAL INFORMATION 64
Major Specifications 84
INTAKE AND EXHAUST 67
Exhaust Pipe 67
Intake Manifold and Exhaust Manifold 67
MOUNT 87

ENGINE <NON-TURBO>

GENERAL INFORMATION

N71AA01AA

This 420A 2.0-liter engine is a product of Chrysler Corporation. It is not equipped with a turbocharger.

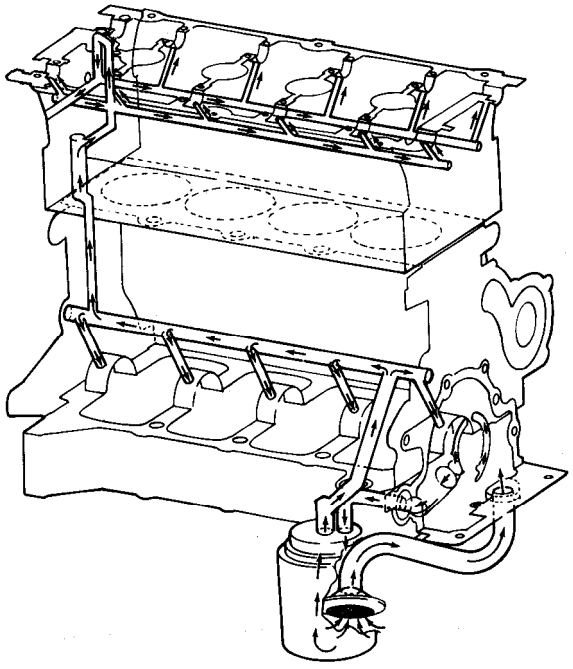
MAJOR SPECIFICATIONS

Items	Specifications
Total displacement cm³ (cu.in.)	1,996 (121.8)
Bore x Stroke mm (in.)	87.5 (3.45) x 83.0 (3.27)
Compression ratio	9.6
Camshaft arrangement	DOHC
Valve timing At 0.5 mm (.0197 in.) lift	
Intake	
Open	1.3" BTDC
Close	39.7" ABDC
Exhaust	
Open	36" BBDC
Close	1.1" ATDC
Rocker arm	Roller type
Lash adjuster	Equipped

LUBRICATION SYSTEM

N71AA02AA

System is full flow filtration, pressure feed type. The oil pump is mounted in the front engine cover and driven by the crankshaft. Pressurized oil is then routed through the main oil gallery, running the length of the cylinder block, supplying main and rod bearings with further routing. Pistons are lubricated from rod bearing throw-off and slinger slots on the connecting rod assemblies. Camshaft and valve mechanisms are lubricated from a full-length cylinder head oil gallery supplied from the crankcase main oil gallery.



CEN0098

BASE ENGINE

CYLINDER HEAD

N71AB01AA

Features a Dual Over Head Camshaft (DOHC) 4-valves per cylinder cross flow design. The valves are arranged in two inline banks. Incorporated powder metal valve guides and seats. Integral oil galleys within the cylinder head supplies oil to the hydraulic lash adjusters, camshaft and valve mechanisms.

CYLINDER BLOCK AND BED-PLATE

N71AB02AA

Five different engine designs were considered, the only engine design that met all the criteria was one that utilized a bed-plate. There are several forces at work in the lower end of an engine block. These are:

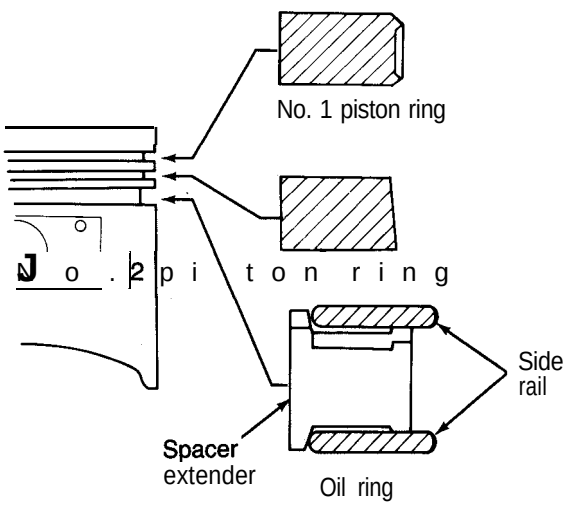
- Vertical bending
- Horizontal bending – 90 degrees to the cylinder bore
- Torsional bending along the crankshaft axis
- Individual main cap flutter co-inciding to individual cylinder firing

All these factors contribute to noise, vibration and harshness. Because this is a four cylinder engine, design criteria becomes even more important. Bed-plate design makes for a much stronger lower end because it ties all of the main caps together to substantially improve block stiffness. The block is a two-piece assembly, encompassing the bed-plate and the cylinder block. The bed-plate is made of cast iron and is totally separable from the block. When installed, it becomes part of the block and strengthens the lower end considerably. The bed-plate and block are cast separately, then machined together. Once machined, the bed-plate and block are drilled and doweled together to become a mated unit. This ensures that the bed-plate and block are in perfect alignment even after assembly and disassembly.

PISTON

N71AB03AA

The piston has an oval shape (elliptical) that expands as the engine warms-up. This reduces cold engine piston noise, helps the piston fit into the bore better and avoids piston scuffing.
The piston pin has a 1 mm (.0394 in.) offset toward the thrust side of the piston for improved noise characteristics. The top ring is a steel unit with a plasma sprayed molybdenum faced center section for reliable compression sealing. The upper ring is not directional. The black coating as a rust preventative. A taper faced cast iron second compression ring is used for additional cylinder compression control. Both compression rings are 1.2 mm (.0472 in.) thick. The oil ring is a three piece design using chrome faced fails and a separate center expander. Use the running clearance notches and is identifiable by a slight dish at the top of the piston.
This engine is pressed-in piston pins to attach forged powder metal connecting rods. Incorporate hex head cap screw threaded into the connecting rod. Piston and Rods are serviced as an assembly.



CENO066

CONNECTING RODS

N71AB04AA

The connecting rods are different from past designs because the manufacturing process has changed. The connecting rod is forged as one piece from powdered metal. The powdered metal is placed in a form that is slightly oversized and then sent to sintering furnace. It melts the powdered metal in the mold. The mold travels to a forging press where the rod is forged to the final shape. This is done while the rod is still warm, but not molten. After the forging process, the inside diameter of the crankshaft end of the rod is scribed with a laser and is fractured in a fixture. This creates a rod cap and rod that only fit together one way. The final step in the process is shot peening which increases the surface hardness slightly. This design process eliminates the need for several machining operations that are required for cast iron, connecting rod assemblies. Other designs required machining the connecting rod and connecting rod cap individually, then finish machining, honing, and balancing are performed as an assembly.

Note
The new process and the different metal does not prohibit the use of standard tools. If the connecting rods require removal from the engine a center punch can be used to identify the correct position of the connecting rod and cap.

CAMSHAFT

N71AB05AA

The camshafts have six bearing journals and 2 cam lobes per cylinder. Flanges at the rear journals control camshaft end play. Provision for cam position sensor on the exhaust camshaft at the rear of cylinder head. A hydrodynamic oil seal is used for oil control at the front of the camshaft.

CRANKSHAFT

N71AB06AA

The engine has 5 main bearings, with number 3 flanged to control thrust. The 52 mm (2.0472 in.) diameter main and 48 mm (1.8898 in.) diameter crank pin journals (all) have undercut fillets that are deep rolled for added strength. To evenly distribute bearing loads and minimize internal stress, 8 counterweights are used. Hydrodynamic seals provide end sealing, where the crankshaft exits the block. Anaerobic gasket material is used for parting line sealing in the block. A sintered powder metal timing belt sprocket is mounted on the crankshaft nose. This sprocket provides motive power; via timing belt to the camshaft sprockets (providing timed valve actuation) and to the water pump.

CRANKSHAFT AND CAMSHAFT TIMING

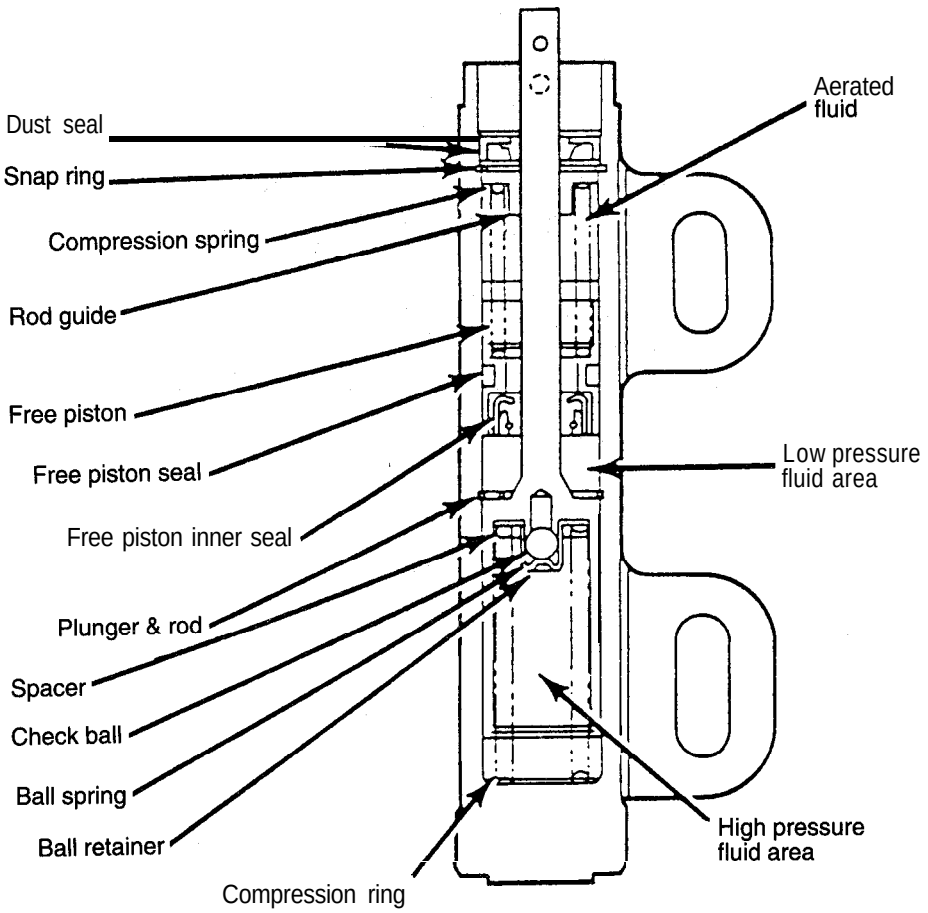
N71AB07AA

This engine does not have broken-belt valve clearance. The reason for this design is to improve hydrocarbon emissions by eliminating valve pockets cut into the pistons that would normally provide this clearance. If the engine is rotated with the timing belt removed or the cam timing is set improperly, the valves will hit the pistons. However, if the camshafts are out of time on engines, the valves can strike each other as well as the pistons. This is due to the intake and exhaust valve-to-valve interference design. Therefore, it is necessary to time the camshafts and crankshaft simultaneously to prevent damage to pistons, exhaust valves, and intake valves.

AUTOMATIC TENSIONER

N71AB08AA

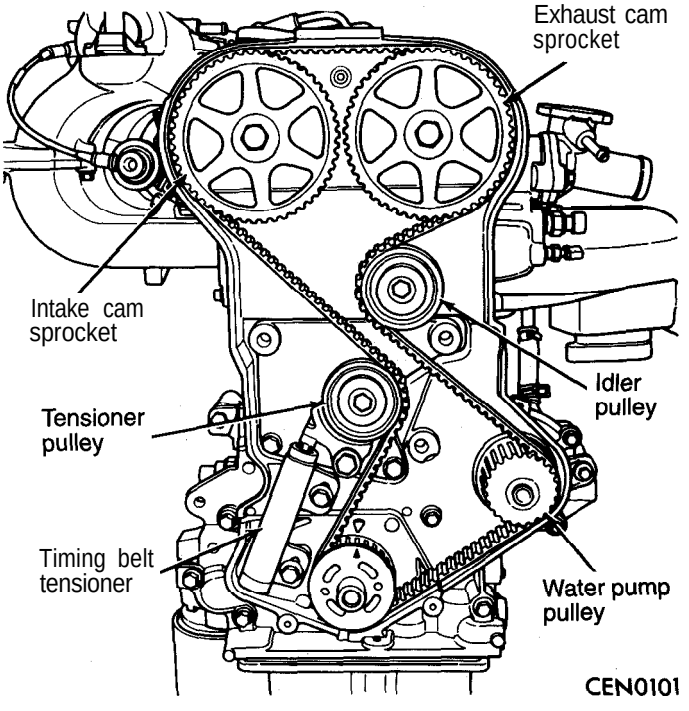
This engine uses a timing-belt cover, crankshaft sprocket, timing belt, "automatic" belt tensioner, two camshafts, and camshaft sprockets. The belt tensioner is spring activated, hydraulically dampened, and self contained. The tensioner consists of a free piston, orifice, silicone fluid, a spring, check ball, and a plunger rod. The check ball is seated as the plunger rod is depressed, trapping the fluid and creating a high pressure area. The area below the plunger rod is the high pressure area for hydraulic dampening. The area between the free piston and the plunger rod is a low pressure area. And, the area above the free piston provides a place to contain aerated fluid. The spring below the plunger rod holds a constant pressure for the belt tensioner pivot bracket.



CEN0099

Prior to installing tensioner on the engine, it is necessary to preload the tensioner plunger. This accomplished by installing the tensioner in a vise and slowly compressing the plunger. A tensioner plunger pin is installed through the body of the tensioner and plunger. When the tensioner is installed on the engine, it is necessary to preload the tensioner pivot bracket assembly with a torque wrench prior to securing the retaining bolts. The automatic tensioner makes up for fluctuations in temperature through cylinder head expansion and contraction and for timing belt stretch over the life of the belt. If the tensioner fails, it is not serviceable and should be replaced.

Timing belt guides are cast into the oil pump and molded into the timing belt cover on engines. The purpose of the guides is to help with installation of the timing belt. They prevent the belt from falling off the sprockets.

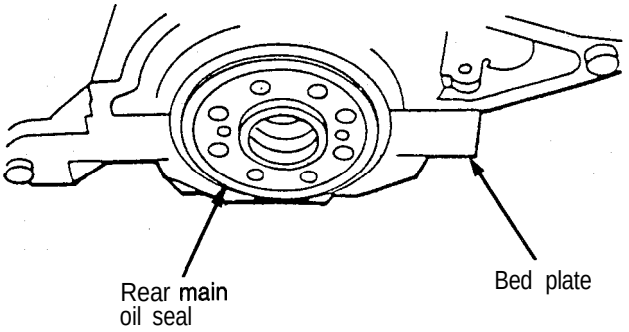


OIL PAN

N71AB09AA

The oil pan is a single-plane design, and is constructed of stamped antiphon steel.

The rear main oil seal is a one-piece lip seal that requires a special sleeve for installation. A new seal comes equipped with the special sleeve that it used to prevent seal rollover.



CEN0100

OIL PUMP

N71AB10AA

The oil pump is located at the front of the engine block, and is driven by the crankshaft. The pump housing is made of cast aluminum, provides a guide for the timing belt, and includes the crankshaft front seal.

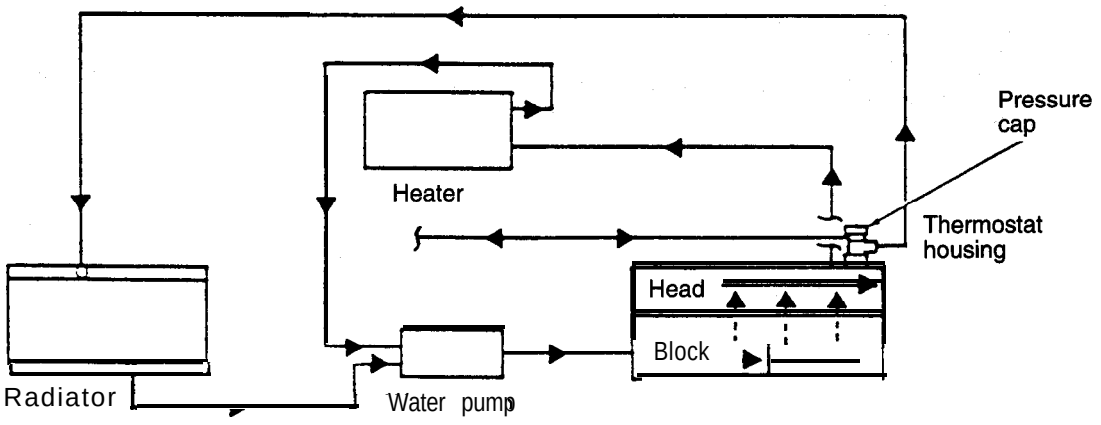
COOLING SYSTEM

N71AD00AA

The cooling system is of the water-cooled, forced circulation type with the following features:

- The water pump is mounted onto the front of the cylinder block, and is driven by the cogged side of the timing belt. The drive sprocket is sintered metal. The pump body is made of die cast aluminum; and a stamped-steel impeller is used to pump coolant through the engine.
- The thermostat housing is located on the left front side of the engine. The thermostat is mounted under the thermostat housing, and the center element is offset from the center of its diameter. Therefore, it can only be installed one way. The thermostat has an air bleed (jiggle pin) located in the flange, and an O-ring with a locating dimple. the bleed faces upward. The thermostat temperature rating is 90.5% (195°F).
- Coolant enters the water pump, where it is routed through the engine block and into the cylinder head. Then, the coolant is routed from cylinder head to both heater core and the radiator (engine hot) or through bypass (engine cold) to the water pump where the cycle starts over again.
- A small-size, high-performance radiator has been adopted for better cooling efficiency and less weight.
- Reduction in size of the automatic transaxle oil cooler had resulted in a lowered radiator position, which has permitted the “slant nose” design of the body.
- The cooling fan control has been integrated into the centralized control by the engine control module for better cooling efficiency, better fuel consumption, less noise, and better acceleration.

COOLANT FLOW

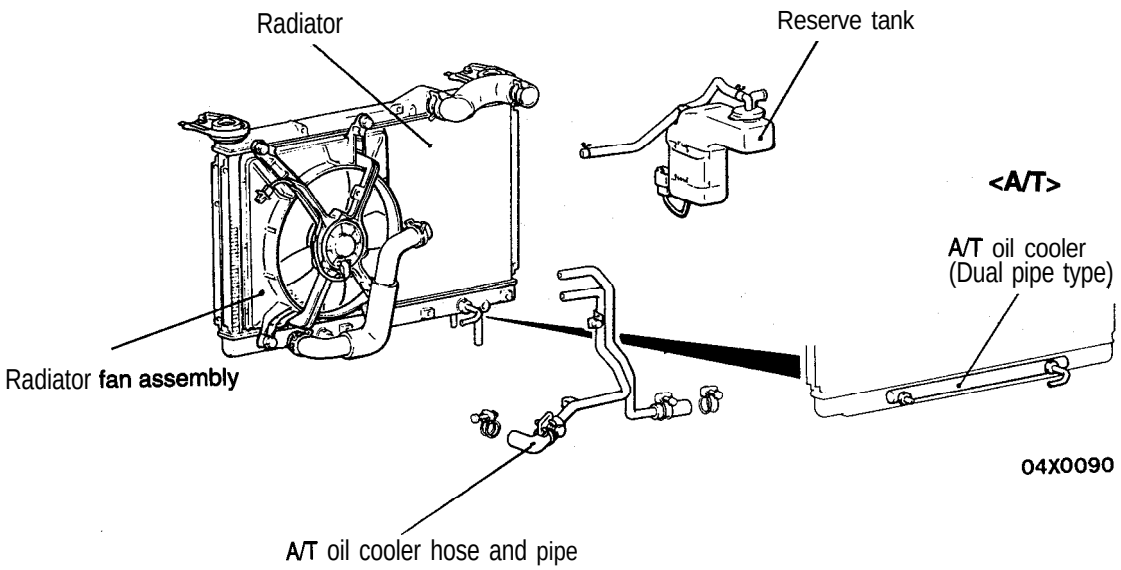


CEN0102

SPECIFICATIONS

Items	Specifications
Cooling method	Water-cooled pressurized, forced circulation with electrical fan
Radiator	
Type	Pressurized corrugated fin type
Thermostat	Wax pellet type with jiggle valve
Water pump	
Type	Centrifugal impeller
Drive method	Timing belt

CONSTRUCTION



INTAKE AND EXHAUST

INTAKE MANIFOLD AND EXHAUST MANIFOLD

N71AE00AA

The intake manifold is a two-piece aluminum casting, attached to the cylinder head with six bolts and two studs. This long branch fan design enhances low and midspeed torque.

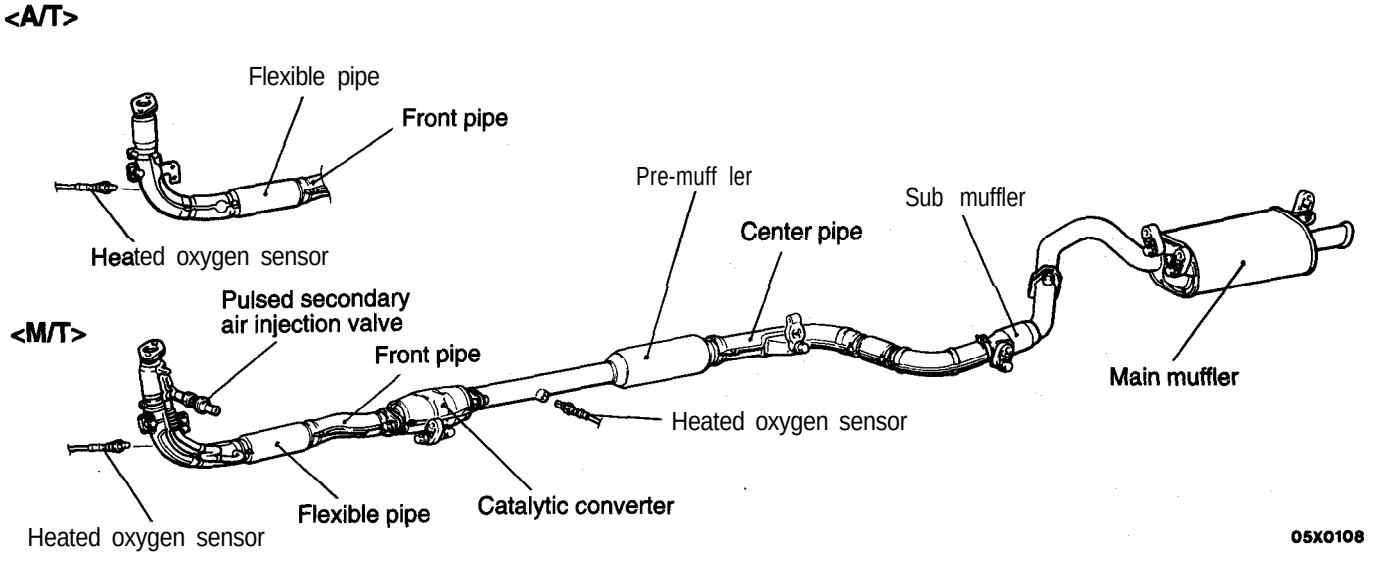
The exhaust manifold is made of nodular cast iron for strength and high temperatures.

EXHAUST PIPE

N71AE01AA

The exhaust pipe consists of three parts: a front pipe, a center pipe, and a main muffler. It is mounted on the body via rubber hangers to minimize vibration transmission from the exhaust system to the body. A large main muffler, sub muffler and pre-muff ler ensure reduced exhaust noise.

CONSTRUCTION

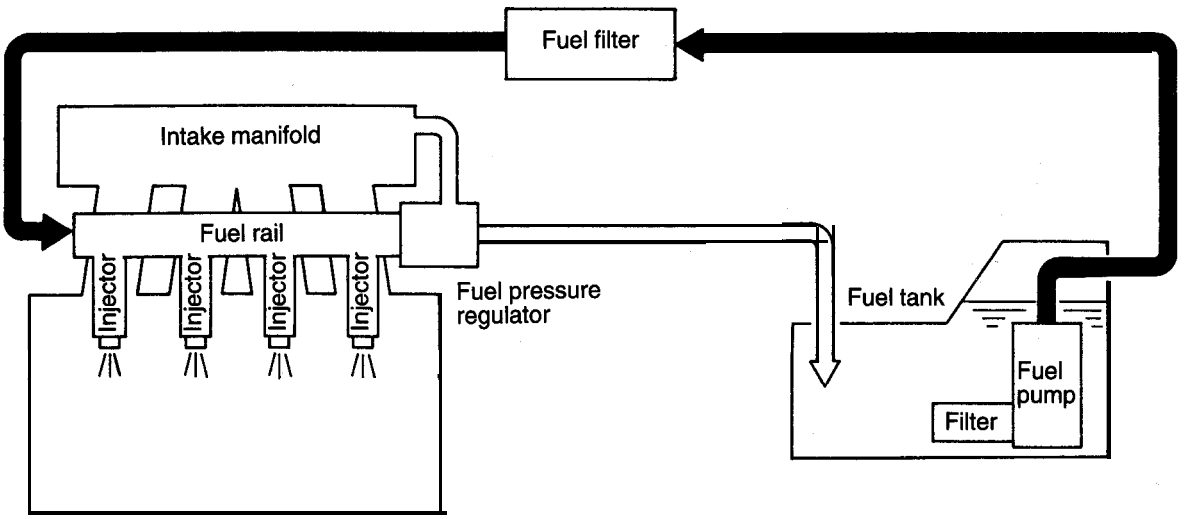


FUEL SYSTEM

N71AF00AA

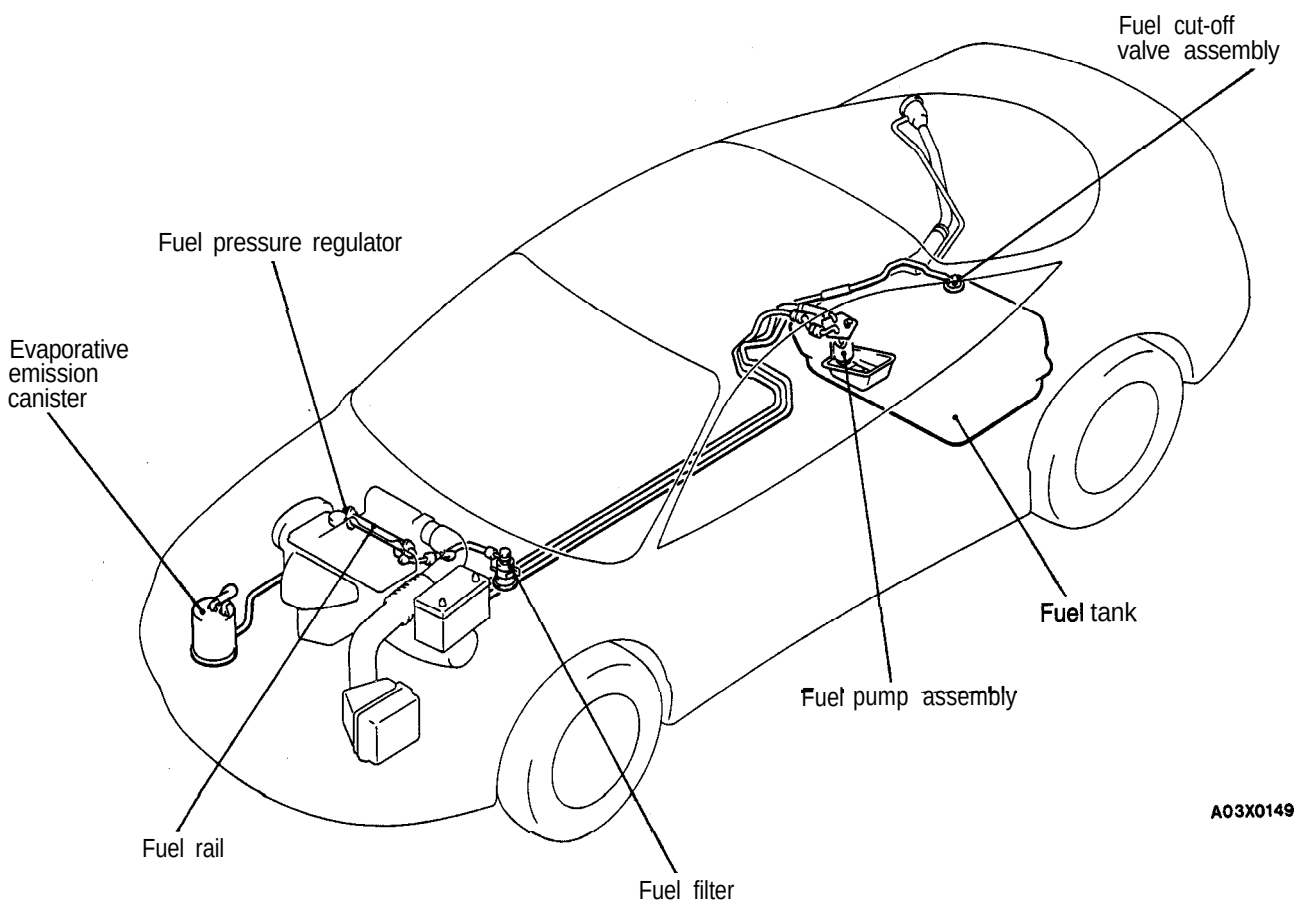
The fuel system for 420A engine consists of electromagnetic fuel injectors, a fuel rail, a fuel pressure regulator, an electric motor-driven fuel pump, fuel filter and fuel tank.

FUEL FLOW DIAGRAM



03A0009

CONFIGURATION DIAGRAM

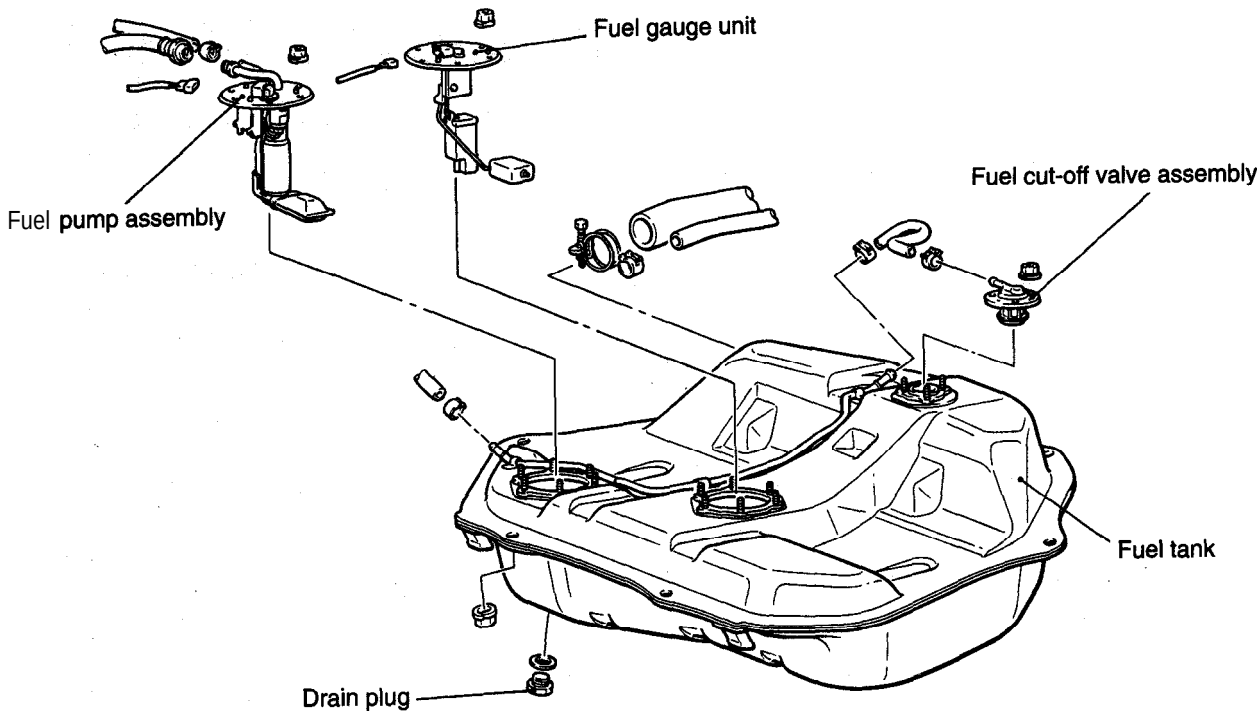


A03X0149

FUEL TANK

N71AF01AA

The fuel tank is made of steel and is arranged under the rear seat floor for higher safety. The fuel tank has an internally mounted fuel pump assembly and fuel gauge unit. In addition, a fuel cut-off valve assembly is standard equipment on all vehicles. The fuel cut-off valve assembly prevents outflow of fuel even when the vehicle rolls over, assuring a higher measure of safety.



CONTROL SYSTEM

N71AK00AA

GENERAL INFORMATION

The fuel system for the 2.0 liter DOHC engine utilizes sequential multi-port fuel injection to deliver precise amounts of fuel to the intake manifold.
Basic injector duration is controlled by a combination of signals from the front oxygen sensor and an air density signal from a MAP sensor.

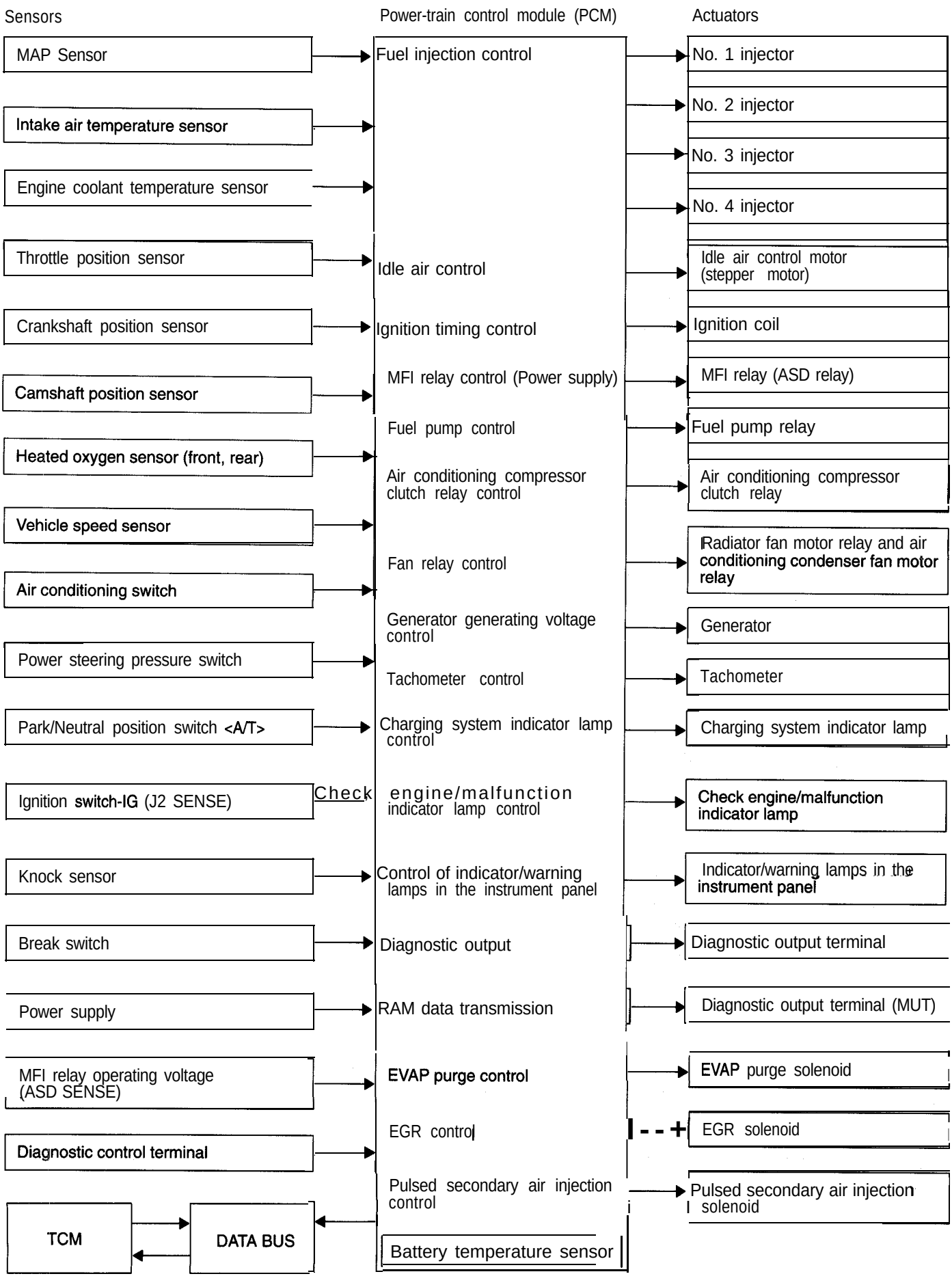
This vehicle uses a direct ignition system, eliminating the need for a distributor. Ignition and fuel injector operation are controlled by a new power-train control module (PCM) which reviews inputs from a number of sensors. The PCM provides outputs to fuel and ignition system components to promote the most efficient operation possible. The vehicle includes a catalytic converter and sophisticated emissions system diagnostic process (OBD II) to ensure that emissions meet clean air regulations.

Major differences from the 1994 4G63 2.0 liter DOHC engine are as follows:

Major difference	Remarks
Fast idle air valve is not equipped.	On Mitsubishi manufactured engines, a fast idle air valve is equipped in the throttle body.
Closed throttle position switch is not equipped.	
Speed adjusting screw is not equipped.	Basic idle speed is not adjustable.
Fixed SAS is fixed at the production line.	Fixed SAS is not equipped.
Throttle position sensor is fixed to the throttle body at the production line.	Throttle position sensor is not adjustable.
Camshaft position sensor waveform is different from the current one.	A hall effect sensor is used, however, the construction of the sensor is different.
Crankshaft position sensor waveform and its detection method are different from those current ones.	A same Hall effect sensor is used, however, the construction of the sensor is different.
On vehicles with automatic transaxle, vehicle speed sensor signal is input from TCM.	
Ignition switch-ST (cranking) signal input is not provided .	PCM judges as engine cranking when the engine speed is low.
MFI relay (ASD relay) and fuel pump relay are separately provided.	Currently, these two are combined into one relay.
Generator generating voltage is controlled by PCM.	Currently, it is controlled by the voltage regulator built in the generator.
Tachometer is controlled by PCM.	
Charging system indicator lamp is controlled by PCM.	
Control of the indicator/warning lamps (just after turning ON the ignition switch) is performed by PCM.	
Pulsed secondary air injection is controlled by PCM.	
Data transmission system between PCM and TCM is different from the current one.	
Battery temperature sensor is built in PCM.	
PCM is mounted in the engine compartment.	

SYSTEM BLOCK DIAGRAM

N71AK00AB



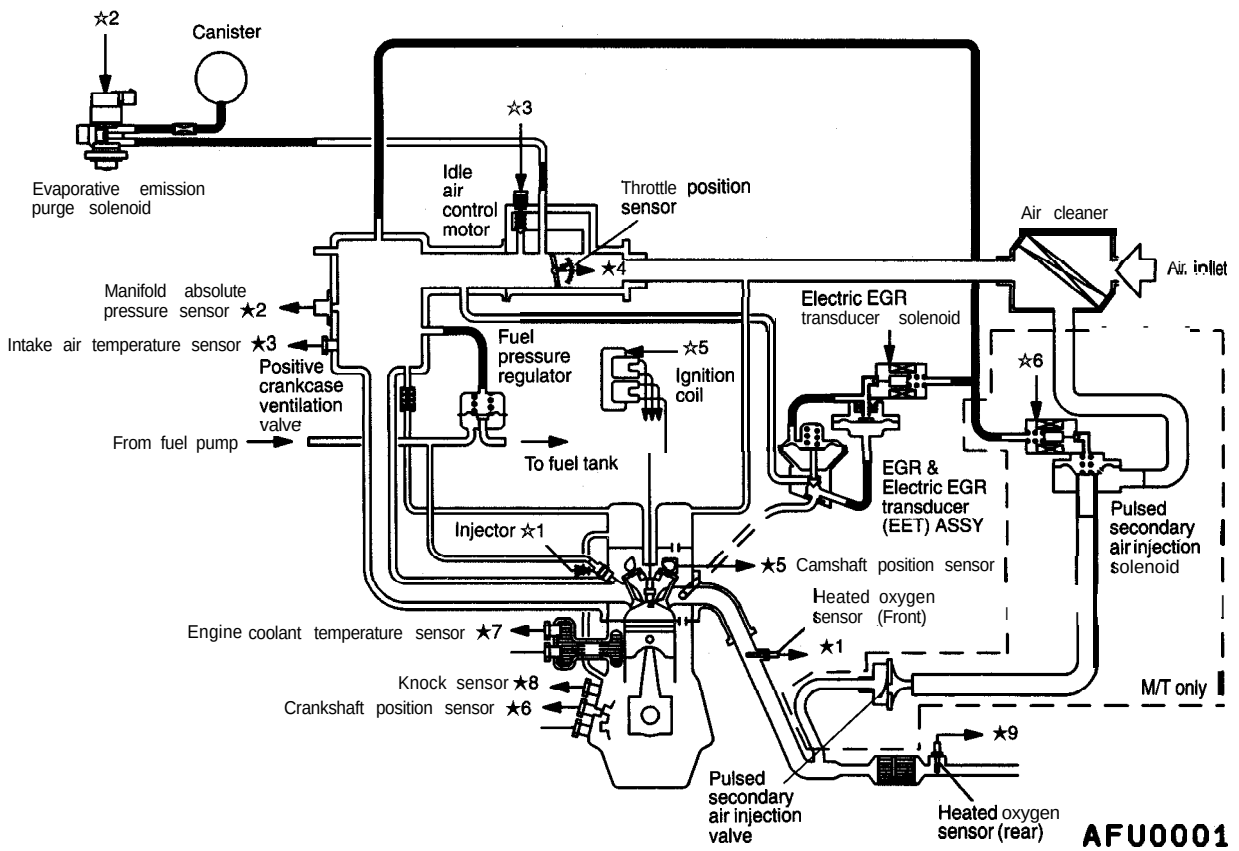
MULTIPORT FUEL INJECTION (MFI) SYSTEM DIAGRAM

N71AK00AC

- ★1 Heated oxygen sensor (Front)
- ★2 Manifold absolute pressure sensor
- ★3 intake air temperature sensor
- ★4 Throttle position sensor
- ★5 Camshaft position sensor
- ★6 Crankshaft position sensor
- ★7 Engine coolant temperature sensor
- ★8 Knock sensor
- ★9 Heated oxygen sensor (Rear)
- Power supply
- Vehicle speed sensor
- A/C switch
- Park/Neutral position switch
- Power steering pressure switch
- Ignition switch-IG (J2 sense)
- Brake switch
- MFI relay (ASD relay)

⇨ Powertrain control module (PCM) ⇨

- al injector
- a2 Evaporative emission purge solenoid
- a3 Idle air control motor
- ☆4 EET solenoid
- ☆5 Ignition coil
- ☆6 Pulsed secondary air injection solenoid
- Fuel pump relay
- Multiport fuel injection (MFI) relay (ASD relay)
- Air conditioning compressor clutch relay
- Check engine/Malfunction indicator lamp
- Diagnostic output
- Fan motor relay
- Generator
- Engine speed meter
- Changing warning light
- Indicator/warning lamps in the instrument panel



SENSORS

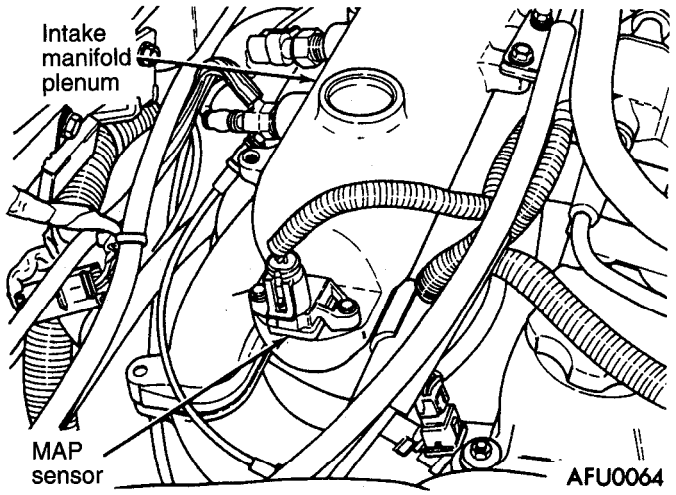
N71AK01AA

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The powertrain control module (PCM) supplies 5 volts direct current to the MAP sensor. The MAP sensor converts intake manifold pressure into voltage. The PCM monitors the MAP sensor output voltage. As vacuum increases, MAP sensor voltage decreases proportionately. Also, as vacuum decreases, MAP sensor voltage increases proportionately.

At wide-open-throttle and during cranking, before the engine starts running, the PCM determines atmospheric air pressure from the MAP sensor voltage. While the engine operates, the PCM determines intake manifold pressure from the MAP sensor voltage. Based on MAP sensor voltage and inputs from other sensors, the PCM adjusts spark advance and the air/fuel mixture.

The MAP sensor mounts to the intake manifold.

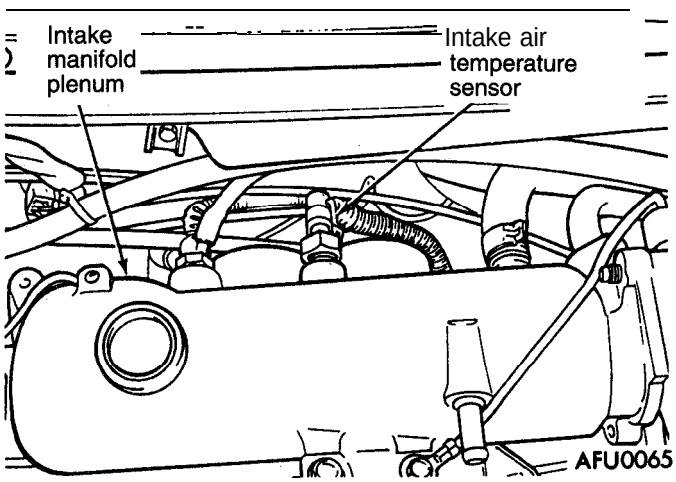


INTAKE AIR TEMPERATURE SENSOR

N71AK02AA

The intake air temperature sensor measures the temperature of the air as it enters the engine. The sensor supplies one of the inputs the PCM uses to determine injector pulse width and spark advance.

The intake air temperature sensor threads into the intake manifold.



ENGINE COOLANT TEMPERATURE SENSOR

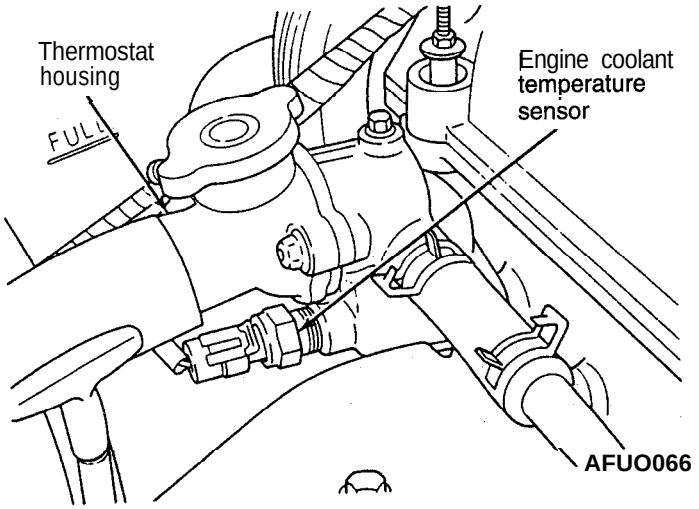
N71AK03AA

The coolant temperature sensor provides an input voltage to the power-train control module (PCM). The PCM determines engine coolant temperature from the engine coolant temperature sensor.

As coolant temperature varies, the coolant temperature sensor's resistance changes, resulting in a different input voltage to the PCM.

When the engine is cold, the PCM will demand slightly richer air-fuel mixtures and higher idle speeds until normal operating temperatures are reached.

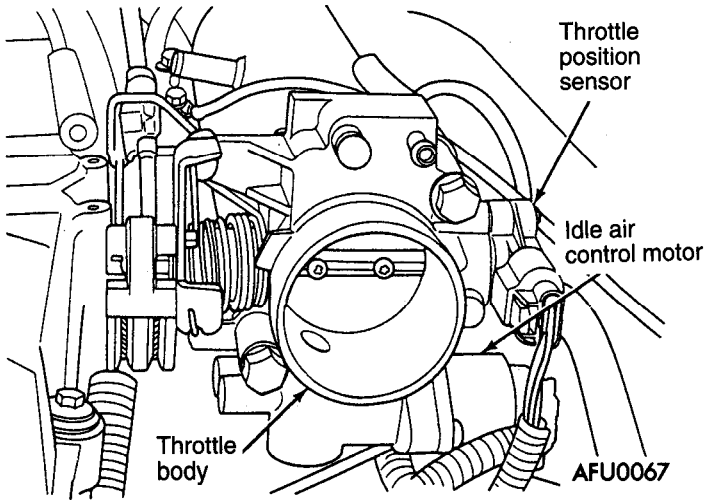
The engine coolant sensor threads into the water jacket below the thermostat housing. New sensors have sealant applied to the threads.



THROTTLE POSITION SENSOR

N71AK04AA

The throttle position sensor mounts to the side of the throttle body.



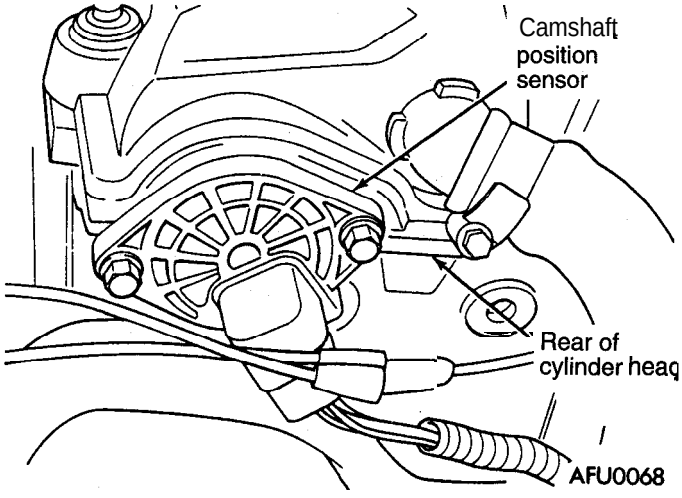
The throttle position sensor (TPS) connects to the throttle blade shaft. The TPS is a variable resistor that provides the powertrain control module (PCM) with an input signal (voltage). The signal represents throttle blade position. As the position of the throttle blade changes, the resistance of the TPS changes.

The PCM supplies approximately 5 volts to the TPS. The TPS output voltage (input signal to the powertrain control module) represents throttle blade position. The TPS output voltage to the PCM varies from approximately 0.40 volt at minimum throttle opening (idle) to a maximum of 3.80 volts at wide open throttle.

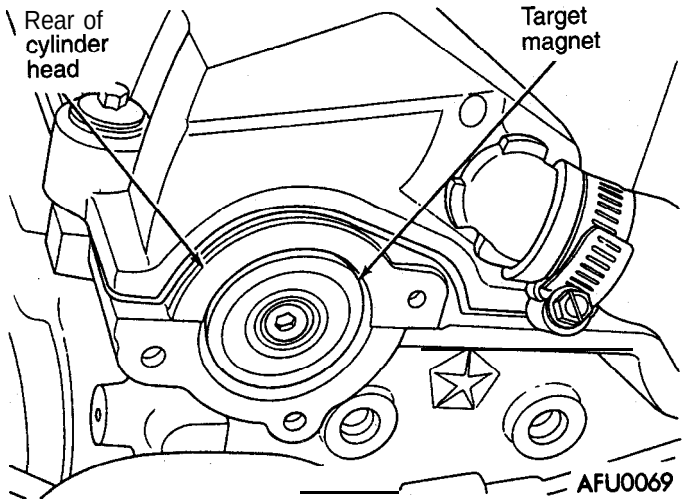
Along with inputs from other sensors, the PCM uses the TPS input to determine current engine operating conditions. The PCM also adjusts fuel injector pulse width and ignition timing based on these inputs.

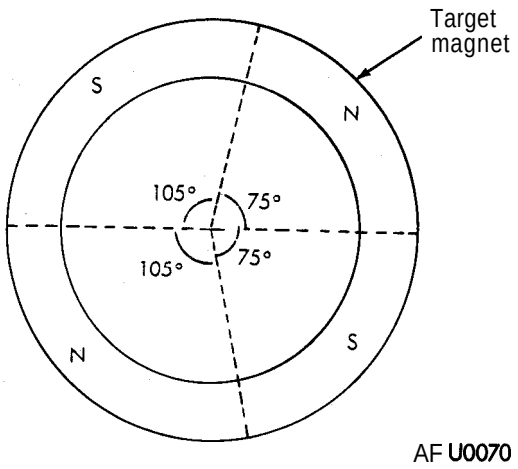
CAMSHAFT POSITION SENSOR N71AK05AA

The PCM determines ignition and fuel injection synchronization and cylinder identification from inputs provided by the camshaft position sensor and crankshaft position sensor. From the two inputs, the PCM determines crankshaft position and cylinder cycle.



The camshaft position sensor attaches to the rear of the cylinder head. A target magnet attaches to the rear of the camshaft and indexes to the correct position. The target magnet has four different poles arranged in an asymmetrical pattern. As the target magnet rotates, the camshaft position sensor senses the change in polarity. The sensor output switches from high (5.0 volts) to low (0.30 volts) as the target magnet rotates. When the north pole of the target magnet passes under the sensor, the output switches high. The sensor output switches low when the south pole of the target magnet passes underneath.

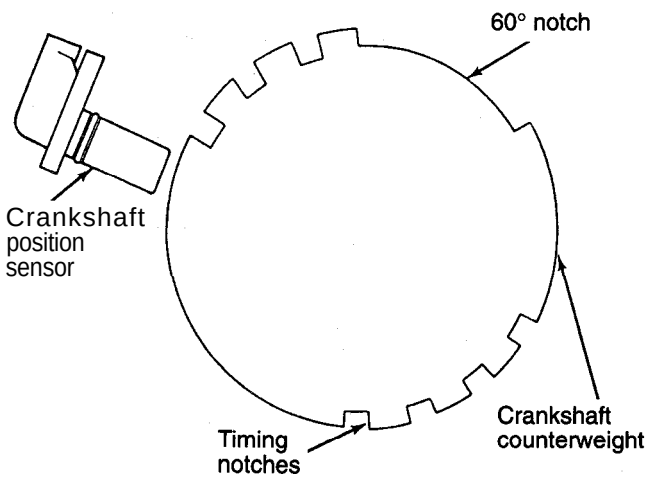




The camshaft position sensor is mounted to the rear of the cylinder head. The sensor also acts as a thrust plate to control camshaft endplay.

CRANKSHAFT POSITION SENSOR N71AK06AA

The PCM determines what ignition coil to energize from the crankshaft position sensor input and the camshaft position sensor input. The second crankshaft counterweight has machined into it two sets of four timing reference notches and a 60 degree signature notch. From the crankshaft position sensor input the PCM determines engine speed and crankshaft angle (position).

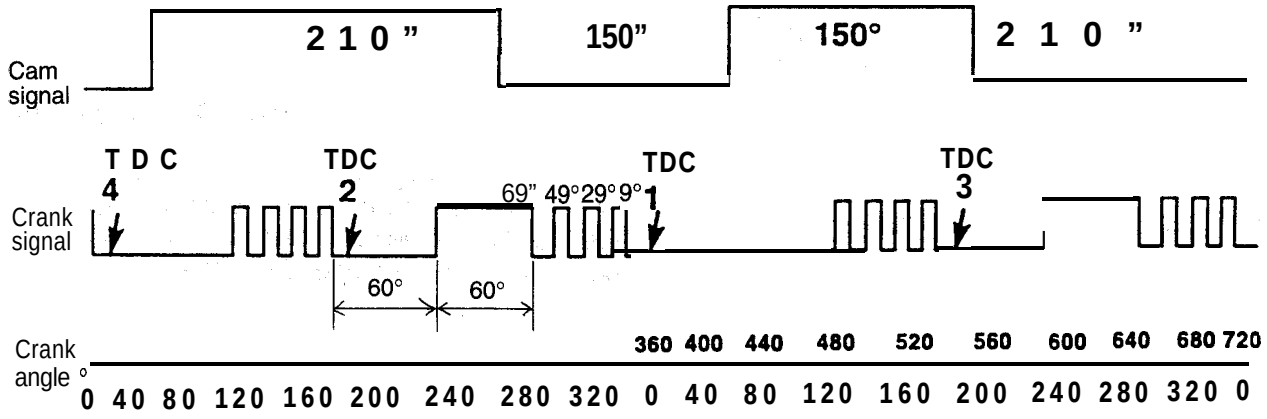


The notches generate pulses from high to low in the crankshaft position sensor output voltage. When a metal portion of the counterweight aligns with the crankshaft position sensor, the sensor output voltage goes low (less than 0.3 volts). When a notch aligns with the sensor, voltage spikes high (5.0 volts). As a group of notches pass under the sensor, the output voltage switches from low (metal) to high (notch) then back to low.

If available, an oscilloscope can display the square wave patterns of each voltage pulse. From the width of the output voltage pulses, the PCM calculates engine speed. The width of the pulses represent the amount of time the output voltage stays high before switching back to low. The period of time the sensor output voltage stays high before switching back to low is referred to as pulse width. The faster the engine is operating, the smaller the pulse width on the oscilloscope.

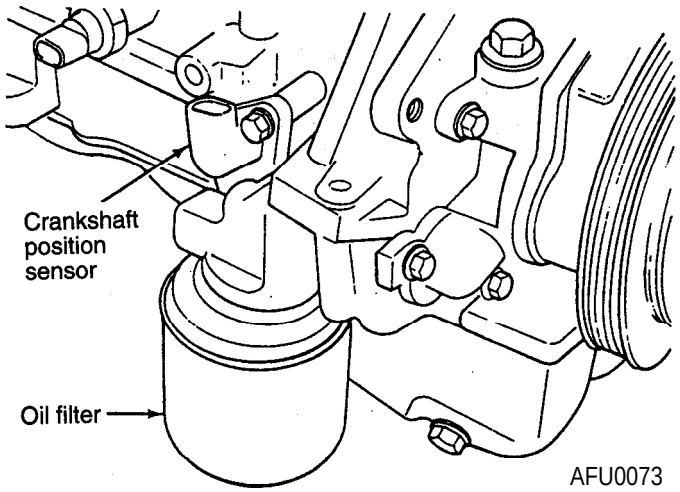
By counting the pulses and referencing the pulse from the 60 degree signature notch, the PMC calculates crankshaft angle (position). In each group of timing reference notches, the first notch represents 69 degrees before top dead center (BTDC). The second notch represents 49 degrees BTDC. The third notch represents 29 degrees. The last notch in each set represents 9 degrees before top dead center (TDC).

The timing reference notches are machined to a uniform width representing 13.6 degrees of crankshaft rotation. From the voltage pulse width the PCM tells the difference between the timing reference notches and the 60 degree signature notch. The 60 degree signature notch produces a longer pulse width than the smaller timing reference notches. If the camshaft position sensor input switches from high to low when the 60 degree signature notch passes under the crankshaft position sensor, the PCM knows cylinder number one is the next cylinder at TDC.



AFU0072

The crankshaft position sensor mounts to the engine block behind the generator, just above the oil filter.



HEATED OXYGEN SENSORS

N71AK07AA

As vehicles accumulate mileage, the catalytic convertor deteriorates. The deterioration results in a less efficient catalyst. To monitor catalytic convertor deterioration, the fuel injection system uses two heated oxygen sensors. One sensor upstream of the catalytic convertor, one downstream of the convertor. The powertrain control module (PCM) compares the reading from the sensors to calculate the catalytic convertor oxygen storage capacity and efficiency. Also, the PCM uses the upstream heated oxygen sensor input when adjusting injector pulse width.

When a deteriorating catalyst's efficiency drops below emission standards, the PCM stores a diagnostic trouble code and illuminates the malfunction indicator lamp (MIL).

The MFI relay (automatic shut down relay) supplies battery voltage to both the upstream and downstream heated oxygen sensors. The oxygen sensors are equipped with a heating element. The heating element keeps the sensors at proper operating temperature during all operating modes.

-Upstream

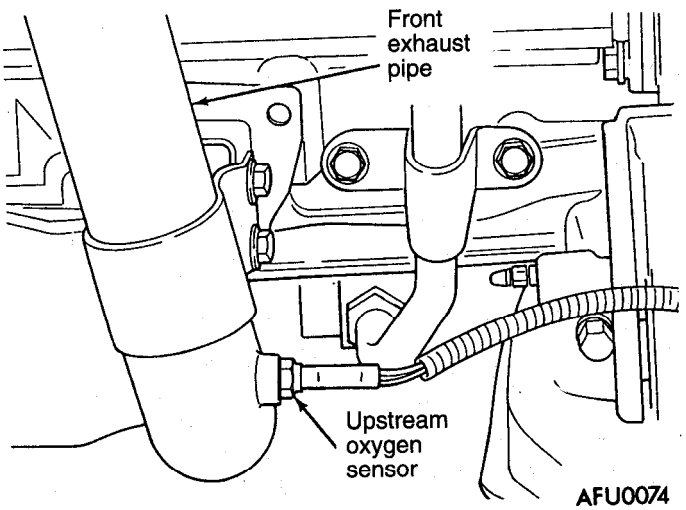
The input from the upstream heated oxygen sensor tells the PCM the oxygen content of the exhaust gas. Based on this input, the PCM fine tunes the air-fuel ratio by adjusting injector pulse width.

The sensor produces from 0 to 1 volt, depending upon the oxygen content of the exhaust gas in the exhaust manifold. When a large amount of oxygen is present (caused by a lean air-fuel mixture), the sensor produces voltage as low as 0.1 volt. When there is a lesser amount of oxygen present (rich air-fuel mixture) the sensor produces a voltage as high as 1.0 volt. By monitoring the oxygen content and converting it to electrical voltage, the sensor acts as a rich-lean switch.

The heating element in the sensor maintains correct oxygen sensor temperature. Maintaining correct sensor temperature at all times allows the system to enter into Closed Loop operation sooner. Also, it allows the system to remain in Closed Loop operation during periods extended' idle.

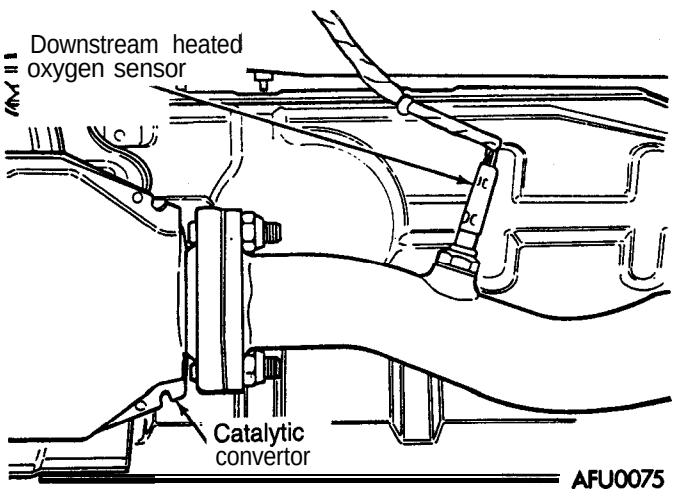
In Closed Loop operation the PCM monitors the inputs from the heated oxygen sensors (along with other inputs). In Closed Loop, the PCM adjusts injector pulse width based on the upstream heated oxygen sensor input. During Open Loop operation the PCM ignores the inputs from both the upstream and downstream heated oxygen sensors. In Open Loop, the PCM adjusts injector pulse width based on preprogrammed (fixed) values and inputs from other sensors.

The upstream oxygen sensor threads into the outlet flange of the exhaust manifold.



Downstream

The downstream heated oxygen sensor threads into the exhaust pipe at the rear of the catalytic convertor. The downstream heated oxygen sensor input is used to detect catalytic convertor deterioration. As the convertor deteriorates, the input from the downstream sensor begins to match the upstream sensor input except for a slight time delay. By comparing the downstream heated oxygen sensor input to the input from the upstream sensor, the PCM calculates catalytic convertor efficiency.



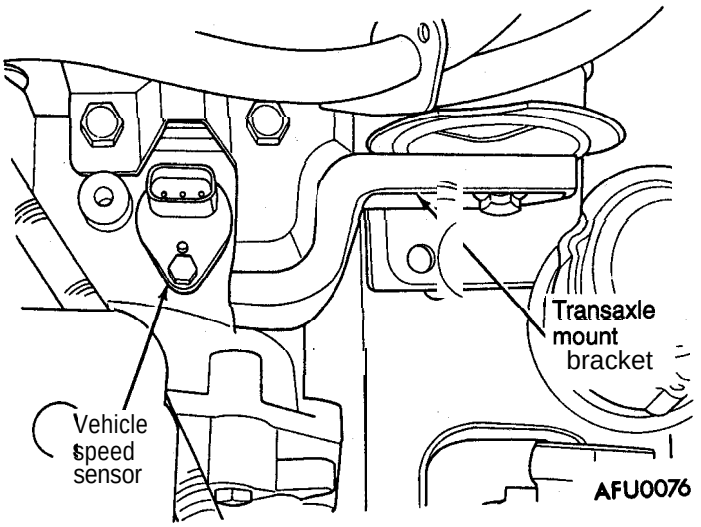
VEHICLE SPEED SENSOR

N71AK08AA

Vehicles with manual transaxle use a vehicle speed sensor. The sensor is located in the transaxle extension housing. The power-train control module (PCM) determines vehicle speed from the sensor input.

The vehicle speed sensor generates 8 pulses per sensor revolution. These signals are interpreted along with a closed throttle signal from the throttle position sensor by the PCM. The inputs are used to determine if a closed throttle deceleration or a normal idle (vehicle stopped) condition exists. Under deceleration conditions, the PCM adjusts the idle air control motor to maintain a desired MAP value. Under idle conditions, the PCM adjusts the idle air control motor maintain a desired engine speed.

On vehicles with automatic transaxles, the PCM receives the vehicle speed input from the transaxle control module (TCM). The TCM calculates vehicle speed from its output speed sensor and turbine speed sensor.



AIR CONDITIONING SWITCH

N71AK09AA

When air conditioning or defrost is selected the PCM receives an input signal that allows it to ground the A/C clutch relay. This provides power to the A/C clutch. In addition, the PCM adjusts the idle air controller motor to compensate for the increased engine load and maintain target idle.

POWER STEERING PRESSURE SWITCH

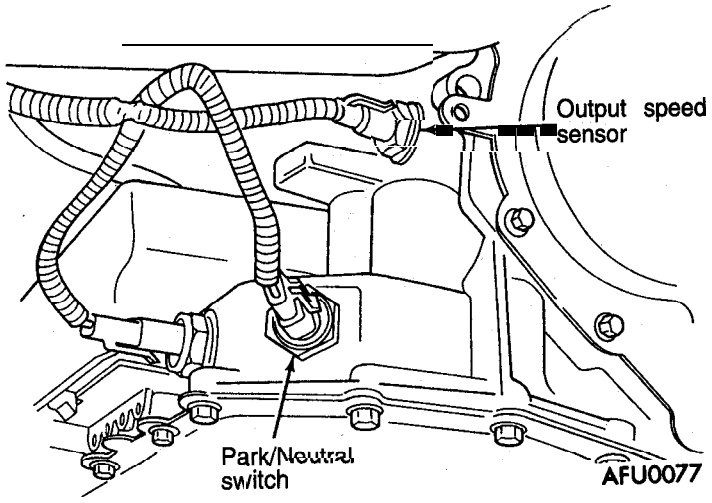
N71AK10AA

A pressure switch is located on the power steering unit's body to signal periods of high pump load and pressure, such as those which occur during parking maneuvers. This allows the PCM to maintain target idle speed. To compensate for the additional engine load, the PCM increases airflow by adjusting the idle air control motor.

PARK/NEUTRAL SWITCH

N71AK11AA

The park/neutral switch is located on the automatic transxale housing. Manual transaxles do not use park neutral switches. The switch provides an input to the PCM. The input indicates whether the automatic transaxle is in Park, Neutral, or a drive gear selection. This input is used to determine idle speed (varying with gear selection), fuel injector pulse width, and ignition timing advance. The park neutral switch is sometimes referred to as the neutral safety switch.



IGNITION SWITCH-IG (J2 SENSE)

N71AK12AA

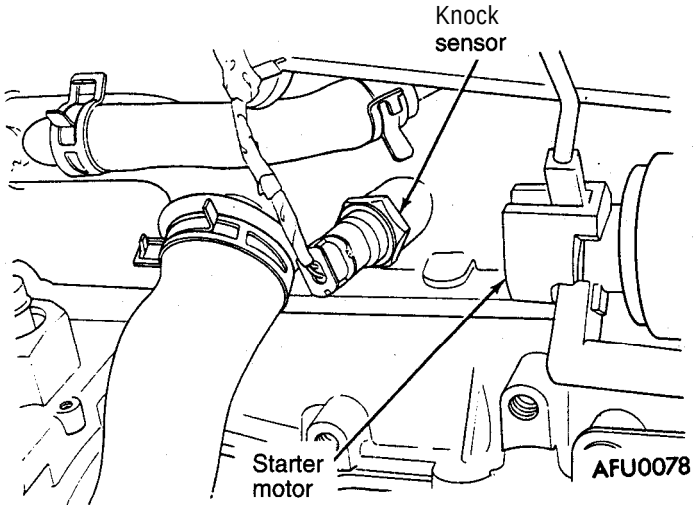
The ignition sense input informs the power-train control module (PCM) that the ignition switch is in the Crank or Run position.

KNOCK SENSOR

N71AK13AA

The knock sensor threads into the side of the cylinder block below the intake manifold. When the knock sensor detects a knock in one of the cylinders, it sends an input signal to the PCM. In response, the PCM retards ignition timing for all cylinders by a scheduled amount.

Knock sensors contain a piezoelectric material which constantly detects engine knock vibration and sends an input voltage (signal) to the PCM while the engine operates. As the intensity of the engine knock increases, the knock sensor output voltage also increases.



BRAKE SWITCH

N71AK14AA

When the brake switch is activated, the power-train control module (PCM) receives an input indicating that the brakes are being applied. After receiving this input the PCM maintains idle speed to scheduled RPM through control of the idle air control motor. The brake switch is mounted on the brake pedal support bracket.

BATTERY VOLTAGE

N71AK15AA

The power-train control module (PCM) monitors the battery voltage input to determine fuel injector pulse width and generator field control. If battery voltage is low the PCM will increase injector pulse width (period of time that the injector is energized).

ACTUATORS AND CONTROL

N71AK20AA

FUEL INJECTORS

The 2.0L engine uses electrically operated top feed fuel injectors. The MFI relay (automatic shut down relay) supplies battery voltage to the fuel injectors. The PCM controls the ground path for each injector in sequence. By switching the ground paths on and off, the PCM fine-tunes injector pulse width. Injector pulse width refers to the amount of time an injector operates.

The PCM determines injector synchronization from the camshaft position sensor and crankshaft position sensor inputs. The PCM grounds the MFI and fuel pump relays after receiving the camshaft position sensor and crankshaft position sensor inputs.

The PCM energizes the injectors in a sequential order during all engine operating conditions except start-up. For the first injector pulse width during start-up, all injectors are energized at the same time. Once the PCM determines crankshaft position, it beings energizing the injectors in sequence.

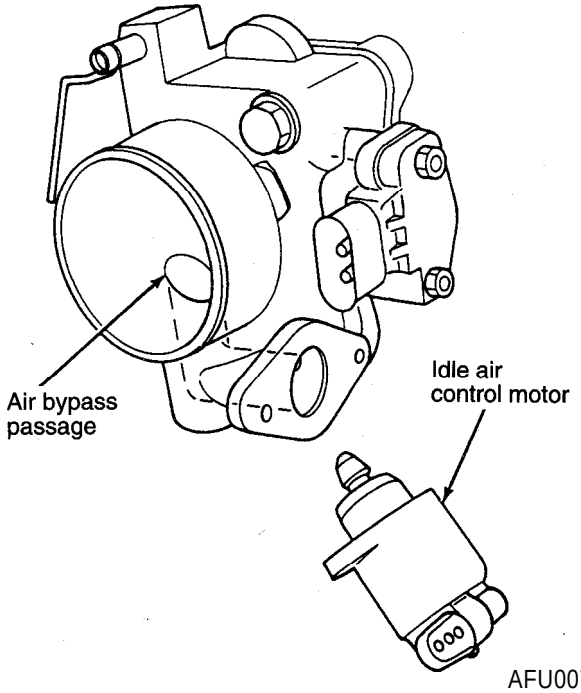
IDLE AIR CONTROL MOTOR

N71AK21AA

The idle air control (IAC) motor is mounted on the throttle body. The PCM operates the idle air control motor. The PCM adjusts engine idle speed through the idle air control motor to compensate for engine load or ambient conditions.

The throttle body has an air bypass passage that provides air for the engine during closed throttle idle. The idle air control motor pintle protrudes into the air bypass passage and regulates air flow through it.

The PCM adjusts engine idle speed by moving the IAC motor pintle in and out of the bypass passage. The adjustments are based on inputs the PCM receives. The inputs include the throttle position sensor, crankshaft position sensor, coolant temperature sensor, vehicle speed sensor and various switch operations (brake, park/neutral, air conditioning, power steering).

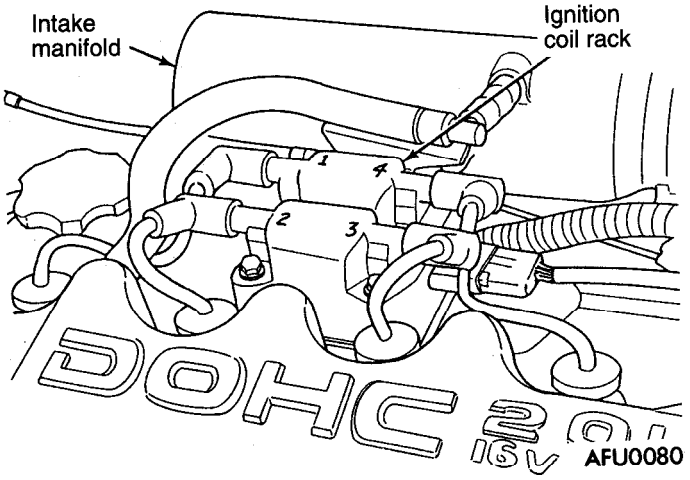


AFU0079

IGNITION COIL N71AK22AA

The coil assembly consists of 2 coils molded together. The coil assembly is mounted on the cylinder head cover. High tension leads route to each cylinder from the coil. The coil fires two spark plugs every power stroke. One plug is the cylinder under compression, the other cylinder fires on the exhaust stroke. Coil number one fires cylinders 1 and 4. Coil number two fires cylinders 2 and 3. The powertrain control module (PCM) determines which of the coils to charge and fire at the correct time.

The MFI relay (automatic shut down relay) provides battery voltage to the ignition coil. The PCM provides a ground contact (circuit) for energizing the coil. When the PCM breaks the contact, the energy in the coil primary transfers to the secondary causing the spark. The PCM will de-energize the MFI relay if it does not receive the crankshaft position sensor and camshaft position sensor inputs. Refer to MFI Relay PCM Output in this section for relay operation.

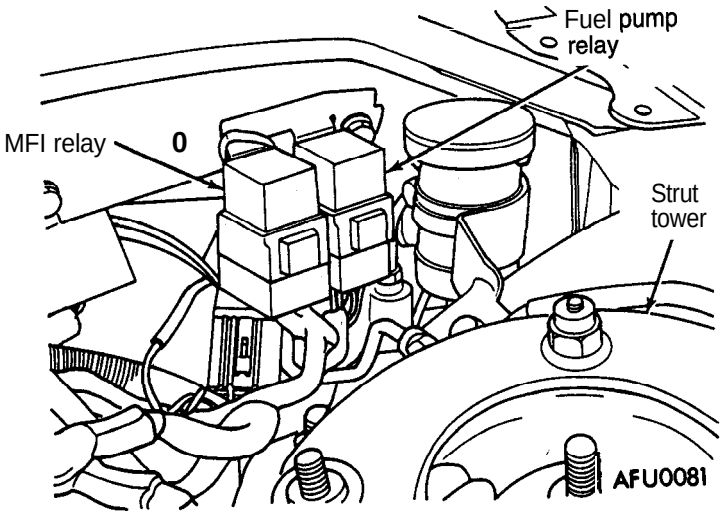


MFI RELAY (Automatic Shut Down) N71AK47AA

The MFI relay (automatic shut down relay) supplies battery voltage to the fuel injectors, electronic ignition coil, generator, and the heating elements in the oxygen sensors.

The PCM controls the relay by switching the ground path for the solenoid side of the relay on and off. The PCM turns the ground path off when the ignition switch is in the Off position. When the ignition switch is in the On or Crank position, the PCM monitors the crankshaft position sensor and camshaft position sensor signals to determine engine speed and ignition timing (coil dwell). If the PCM does not receive the crankshaft position sensor and camshaft position sensor signals when the ignition switch is in the Run position, it will de-energize the MFI relay.

Along with the fuel pump relay, the MFI relay attaches to a bracket on the drivers side of the dash panel.



FUEL PUMP RELAY N71AK23AA

The fuel pump relay supplies battery voltage to the fuel pump. The PCM controls the fuel pump relay by switching the ground path for the solenoid side of the relay on and off. The PCM turns the ground path off when the ignition switch is in the Off position. When the ignition switch is in the On position, the PCM energizes the fuel pump. If the crankshaft position sensor does not detect engine rotation, the PCM de-energizes the relay after'approximately one second.

Along with the MFI relay, the fuel pump relay attaches to a bracket on the drivers side of the dash panel.

AIR CONDITIONING CLUTCH RELAY N7lAK24AA

The PCM provides the ground path for the relay coil. Relay operation is based on inputs the PCM receives from the air conditioning switch. The PCM deactivates the relay at vehicle start-up and also if it senses a part throttle/wide open throttle launch condition. This temporarily reduces the accessory load on the engine.

RADIATOR FAN RELAY AND AIR CONDITIONING CONDENSER FAN RELAY (High, LOW) N71AK25AA

The PCM operates the relay based on inputs from the engine coolant temperature sensor, vehicle speed sensor and A/C system. The PCM supplies the ground circuit for the High/Low relay coil to operate the fan motor in high/low speeds.

CHARGING SYSTEM INDICATOR LAMP N71AK26AA

The PCM controls operation of the charging system indicator lamp located in the vehicle's instrument cluster. The PCM provides a ground to complete the lamp circuit if the charging output falls below a specified threshold. The PCM also supplies the ground circuit for the lamp circuit for 3 seconds after the ignition switch is turned to the ON position and illuminates the indicator lamp.

TACHOMETER N71AK27AA

The PCM operates the tachometer on the instrument panel. The PCM calculates engine RPM from the crankshaft position sensor input.

GENERATOR N71AK28AA

The PCM controls the generator field current to regulate the generator output voltage to the target voltages in accordance with the battery temperatures.

DUTY CYCLE EVAP PURGE SOLENOID

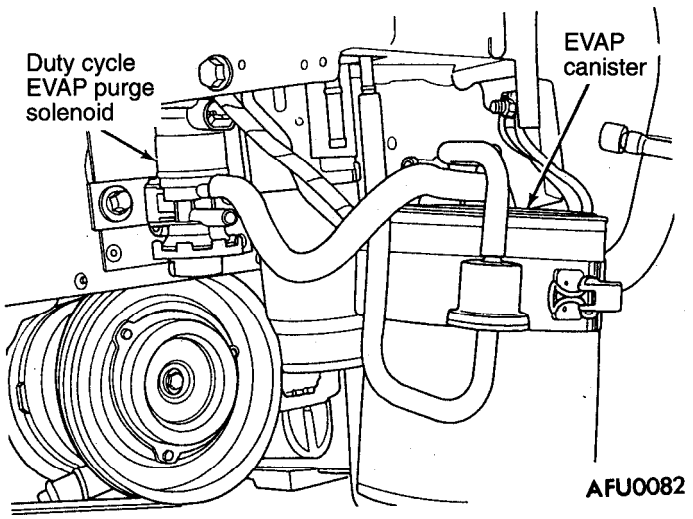
N71AK29AA

The duty cycle EVAP purge solenoid regulates the rate of vapor flow from the EVAP canister to the throttle body. The power-train control module operates the solenoid.

During the cold start warm-up period and the hot start time delay, the PCM does not energize the solenoid. When de-energized, no vapors are purged. The PCM de-energizes the solenoid during Open Loop operation.

The engine enters Closed Loop operation after it reaches a specified temperature and the programmed time delay ends. During Closed Loop operation, the PCM energizes and de-energizes the solenoid 5 to 10 times per second, depending upon operating conditions. The PCM varies the vapor flow rate by changing solenoid pulse width. Pulse width is the amount of time the solenoid is de-energized.

The solenoid attaches to a bracket next to the EVAP canister. The canister is located ahead of the passenger's front wheel well.



ELECTRIC EGR TRANSDUCER

N71AK30AA

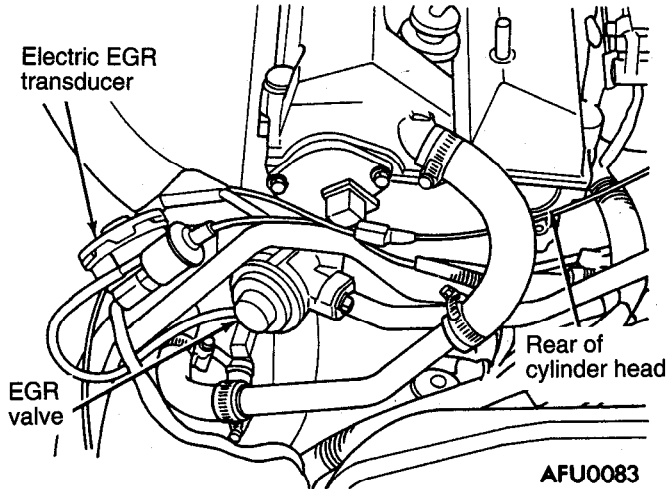
The Electronic EGR Transducer (EET) contains an electrically operated solenoid and a back-pressure controlled vacuum transducer. The PCM operates the solenoid based on inputs from the multi-port fuel injection system. The EET and EGR valve are serviced as an assembly.

When the PCM de-energizes the solenoid, vacuum does not reach the transducer. Vacuum flows to the transducer when the PCM energizes the solenoid.

When exhaust system back-pressure becomes high enough, it fully closes a bleed valve in the vacuum transducer. When the PCM energizes the solenoid and back-pressure closes the transducer bleed valve, vacuum flows through the transducer to operate the EGR valve.

Energizing the solenoid, but not fully closing the transducer bleed hole (because of low back-pressure), varies the strength of the vacuum signal applied to the EGR valve. Varying the strength of the vacuum signal changes the amount of EGR supplied to the engine. This provides the correct amount of exhaust gas recirculation for different operating conditions.

The EET and EGR valve mount to the rear of the cylinder head.



DIAGNOSTIC SYSTEM

MALFUNCTION INDICATOR LAMP (MIL)

N71AK31AA

The PCM provides the ground path for the malfunction indicator lamp (Check Engine light in the gauge cluster on the instrument panel). The lamp comes on each time the ignition key is turned ON and stays on for a 3 seconds bulb test.

The MIL lamp stays on continuously, when the PCM has entered a Limp-in mode or identified a failed emission component. During Limp-in Mode, the PCM attempts to keep the system operational. The malfunction indicator lamp signals the need for immediate service. In limp-in mode, the PCM compensates for the failure of certain components that send incorrect signals by substituting inputs from other sensors.

If the PCM detects active engine misfire severe enough to cause catalyst damage, it flashes the malfunction indicator lamp (Check Engine light). ,At the same time the PCM also sets a diagnostic trouble code. <vehicles with manual transaxle>

The malfunction indicator lamp can also display diagnostic trouble codes. Cycle the ignition switch on, off, on, off, on, within five seconds and the PCM displays any diagnostic trouble codes stored in memory.

The diagnostic trouble codes can also be read by the scan tool.

GENERAL INFORMATION

N71AK32AA

The diagnostic system for vehicles with a manual transaxle conforms to OBD-II, where the one for vehicles with an automatic transaxle conforms to OBD-I.

OBD II has been developed to allow to meet the requirements of the Federal Clean Air Act and California Air Resources Board (CARB) legislation.

It is impractical (and very expensive) to provide every vehicle on the road with the equipment necessary to measure emissions of carbon monoxide (CO), hydrocarbons (HC) and oxides of nitrogen (NOx). Instead, the proven emissions control devices available for these vehicles are checked for proper operation.

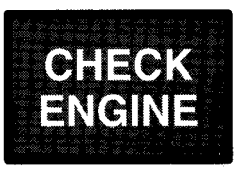
NOTE

When monitoring the misfire and fuel system, if trouble is detected, the MIL will light until the completion of the next operation cycle (trip) following the cycle where the trouble is detected. In addition, if the detected trouble may cause damage to the catalytic converter, the MIL will light immediately. However, if the trouble is not detected in the succeeding trip under almost the same driving condition, MIL should go out. And if the same trouble will not be detected within 80 trips following the trip where the trouble is detected, the diagnostic trouble code will be erased.

MIL ILLUMINATION:

. FAULT ON TWO SUCCESSIVE TRIPS → MIL ON

. (MIL ON) NO FAULT ON THREE SUCCESSIVE TRIPS → MIL OFF



FAULT CODE STORAGE:

. FAULT ON TWO SUCCESSIVE TRIPS → DIAGNOSTIC TROUBLE CODE STORED

. (DTC) NO FAULT ON 40-80 SUCCESSIVE TRIPS → DIAGNOSTIC TROUBLE CODE ERASED

In addition to illuminating the MIL lamp, a diagnostic trouble code (DTC) is stored in the Powertrain Control Module (PCM) and can be retrieved by a service technician using a diagnostic scan tool.

To meet OBD-II requirements the following systems must be monitored:

- Catalyst
- Fuel System
- Misfire
- Oxygen Sensor and Oxygen Sensor Heater
- Secondary Air
- Evaporative System (Purge)
- Exhaust Gas Recirculation
- Any other input or output component that can affect emissions

The operating conditions of the components can be monitored using MUT-II scan tool, as well as general purpose scan tools. The OBD II system monitors are different. They are checks made by the PCM's software to determine not only if these specific systems are operating, but if they are operating within pre-established limits. While OBD I tests measure a component's electrical operation, OBD II monitors check a system's performance.

The California Air Resources Board (CARB) monitors emission system repairs from several California dealers. If a specific component or system fails on more than 4% of the vehicles sampled, the manufacturer is required to research and evaluate the reasons. If the failure is not attributable to owner negligence or misuse, a component failure rate of 4% could lead to vehicle recalls. The federal government is considering a similar program. The manufacturer is relying on its technicians throughout the country to appropriately diagnose emissions concerns and replace only those parts that have failed. The sloppy practice of "hanging" parts on a car under emissions warranty could lead to an unnecessary (and expensive) fleet-wide recall.

DIAGNOSTIC SYSTEM OPERATION

Trip Indicator

N71AK33AA

"Trip" is a difficult concept to define because the requirements for a trip vary depending on the test being run. These conditions can include seemingly unrelated items such as driving style, length of trip, and ambient temperature. The minimum requirement for a trip is that it includes one key cycle with the vehicle having to meet certain enabling conditions before a test is performed. Vehicle tests vary in length and may be performed only once per trip or may be performed continuously. If the pertinent enabling conditions are not met during that key cycle, the tests may not run at all.

NOTE
In California and other states requiring the PCM to indicate that all monitors have passed before issuing license plates, removing the vehicle's battery or using the MUT-II scan tool to erase DTC's before testing erases any record of passing a monitor. If the monitor does not complete a trip on subsequent key cycles, the vehicle will fail a licensing test.

What constitutes a trip for a particular OBD test is important because in many instances, the vehicle must fail a test on more than once before the MIL is illuminated and a DTC is recorded. Tests that illuminate the MIL when a single failure is recorded are known as "one trip" monitors. "Two trip" monitors allow the system to double check itself and help prevent unnecessary MIL illumination.

If the conditions to run the test are not met on consecutive key cycles, the information from the first test is not lost. The diagnostic system waits until the next time the appropriate test conditions occur and continues the count.

If this is a "two trip fault" and the test failed the first time, a malfunction the second consecutive time the test is run (even if there were ten key cycles between these tests) will illuminate the MIL. If the malfunction does not occur the second time the test is run, the MIL lamp does not illuminate and no DTC is recorded.

The diagnostic system can turn the MIL off if it records three consecutive trips where the system passes the test. However, with the misfire and fuel monitors, the system must past the test under the same circumstances (within 375 rpm) under which it failed the test.

In summary, it is the diagnostic system's job to determine if the conditions are appropriate for a test to be run, know the definition of a trip for each test, and record the results of each test when it is run.

DTC Identification, Maturation, and Erasure

N71AK34AA

Once a test has been run, the diagnostic system determines whether the system has passed or failed. It must then determine if the test has failed the specified number of times required to illuminate the MIL. If not, the diagnostic system stores a maturing code. When this test is run again (on the next "trip") the results are once again either pass or fail. If the component fails the test, a code "matures," and a DTC is set. The MIL lamp is illuminated if an emission component is involved. If the component or system passes the test a specified number of times, the maturing code is erased.

NOTE
It is important to understand that a system need not fail a test under exactly the same conditions for a code to nature and trigger the MIL.

DTC's are erased if the component passes the diagnostic test in the course of a number of subsequent warm-up cycles. The number of trips required for this is usually 40. This is why it is best to attempt to diagnose intermittent problems soon after they occur. While initially a DTC may have been available, subsequent trips (which passed the diagnostic test) have erased the code. The OBD II system, based on the latest inputs it received, reconsidered its diagnosis on this intermittent concern.

Of course, a diagnostic scan tool can be used to erase DTC's at any time. In addition, DTC's (along with records of successful trips) are erased whenever the vehicle's battery is disconnected.

Freeze Frame Data Storage and Erasure

N71AK35AA

All monitored systems provide "freeze frame" data of the vehicle's operating conditions when a maturing code was set. This information can be retrieved using the diagnostic scan tool and may help a technical pinpoint the source of a concern more quickly. When there are multiple monitor failures, the first to occur is stored in freeze frame. The exceptions are the misfire and fuel system monitors. They have priority and can write over other freeze frame data.

Information in the freeze frame includes:

- Diagnostic Trouble Code (DTC)
- Engine rpm
- Engine load
- Fuel trim (short term and long term)
- Engine coolant temperature
- Manifold absolute pressure
- Operation mode (open or closed loop)
- Vehicle speed

Freeze Frame Priority

N71AK36AA

The freeze frame only indicates the operating conditions under which the maturing code was set. While these conditions are usually the same as those which trigger the maturation of the DTC, there can be exceptions. This first condition is important for fuel system and misfire DTC's as it is the condition the vehicle must repeat successfully during a test to allow the diagnostic system to erase a DTC and turn off the MIL on its own.

Should the diagnostic system determine that the DTC can be erased, the freeze frame related to that code is also eliminated.

MIL Illumination

N71AK37AA

As described earlier, the PCM diagnostic system is responsible for operation of the MIL lamp. This is an important function as unnecessary operation of this lamp has a negative effect on customer satisfaction. In most cases, if a component or system passes diagnostics on three consecutive trips after the MIL has been illuminated, the MIL is extinguished. This explains how customers can note that the "Check Engine" light went on, and then off, on its own. The OBD II has reconsidered its diagnosis. The DTC remains in the memory until a larger number of warm-up cycles (40) have been successfully completed.

The MIL flashed in misfire situations where continued driving could damage the catalytic converter. Continued driving of the vehicle when this condition occurs is not recommended.

The MIL can be used to produce diagnostic trouble codes. Quickly turning the key to the RUN position three times allows the MIL to flash out any existing flash codes.

Test condition

There are a large number of tests waiting to be performed once the vehicle is stat-ted. It is the diagnostic system's job to see that these tests are not only performed, but performed under the appropriate conditions.

An additional job of the diagnostic system is to prevent false DTC's from being stored. The diagnostic system accomplishes this by not running certain tests when it recognizes that faults already in the system or tests currently being run could cause the next test to fail erroneously. For example:

The test for the catalyst monitor does not run if the MIL light is on due to an oxygen sensor fault. The oxygen sensor is a key component in the catalyst monitor test. If the sensor is not functioning properly, there is no reason to run the catalyst monitor – it won't pass. This test will not be run pending repair of the sensor concern.

N71AK38AA

The diagnostic system does not run the test monitoring catalyst operation if the EGR monitor test is being run. The EGR monitor is an "intrusive" test and will cause the catalyst monitor to produce data not representative of normal operating conditions. This represents a conflict of test data. The diagnostic system will wait until the EGR monitor is finished before running the catalyst monitor.

Finally, the results from the catalyst monitor are always held until the oxygen sensor test has been successfully completed. The results from the test are suspended until the required prerequisite test has been completed.

By reviewing these guidelines, the diagnostic system avoids storing DTC's that are the result of failure of other components in the system. The diagnostic system allows you to use the diagnostic scan tool more confidently in diagnosing and repairing a concern.

DIAGNOSTIC TROUBLE CODES

N71AK39AA

The diagnostic items are shown in the following table. Note that a fault's numeric codes are different, depending on the method of inspection.

Diagnostic trouble code No.			Diagnostic items
Scan tool (MUT-II)	General scan tool	MIL	
01	PO340	54	No cam signal at PCM
02	PO605	53	Internal controller failure
05		47	Charging system voltage too low
06		46	Charging system voltage too high
10		42	MFI relay (ASD relay) control circuit
11		41	Generator field not switching properly
16	–	33	A/C clutch relay circuit
17	PO403	32	EGR solenoid circuit
18	PO443	31	EVAP solenoid circuit
19	PO203	27	Injector #3 control circuit
20	PO202	27	Injector #2 control circuit
21	PO201	27	Injector #1 control circuit
25	PO505	25	Idle air control motor circuits
26	PO122	24	Throttle position sensor voltage low

MIL: Check engine/Malfunction indicator lamp

Diagnostic trouble code No.			Diagnostic items
Scan tool (MUT-II)	General scan tool	MIL	
27	PO123	24	Throttle position sensor voltage high
30	PO117	22	Engine coolant temperature sensor voltage too low
31	PO118	22	Engine coolant temperature sensor voltage too high
32	PO134	21	Upstream H02S stays at center
33		17	Engine is cold too long
35	PO500	15	No vehicle speed sensor signal
36	PO1 07	14	MAP sensor voltage too low
37	PO1 08	14	MAP sensor voltage too high
39	P1297	13	No change in MAP from start to run
40	PO335	11	No crank reference signal at PCM
42	PO352	43	Ignition coil #2 primary circuit
43	PO351	43	Ignition coil #1 primary circuit
44		42	No MFI relay (ASD relay) output voltage at PCM
46	PO401	32	EGR system failure
48		62	PCM failure SRI mile not stored
49	–	63	PCM failure EEPROM write denied
51	PO412	36	Pulsed secondary air injection solenoid circuit <M/T>
57	PO112	23	Intake air temperature sensor voltage low
58	PO113	23	Intake air temperature sensor voltage high
59	PO325	16	Knock sensor #1 circuit
61	PO204	27	Injector #4 control circuit
62	PO132	21	Upstream H02S shorted to voltage
68	PO605	53	PCM failure SPI communications
71		44	Battery temperature sensor volts out of limit
92	P1490	35	Low speed fan control relay circuit
93	P1489	35	High speed fan control relay circuit
96	P1698	66	No CCD messages from TCM <A/T>
101	–	42	Fuel pump relay control circuit
102	PO133	21	Upstream H02S response <M/T>
103	PO135	21	Upstream H02S heater failure <M/T>

MIL: Check engine/Malfunction indicator lamp
SRI: Service Reminder Indicator

Diagnostic trouble code No.			Diagnostic items
Scan tool (MUT-II)	General scan tool	MIL	
104	PO1 39	21	Downstream H02S stays at center <M/T>
105	PO141	21	Downstream H02S heater failure <M/T>
106	PO300	43	Multiple cylinder misfire* <M/T>
107	PO301	43	Cylinder #1 misfire* <M/T>
108	PO302	43	Cylinder #2 misfire* <M/T>
109	PO303	43	Cylinder #3 misfire* <M/T>
110	PO304	43	Cylinder #4 misfire* <M/T>
111	P041 1	36	Too little secondary air or too much secondary air <M/T>
112	PO422	64	Catalytic converter efficiency failure <M/T>
113	PO441	31	Evaporative purge flow monitor failure <M/T>
114	P1899	37	Park/Neutral switch <A/T>
115	PO551	65	Power steering switch failure <M/T>
118	PO1 72	52	Fuel system rich*
119	PO171	51	Fuel system lean*
126	PO138	21	Downstream H02S shorted to voltage <M/T>
128	PO125	17	Closed loop temperature not reached <M/T>
132	PO121	24	Throttle position sensor voltage does not agree with MAP <M/T>
133	P1390	11	Timing belt skipped 1 tooth or more
138	P1294	25	Target idle not reached (±200 r/min) <M/T>
157	P1391	11	Intermittent loss of CMP or CKP

MIL: Check engine/Malfunction indicator lamp
*: The diagnostic code is memorized on the first detection of the trouble.

MAIN MONITORS

N71AK40AA

To meet OBD II requirements, the on-board diagnostic system must monitor the electrical input signals and the performance of output responses that can have an effect on vehicle emissions. In addition, there are several "main monitors" that review the result of system operations and their effect on emissions. The main monitors are as follows:

- Catalyst
- Fuel System
- Misfire
- Oxygen Sensor
- Exhaust Gas Recirculation
- Secondary air (air injection)

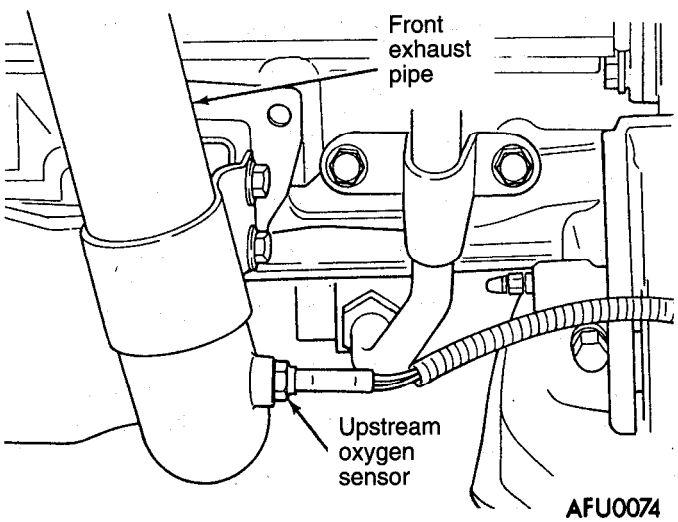
Each of the main monitors is listed below with a brief background explanation and a description of how the monitor operates. Following these conditions is the diagnostic trouble code (DTC) this monitor produces along with the DTC flashout number and a number referred to as a SAE J 2012 or "P" code. SAE J 2012 codes required by law for use with generic diagnostic scan tools.

Oxygen Sensor Monitor

N71AK41AA

Background

Effective control of exhaust emissions is achieved by an oxygen feedback system. The most important element in this system is the oxygen (O_2) sensor mounted in the exhaust manifold.



Operation

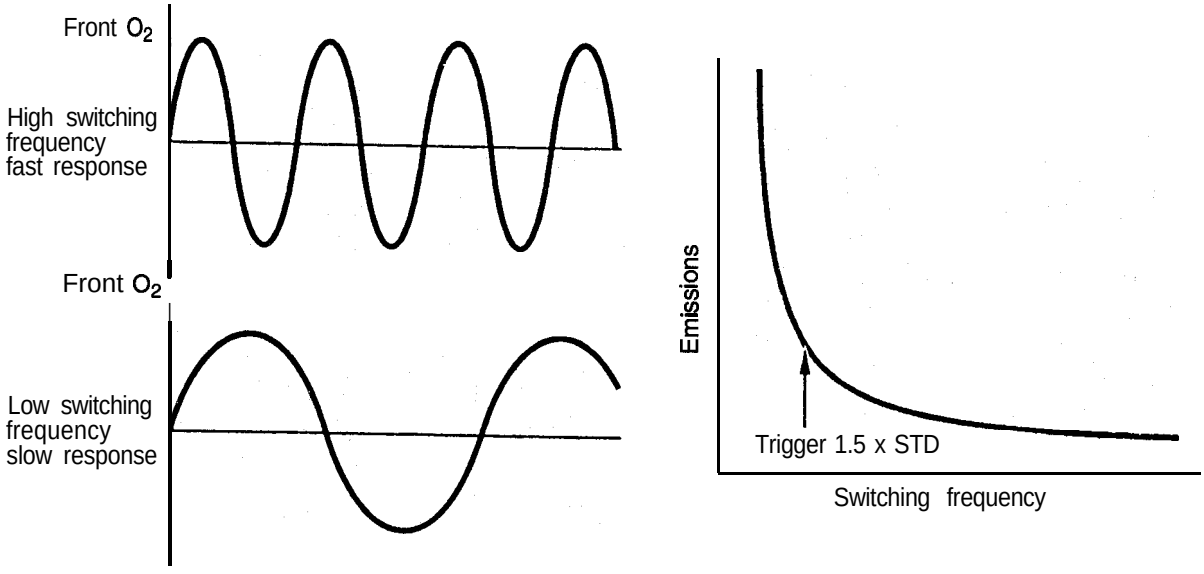
Once it reaches its operating temperature of 572° to 662°F, the sensor generates a voltage inversely proportional to the amount of oxygen in the exhaust. This information is used by the PCM to calculate the fuel injector pulse width necessary to provide the critical 14.7 to 1 air/fuel ratio (stoichiometric).

A properly operating sensor must not only be able to generate an output voltage across its operating range of 0 to 1 volt as it is exposed to different O_2 levels, it also must be able to detect these changes quickly. To detect a shift in the air/fuel mixture (lean or rich) the output voltage must change beyond a threshold value. A malfunctioning sensor could have difficulty changing beyond the threshold value.

While there are existing tests that determine if an O_2 sensor is shorted to voltage, contains an open circuit, or does not function at all, prior to OBD II, it was impossible to identify sluggish or marginal sensors.

A slow response rate or reduced voltage output are all signs of an improperly operating oxygen sensor. This could mean longer instances of combustion of less than optimum air/fuel mixtures. This can significantly increase emissions.

The O_2 sensor must have a voltage output of greater than .67 volt in order to pass the test. It must also switch more times over a 120 second period than a given threshold (to demonstrate quick response) or produce a given number of steep slope switches (demonstrating dynamic range and quick response) over the same time period. Data is not stored unless idle time exceeds 10 seconds.



AFUOO88

O_2 Heater Monitor

Background

In order for the O_2 sensor to function properly, the O_2 sensor must be heated to approximately 572" – 662°F. To assist the O_2 sensor in achieving this temperature, the O_2 sensor is equipped with a Positive Thermal Coefficient (PTC) heater element. Both the upstream an downstream's heater element is fed battery voltage any time the MFI relay is energized. The ground for the heater element is routed through the O_2 sensor's 4-pin connector to an external ground source. As current flows through the element, the temperature of the O_2 sensor increases. As the temperature increases, the resistance of the element increases causing the current flow to decrease. The O_2 sensor's heater maintains the temperature of the sensor to around 1200°F.

After the engine has started, the upstream O_2 sensor's information is used by the PCM to assist in the air/fuel calculation. If the sensor is not up to operating temperatures, the information given by the sensor may be inaccurate, possibly causing an increase in emissions.

The downstream O_2 sensor is used by the PCM to calculate the efficiency of the catalytic converter. The sensor must be heated to allow the O_2 sensor to function normally. Without the O_2 functioning normally, the catalytic converter test would be invalid.

Operation

The resistance of the O_2 sensor changes with temperature and age. It's resistance normally is between 100 Ω to 4.5 MegΩ. When the temperature of the sensor is increased, the resistance of the sensor decreases. Inversely, as the sensor ages, the resistance increases. It is the resistance of the sensor's output circuit that is tested for proper heater operation, not the heater element itself.

The test begins approximately 5 seconds after the engine has been turned off with the ignition key and battery voltage greater than 10 volts (the PCM still operates even though the key is in the off position). Once the timer has timed out, the PCM bias 5 volts to the O_2 sensors output wire once every 1.6 seconds, and keeps it biased each time for 35 ms. During this portion of the test, the PCM monitors the voltage on the output wire of the O_2 sensor. As the sensor cools down, the resistance should increase, causing the PCM to register an increase of voltage. The PCM determines a O_2 sensor that has cooled enough by detecting an increase of 0.49 – 1.56 volts higher what the PCM detected at the beginning of the test. The maximum amount of time to perform this portion of the test is 144 seconds.

When the O_2 sensor has cooled enough, the PCM energizes the MFI relay for the next 48 seconds. With the relay energized, current should flow through the heater element causing an increase of temperature at the sensor. As the heater warms the O_2 sensor, resistance of the O_2 sensors output circuit should decrease. As the resistance decreases, voltage at the PCM decreases. While the MFI relay is energized, the PCM pulses the 5 volt biased signal 30 times. Each time the biased voltage is activated, the PCM checks for a voltage drop. The O_2 heater monitor test passes if the PCM detects at least 0.157 volt decrease in 15 out of the 30 pulsed signals.

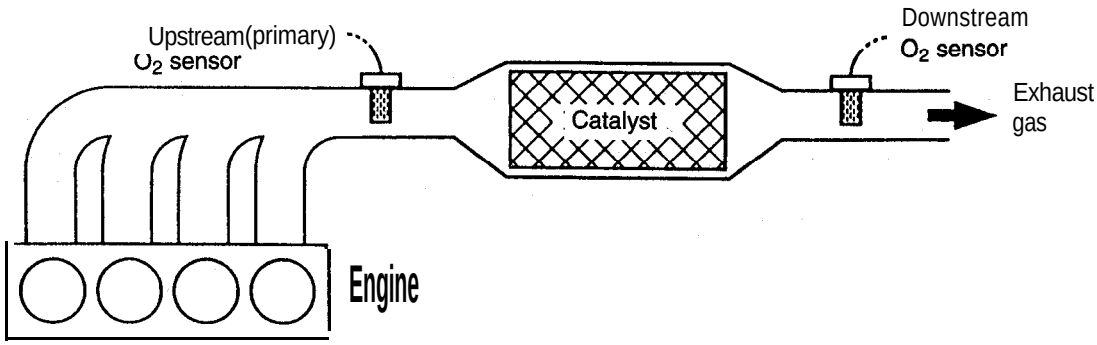
Catalyst Monitor

U71AK42AA

Current vehicles use a three-way catalytic converter to reduce emission of harmful gases. The converters are referred to as three-way because they specifically address three pollutants (hydrocarbons, carbon monoxide, and nitrogen oxide) produced in the combustion chamber. The catalyst monitor uses a pair of inputs to indirectly measure just how effective the catalyst is at reducing emissions.

Operation

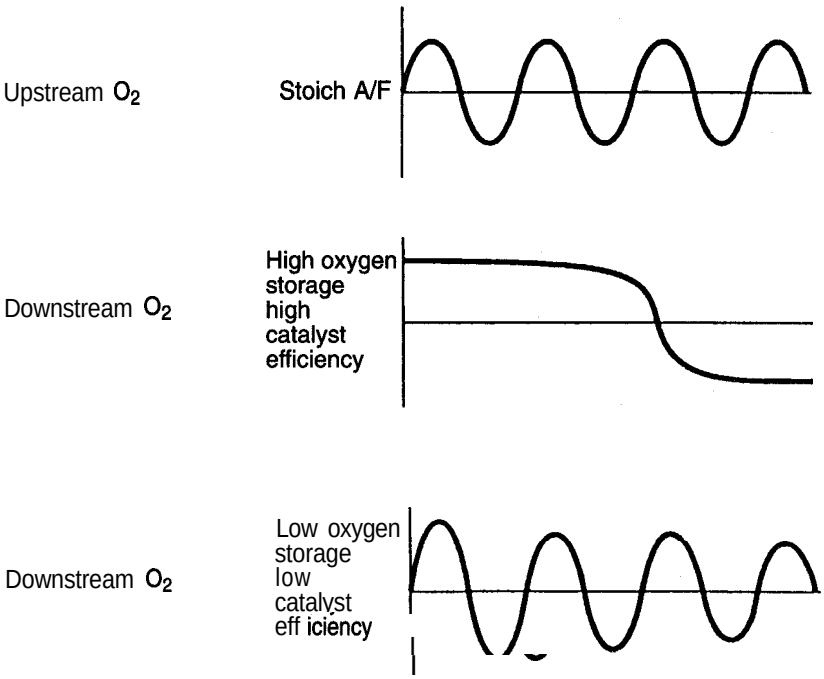
02 sensors located above (upstream) and below (downstream) the catalytic converter are able to monitor the efficiency of the converter. The dual 02 sensor strategy is based on the fact that as a catalyst deteriorates, it oxygen storage capacity and efficiency are both reduced. By monitoring the oxygen storage capacity of the catalyst, its efficiency can be indirectly calculated. The upstream sensor detects the amount of oxygen in the exhaust gas before it enters the converter. This sensor should switch fairly rapidly.



AFUO089

A functioning converter stores oxygen so it can be used for oxidation of hydrocarbons (HC) and carbon monoxide (CO). The downstream sensor detects a lower oxygen level in the exhaust than the upstream sensor. It indicates this by switching at a significantly slower rate than the upstream sensor.

As the converter deteriorates and loses its ability to store oxygen, the switch rate at the downstream oxygen sensor approaches that of the upstream sensor. The system is monitored so that when the switch rate of the downstream sensor reaches 90% of the switch rate of the upstream sensor (automatic transmissions), the MIL is illuminated. The threshold for manual transmissions is 70%. At this point, exhaust emissions are projected to exceed 1 1/2 times the legal limit.



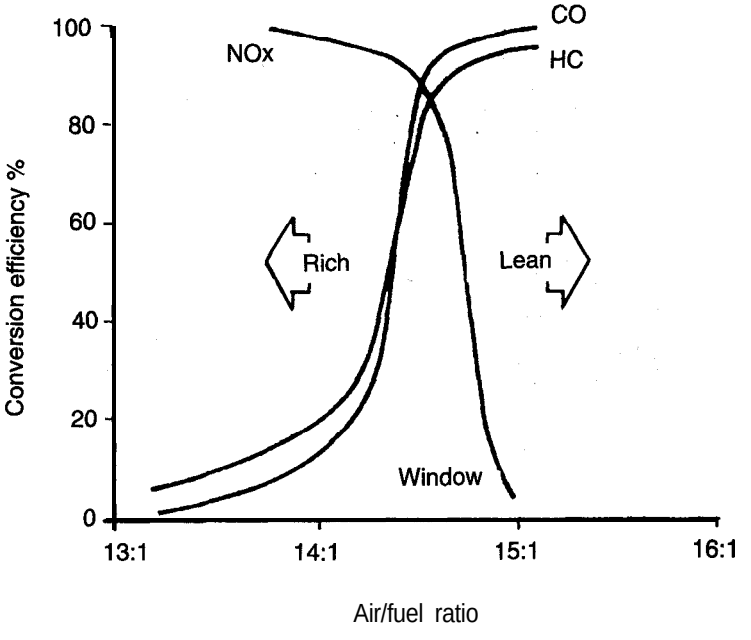
AFU0090

Fuel System Monitor

N71AK43AA

Background

To control the level of undesirable emissions, the fuel system must be able to maintain strict control of the air/fuel ratio. Stoichiometry is the optimum air/fuel ratio, which is 14.7 to 1. At this point the best balance between the production of HC's and CO's (which drop as the mixture becomes leaner) and NOx (which increases as the air/fuel mix becomes leaner) can be found. This is also the point where the catalytic converter is most efficient at converting all three gases to less harmful compounds. The goal of the PCM is to examine input information and control outputs to produce a constant stoichiometric ratio.

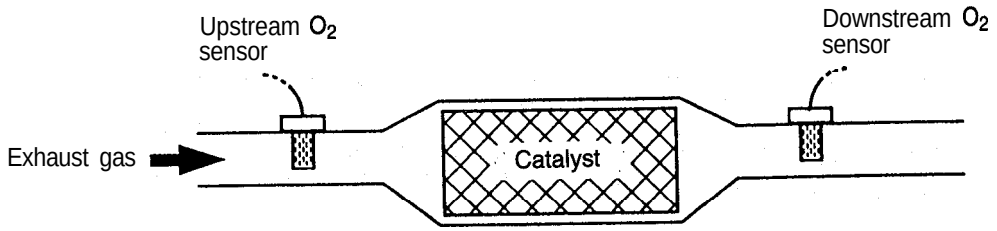


AFU0091

Operation

The Power-train Control Module (PCM) varies the pulse width of the fuel injectors to provide precise control of the air/fuel mixture. Wider pulse widths increase the volume of fuel delivered to the cylinders. The PCM uses the input from a number of sensors in its attempt to reach and maintain this air/fuel ratio. Manifold Absolute Pressure (MAP), and the O_2 sensor have the greatest influence (authority) over injector pulse width. Other inputs such as the Throttle Position Sensor (TPS), engine RPM, Engine Coolant Temperature (ECT) Sensor, Intake Air Temperature (IAT) Sensor. Vehicle Speed Sensor (VSS) and battery voltage all have varying levels of influence on pulse width, depending on the circumstances.

As noted earlier, the system uses two oxygen sensors both of which monitor the oxygen content of the combustion byproducts on their way out of the engine as exhaust. Only the upstream sensor has authority over fuel injector pulse width.



AFU0092

If a large amount of oxygen remains following the combustion process, this sensor produces a low voltage. This indicates a lean condition caused by a ratio greater than stoichiometric. Little oxygen in the exhaust allows the sensor to produce a higher voltage, indicating a rich condition where the air/fuel ratio is less than stoich.

Upstream O_2 sensor feedback to the PCM is used to fine tune injector pulse width to maintain stoichiometric and meet emission standards. It can increase or decrease injector pulse width by as much as 50%. Pulse width is calculated from the data supplied from the MAP, TPS, ECT, IAT, upstream O_2 sensor, battery voltage, RPM and VSS.

To control air/fuel ratio feedback, the PCM uses short term correction and long term memory. Before the PCM can alter the programmed injector pulse width, it must enter closed loop operation. The requirements for closed loop operation are listed below:

- Engine temperature exceeds 35°F
- O_2 sensor is in the ready mode
- All timers have timed out -following the START to RUN transfer (The length of these timers varies with engine temperature)

35°F – 41 sec.
50°F – 35 sec.
70°F – 22 sec.
167°F – 11 sec.

Once in the closed loop control, the feedback systems begin to operate. Short term memory works with the long term memory, which is broken down into 14 different cells. Two of these cells (12 and 13) are used only during idle. Each cell represents a manifold pressure and rpm range and can be accessed with the MUT-II diagnostic scan tool.

Long Term Memory Cells

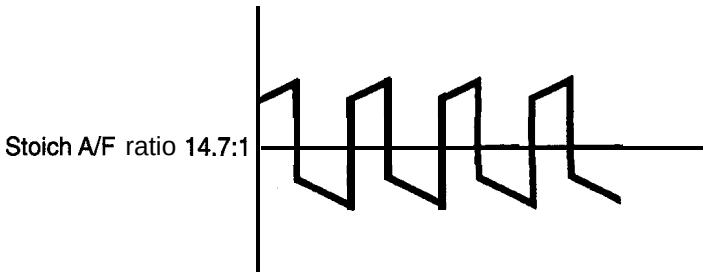
ABOVE 2048 RPM	1	3	5 Purge Free*	7	9	11		13 Idle Neutral Manual Transaxle Purge Free*
BELOW	0	2 Purge Free*	4	6	8	10		
Map Voltage		1.38	2.0	2.64	3.26	3.9		

*PCM disables the canister purge function in these cells to gather data used for purge control and diagnostics.

For example:
If the PCM were in cell 3, the MAP voltage must be between 1.38 and 2.0V and engine rpm must be greater than 2048. This is the cell that the control system would update.

If the oxygen sensor registers a rich or lean condition while driving in this cell, the cell will require updating to aid in fuel control. The short term correction is used first. It starts increasing pulse width quickly (kick), then ramps up slowly. Each control is in inverse relation to the signal sent from the O_2 sensor.

For example:
The O_2 sensor switches lean to rich. Short term compensation kicks in lean, then ramps lean until the O_2 sensor switches lean. At this point short term compensation reverses the process.



AFU0093

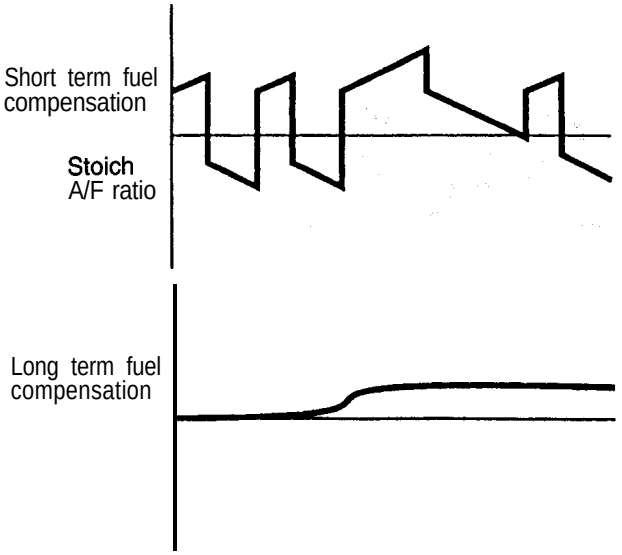
If the oxygen sensor shows lean, the short term compensation goes rich and multiplies the pulse width from long term memory in that cell by an amount greater than 1. If the sensor shows rich, the short term compensation drives the pulse width narrower by multiplying by a number less than 1 (perhaps 0.97). The short term compensation can multiply pulse width by as much as 1.25 or as little as 0.75 to compensate for lean or rich conditions.

In this way, the short term compensation can increase pulse width by up to 25% (by multiplying by 1.25) or decrease pulse width by up to 25% (by multiplying by 0.75).

Example:
Pulse width 0.05 x 1.25 = 0.0625 (increase of 25%)
Pulse width 0.05 x 0.75 = 0.0375 (decrease of 25%)

Long term memory also has control over pulse width by being able to increase or decrease the pulse width stored in the cell by up to 25%. Long term memory is retained by the battery in the PCM, while short term correction is lost whenever the ignition is turned off.

The long term memory works to bring the short term correction to the point where the average percent of pulse width compensation it provides in this memory cell is 0%. The long term memory returns to this level of pulse width compensation the next time the vehicle enters this cell. It is in this way that the PCM is continually relearning the most appropriate level of control, even as the vehicle ages, internal engine components wear, and operating conditions change.



AFUO094

There are several “purge free” cells. These cells contain information on how much effect the canister has on the air/fuel ratio. The purge solenoid is turned on to shut off the purge flow and the cell is allowed to register any purge corruption. The monitor looks at the combination of short and long term fuel control values to see if the system is in control.

The fuel system is continuously monitored during each trip once the enabling conditions have been met. Short term and long term values are multiplied together. The test fails if the fuel control system reduces pulse width by 25% long term memory and 7% short term compensation due to a rich condition or increases pulse width by 25% long term memory and 12% short term compensation due to a lean condition.

Misfire Monitor

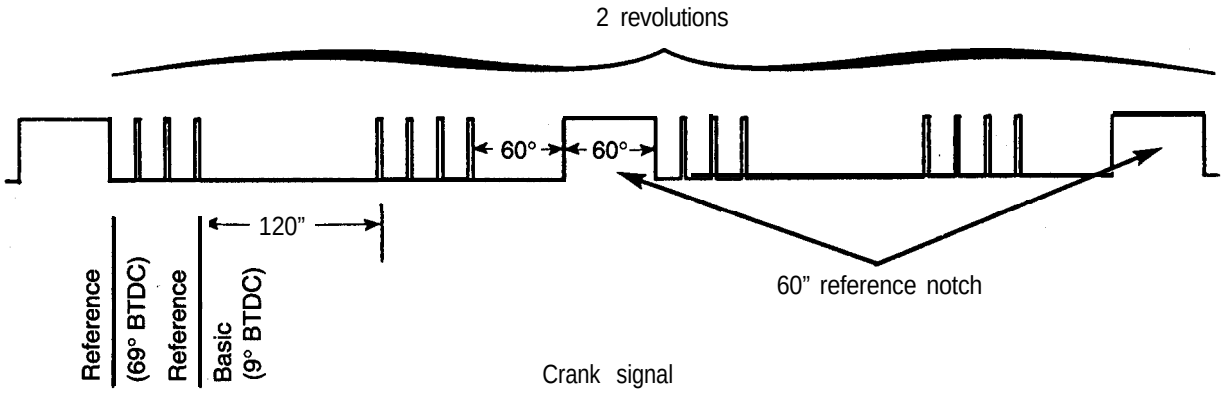
N71AK44AA

Background

Misfire is defined by the California Air Resources Board as the lack of combustion in a cylinder due to absence of spark, poor fueling, compression, or any other cause. As a result, the air/fuel mixture will not burn, and during the exhaust stroke, it enters the exhaust system. The raw fuel and excess oxygen adversely affect the fuel system's feedback mechanism (the oxygen sensor) and can cause permanent damage to the catalytic convertor.

Operation

The OBD II misfire monitor uses information provided by the crank position sensor to determine engine rpm and detect slight variations due to engine misfire. Crankshaft rpm is calculated between the 69° and 9° falling edges of the crankshaft position sensor signal.



AFU0095

The threshold for determining what amount of rpm change indicates misfire varies with engine speed and load. This is required because as engine speed increases or load decreases, the overall effect of a single cylinder misfire diminishes due to the momentum of the crankshaft.

The misfire monitor contains an adaptive feature that can take into account component wear, sensor fatigue, and machining tolerances. The PCM notes rpm variance between cylinders during normal vehicle operation and then uses these figures as a foundation for calculating the threshold at which rpm variance is considered to indicate misfire.

NOTE
The PCM requires normal vehicle operation to update its memory. Because the PCM has no reference for "normal operation", the PCM considers a misfire condition to be normal if installed in a vehicle that is misfiring. The same situation can occur anytime battery power to a PCM is lost and a vehicle is misfiring when the controller is reconnected,

The misfire monitor triggers operation of the MIL in two different operating situations:

1,000 Rev Misfire

Misfire is continuously monitored (in 200 revolution segments) once the enabling conditions have been met. If the monitor detects misfire in more than 1.6% of the engine cycles in a 1,000 revolution period, a temporary fault is set. Freeze frame data of the operating conditions during the last 200 rpm of that 1,000 revolution period are stored. As with other monitors, failure of the misfire monitor on the next trip matures the code, the MIL illuminates, and a DTC is stored. It is important to note that two trips are required for the code to mature. Continued misfiring during the initial trip does not illuminate the MIL.

200 Rev Misfire

If the monitor detects misfire in more than 15% of cylinder firing opportunities during any 200 revolution monitored segment, the MIL immediately begins flashing, a DTC is started, and the freeze frame is stored with information regarding the conditions at which the misfire occurred. This indicates that engine misfire has reached the point where damage to the catalytic converter is likely to occur. The vehicle defaults to open loop operation to prevent the adaptive fuel controls from dumping additional fuel into the cylinders and accelerating damage to the catalyst. Driving the vehicle with the MIL flashing is not recommended.

Once out of the operating condition where the 15% misfire is occurring, the MIL will stop flashing but remain illuminated. The vehicle may be driven, but should be serviced immediately.

Because some misfire is a common occurrence in a number of driving conditions, MIL illumination due to misfire may occur when no component has failed. Try to identify conditions that could trigger the misfire monitor that are not related to component failure. Example of these are included below:

- Damp ignition system components
- Low fuel/running out of gas (monitor triggers as engine sputters)
- "Lugging" the engine
- Pulling heavy loads
- Low quality gasoline

In addition, the following situations could mistakenly trigger the MIL:

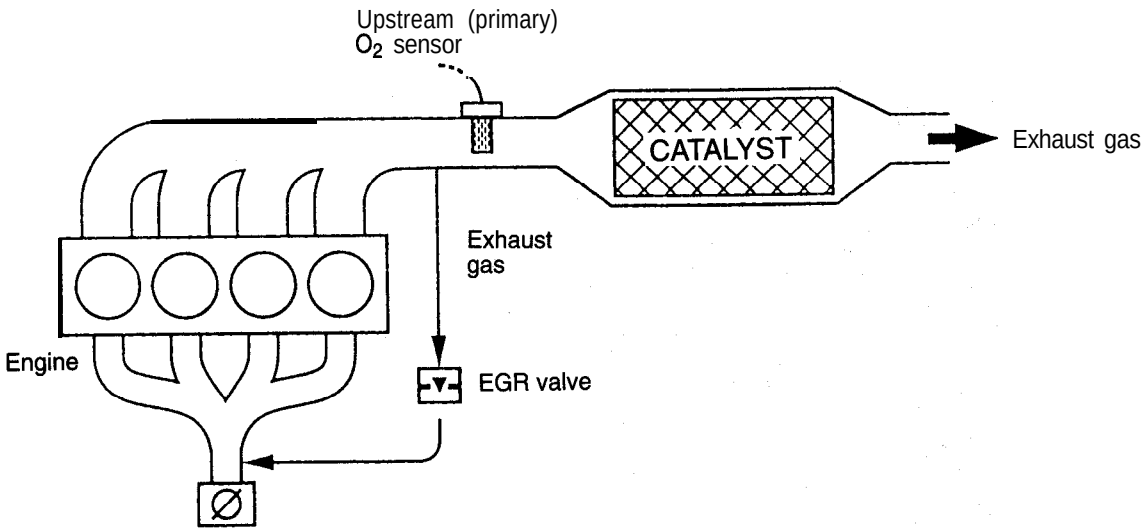
- Large potholes
- Extended rough road operation

Exhaust Gas Recirculation Monitor

N71AK45AA

Background

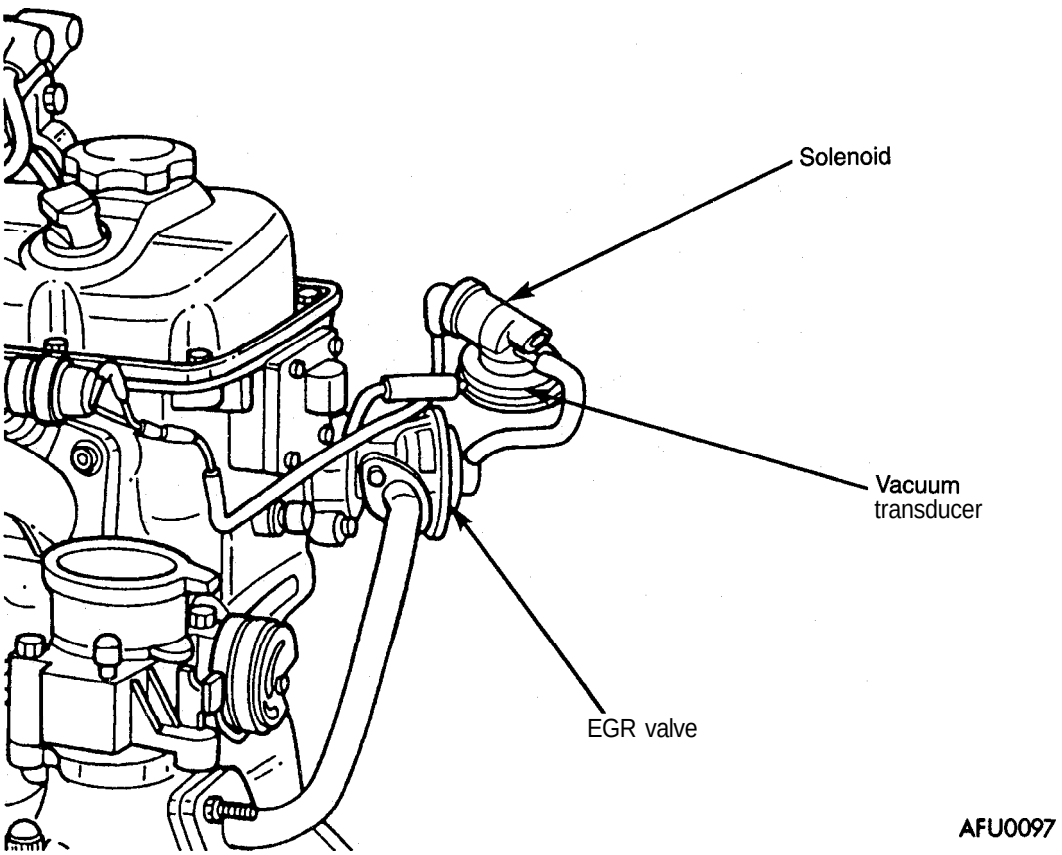
Exhaust Gas Recirculation (EGR) is a method of reducing oxides of nitrogen (NOx) emissions by introducing non-combustible exhaust gases into the combustion chamber. These gases absorb heat and reduce the high cylinder operating temperatures where NOx is most likely to occur. Lower combustion chamber temperatures result in lower NOx emissions.



AFU0096

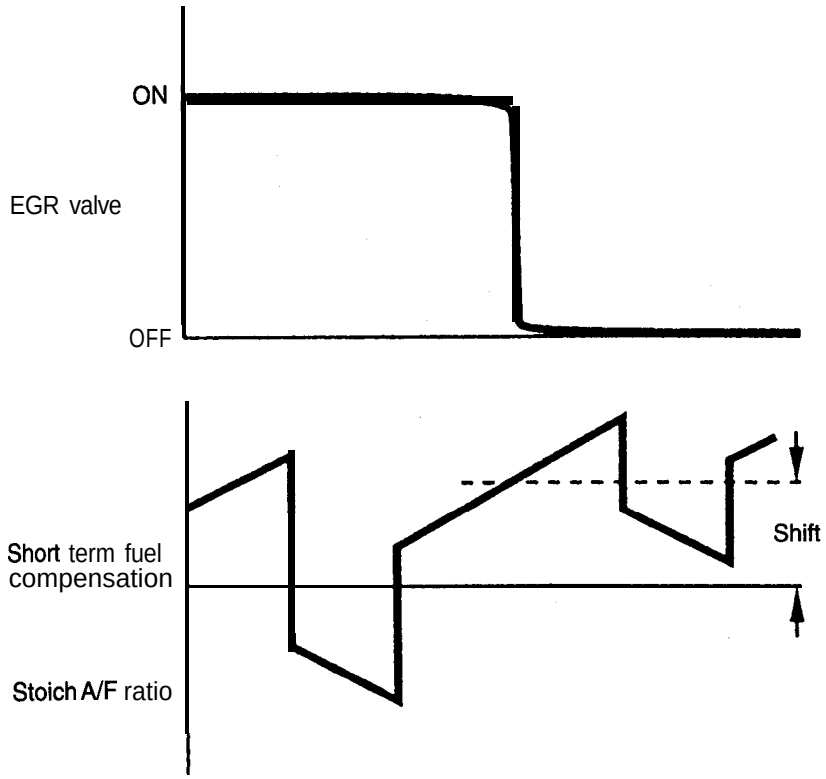
Operation

The EGR system consists of a vacuum solenoid, back pressure transducer and a vacuum operated valve. When activated, the solenoid allows vacuum to flow to the transducer. Negative exhaust backpressure allows manifold vacuum from the solenoid to vent to atmosphere. Positive exhaust backpressure causes the transducer diaphragm to modulate. This allows intake manifold vacuum to reach the EGR valve. The combination of vacuum on one side of the valve diaphragm and exhaust back pressure on the other allows exhaust gases to be introduced into the intake manifold.



An EGR system stuck in the closed position prevents the system from decreasing NOx emissions. A system stuck in the open position can increase hydrocarbon emissions, fuel consumption, and produce rough engine operation.

The detect operation of the system, the solenoid is disabled and the O_2 compensation control is monitored. If ttie EGR system is operating properly, turning'it off shifts the air/fuel ratio in the lean direction. O_2 sensor data should indicate an increase in oxygen in the exhaust gases and cause the short term control to shift rich. The amount of the shift indirectly monitors the operation of the system.



AFU0098

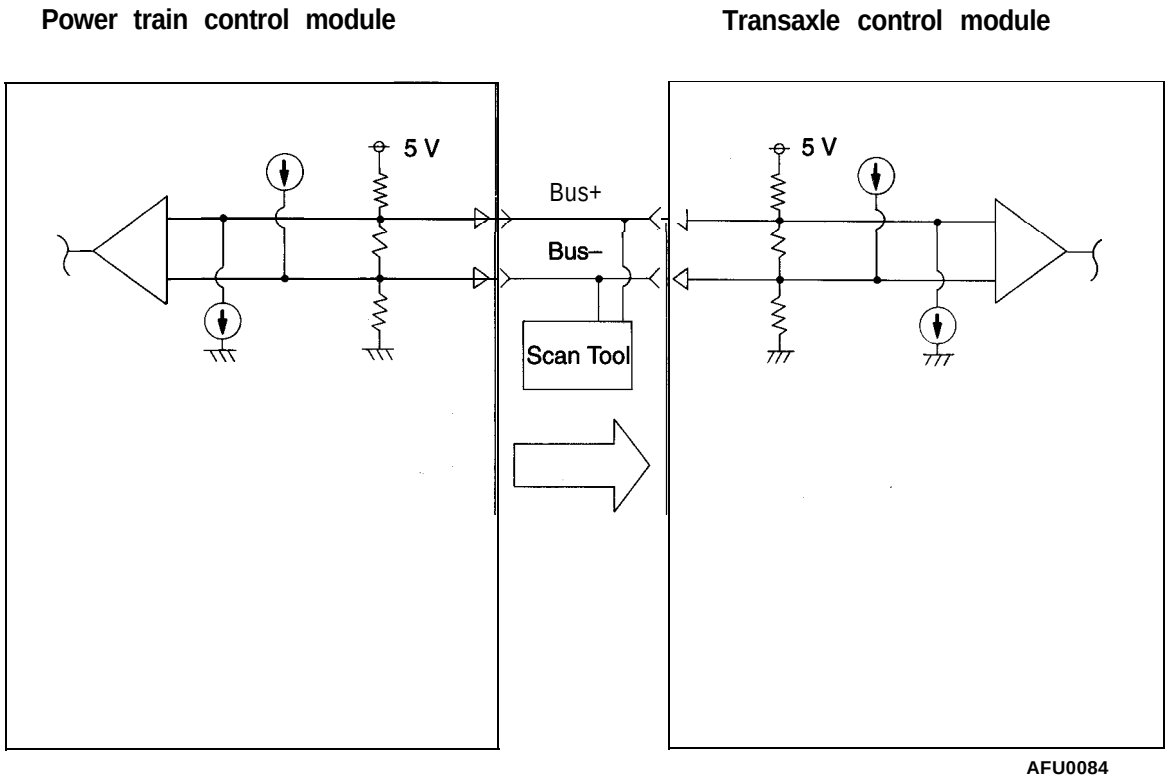
COMPREHENSIVE COMPONENTS N71AK46AA

Refer to Group 13 — Troubleshooting in the Service Manual.

DATA TRANSMISSION SYSTEM

N71AK50AA

The power train control module (PCM) and transaxle control module (TCM) transfer control data to and from each other via a data communication system. The scan tool receives various types of data from the transaxle control module through the data communication line and displays the data on the display. (Various types of data are also received by the scan tool from the power train control module through a line different from this data communication line.)



The power train control module and transaxle control module communicate with each other by alternately sending the data in their respective modules to the data bus.
In other words, the power train control module sends all its data to the data bus, and the transaxle control module receives only those data items it needs from the bus. Then the transaxle control module sends all its data to the data bus. The power train control module does not require any specific data from the data bus.

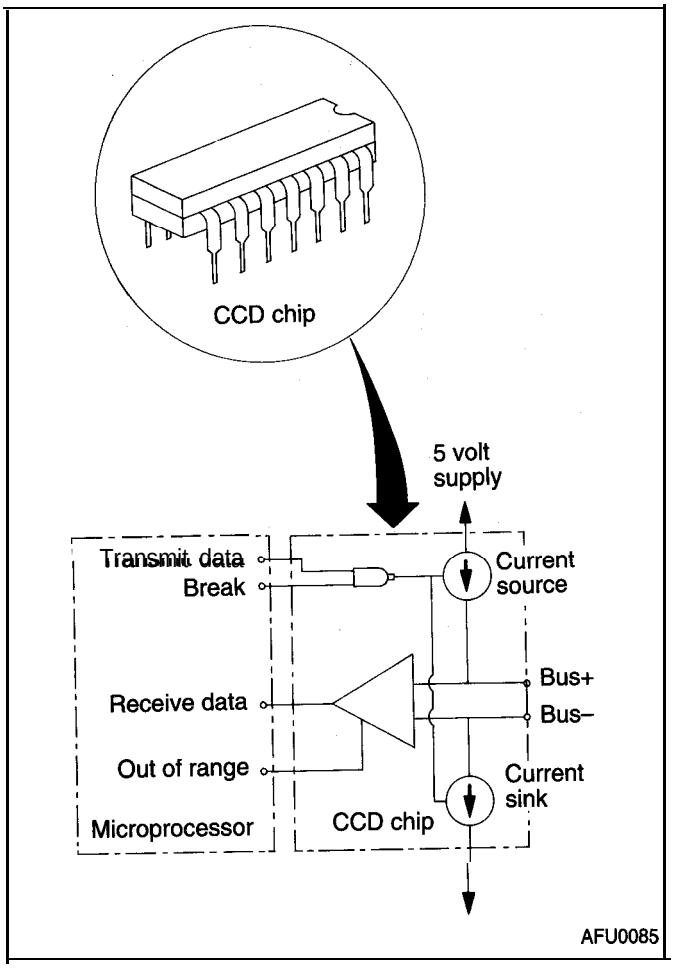
Bus+ and Bus- Circuits

N71AK51 AA

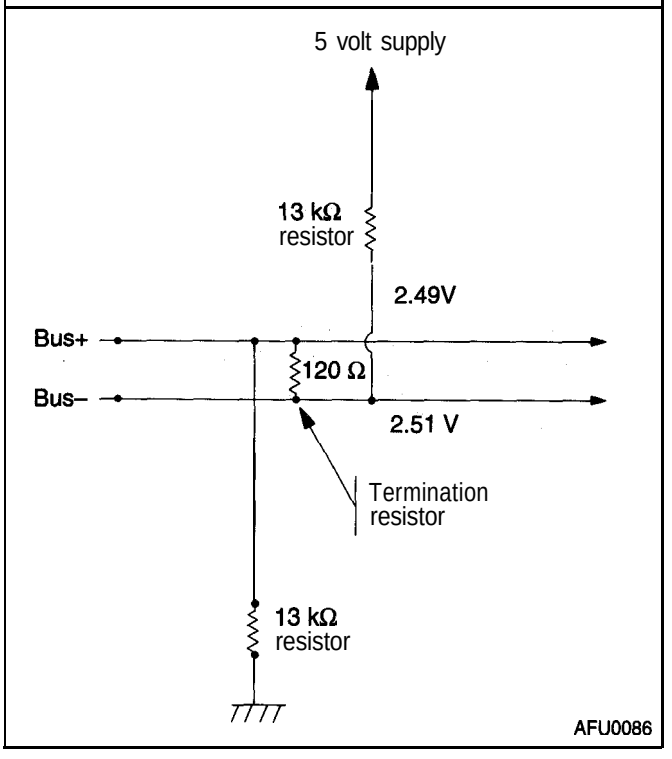
The data transmission system has two wires connected in parallel to the PCM and TCM. One circuit is Bus+, and the other is Bus-. For proper communication, the wires must be twisted together at 1.75" intervals. Twisting of the wires is intended to prevent switched-to-battery or switched-to-ground circuits from inducing electromagnetic interference (EMI) into the bus circuits.

If the twists are not maintained throughout the bus circuits (at connectors and splices), false signals can be conveyed to all modules on the bus.

Communication chip (Communication Control Integrated Circuits)



The bus circuits connect inside all modules to a communication chip. The illustration at left shows a representative communication chip block diagram. For communication to occur, the bus must have Biasing and Termination (see the following sections.)



Biasing N71AK52AA

Both bus circuits are biased (supplied voltage) to approximately 2.5 volts. The Bus+ and Bus- circuits are biased through a series circuit (see the illustration at left). The bus current travels from a 5 volt source through a 13k ohm resistor to Bus-, then through a 120 ohm termination resistor to Bus+, and then to ground through a 13k ohm resistor. Bus bias is the voltage required to operate the bus.

If the system is functioning normally, the Bus- circuit voltage is slightly higher than the Bus+ circuit voltage. This is normal, and is caused by the 120 ohm termination resistor. The operating bus bias range is approximately 1.5 – 3.5 volts. At voltage above or below this range, the bus has difficulty communicating correctly.

Termination

The termination resistors are provided both the inside of PCM and the inside of TCM.
For the bus circuit to be complete, at least one termination point must exist.

The resistance in the bus circuit is due to the termination resistors. It can be measured with an ohmmeter at the data linkconnector by attaching the two ohmmeter leads to the two bus wires. The ohmmeter will read 100 to 140 ohms for one controller with termination and 40 to 80 ohms for two controllers with termination.

The termination points are inside of a controller but outside the communication chip.

Inputs and Outputs N71AK53AA

Messages sent over the communication system can be considered both inputs and outputs. Output messages from any one module are used as input messages to the other modules on the communication system.
Input messages are used by the modules to implement specific features. This arrangement allows more than one module to use information from the same sensor. Another example of output messages are those sent to the scan tool for diagnostic purposes.

Bus Communication

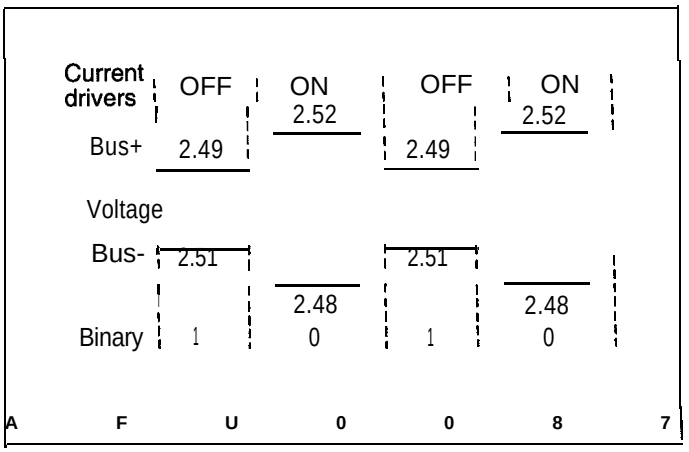
N71AK54AA

For communication to occur, the following basics are needed:

- Bus+ and Bus- wires must be connected in parallel to all modules.
- Bus+ and Bus- wires are biased to approximately 2.5 volts.
- Bus+ and Bus- wires must have at least one point of termination.

Communication is based on voltage differential between the two bus wires. The differential occurs when two parts of the communication chip, the current sink and the current source, are used by the communication chip to control the bus current flow.

Two different signal conditions can exist when the bus functions normally; there can be a "0" bit or a "1" bit.



When the bus circuits are not allowing current to flow, there is a "1" condition. When the bus is idle and no messages are being sent, the bus is in the "1" condition.

When the current source passes a small amount of current into the Bus+ wire, and the current sink allows a small amount of current to be passed to ground, there is a "0" condition.

Messages are made from a series of these "0" and "1" signals. Messages are generally transmitted every ten or more milliseconds.

Each microprocessor on the bus is connected to a communication chip. The communication chip communicates to the CPU the messages transmitted and received on the bus.

ENGINE ELECTRICAL

N71AX01AA

GENERATOR

The generator is mounted on the right side of the engine, and is secured to the cylinder block with a pivot bracket and an adjustment bracket. The pivot bracket is secured with three mounting bolts. The case is grounded to the block, and three electrical connections are provided for charging system operation.

The output voltage of the generator is regulated by the power train control module.

NOTE
The Power supply cable is connected to the generator with a nut. The PCM voltage control circuit is the smaller of the two-way connectors at the rear of the generator.

STARTER MOTOR

N71AX02AA

The starter motor is located on the left side of the engine. Locations to connect the battery positive wires are provided at the starter solenoid.

IGNITION SYSTEM

N71AX03AA

This engine uses the distributorless electronic ignition system. The distributor-less electronic ignition system is referred to as the Direct Ignition System. Basic ignition timing is not adjustable. The powertrain control module (PCM) determines spark advance. The system's three main components are the coil pack, crankshaft position sensor, and camshaft position sensor.

The crankshaft position sensor and camshaft position sensor are hall effect devices. The camshaft position sensor and crankshaft position sensor generate pulses that are inputs to the PCM. The PCM determines crankshaft position from these sensors. The PCM calculates injector sequence and ignition timing from crankshaft position. For a description of both sensors; refer to Camshaft Position Sensor and Crankshaft Position Sensor in this section.

EMISSION CONTROL SYSTEM

GENERAL INFORMATION

N71AP00AA

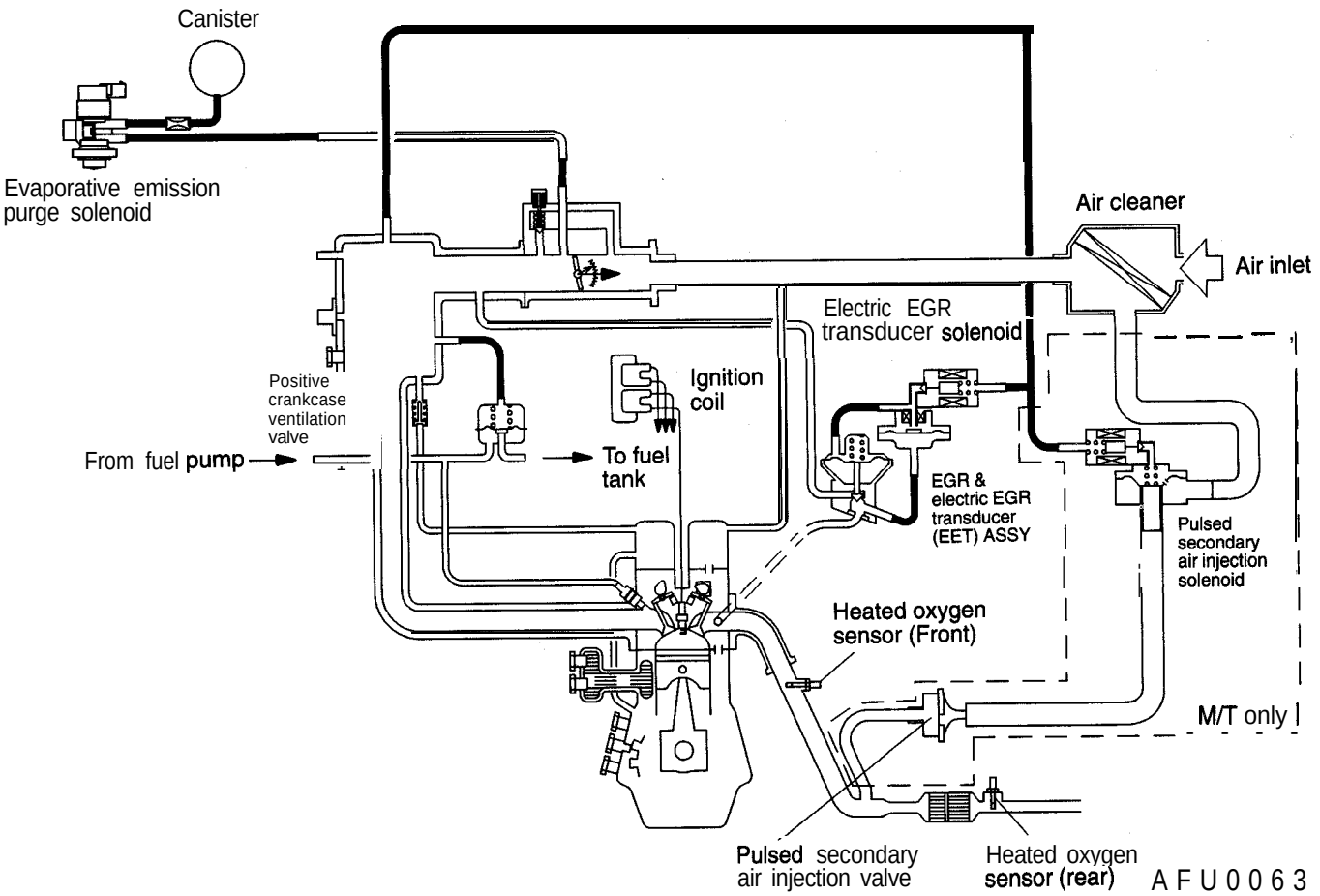
There are three sources of vehicle exhaust emissions generated: the exhaust gases resulting from combustion, the blow-by gases generated within the crankcase, and the evaporative emissions generated from the fuel tank and other components of the fuel line.

The emissions-control system, which is designed to control the discharge of these exhaust gases into the atmosphere, is composed of the following system components.

(1) Exhaust emission control system
(2) Crankcase emission control system
(3) Evaporative emission control system

The exhaust emissions-control system reduces the amount of carbon monoxide, hydro carbon and oxides of nitrogen in the exhaust gases by adding the exhaust gas recirculation device and the catalytic converter to fundamental improvements such as an improvement of the combustion chamber and the camshaft, as well as other improvements to the engine such as feedback control of the air/fuel ratio by the electronically controlled fuel injection system.

The crankcase emissions-control system is a closed type so that blow-by gases are not discharged out to the atmosphere. The evaporative emissions-control system is the canister type; vapors that are generated within the fuel tank are introduced into the intake manifold and are cornbusted so that they are not emitted out to the atmosphere.

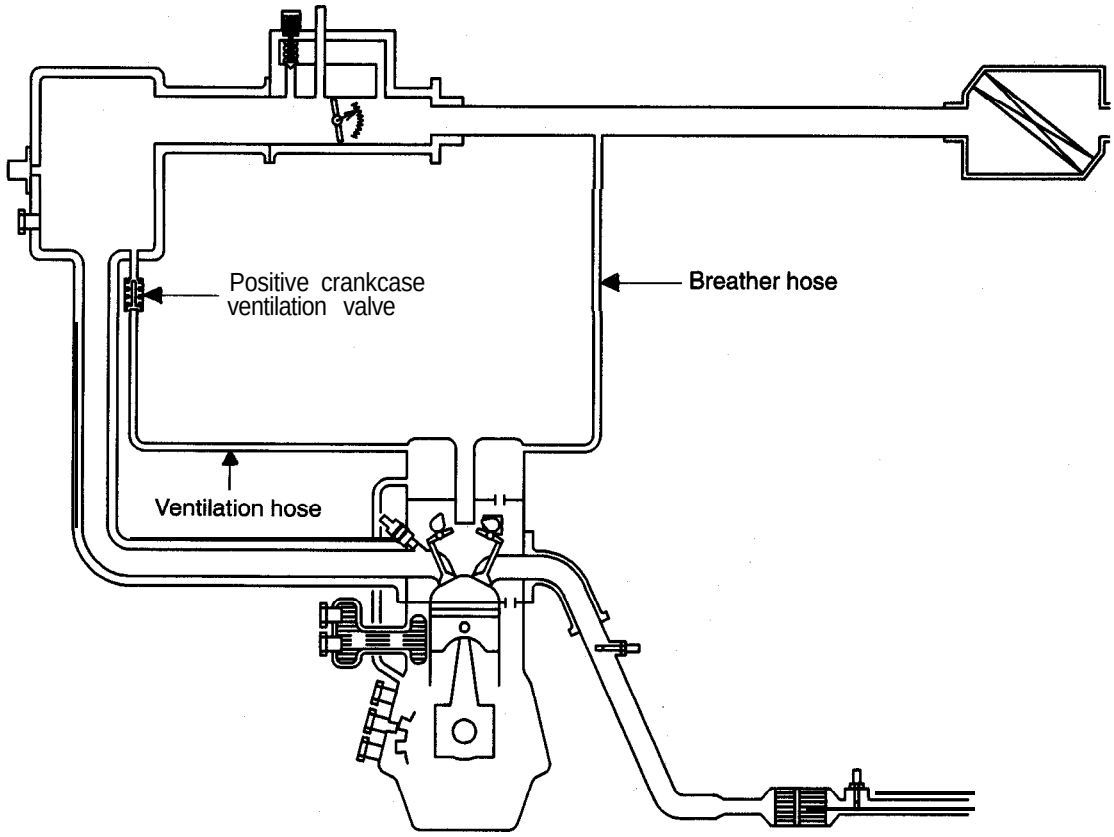


POSITIVE CRANKCASE VENTILATION SYSTEM

N71AP01AA

The positive crankcase ventilation system is a system for preventing the escape of blow-by gases from inside the crankcase into the atmosphere. Fresh air is sent from the air cleaner into the crankcase through the breather hose to be mixed with the blow-by gases inside the crankcase.
The blow-by gas inside the crankcase is drawn into the intake manifold through the positive crankcase ventilation valve.

The positive crankcase ventilation valve is designed to lift the plunger according to the intake manifold vacuum so as to regulate the flow of blow-by gas properly.
In other words, the blow-by gas flow is regulated during low load engine operation to maintain engine stability, while the flow is increased during high load operation to improve the ventilation performance.



AFU0003

EVAPORATIVE EMISSION CONTROL SYSTEM

N71AP02AA

The evaporative emission control system prevents the emission of fuel tankvapors into the atmosphere. When fuel evaporates in the fuel tank, the vapors pass through vent hoses or tubes to the charcoal filled EVAP canister. The EVAP canister temporarily holds the vapors. Through the EVAP purge solenoid, the power-train control module (PCM) allows intake manifold vacuum to draw vapors into the combustion chambers during certain operating conditions. The solenoid regulates vapor flow from the canister to the engine.

OPERATION

The EVAP purge solenoid regulates the rate of vapor flow from the EVAP canister to the throttle body. The PCM operates the solenoid.

During the cold start warm-up period and the hot start time delay, the PCM does not energize the solenoid. When de-energized, no vapors are purged. The PCM de-energizes the solenoid during open loop operation.

The engine enters closed loop operation after it reaches a specified temperature and the programmed time delay ends. During closed loop operation, the PCM energizes and de-energizes the solenoid approximately 5 to 10 times per second, depending upon operating conditions. The PCM varies the vapor flow rate by changing solenoid pulse width. Pulse width is the amount of time the solenoid de-energizes.

PULSED SECONDARY AIR INJECTION SYSTEM

N71AP03AA

Only manual transaxle vehicles have a pulsed secondary air injection system. The system injects fresh air upstream of the catalytic convertor. It operates for a short period after cold engine start-up until the engine coolant temperature reaches approximately 5% (125°F)

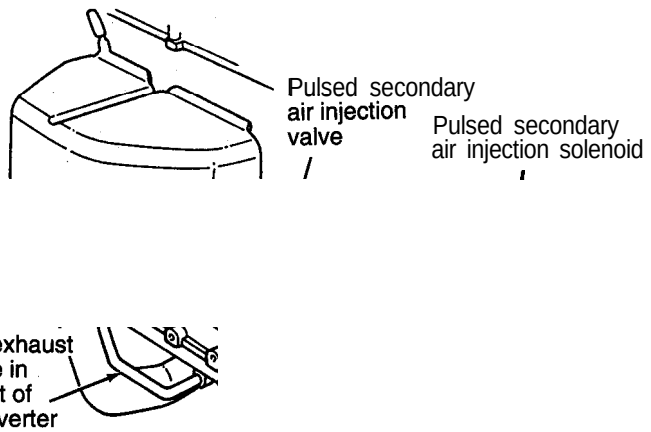
The secondary air injection system contains:

- Pulsed secondary air injection valve
- Pulsed secondary air injection solenoid
- Connecting hoses and tubes

OPERATION

The PCM controls the ground path for the solenoid. When the PCM grounds the solenoid, fresh air from the air cleaner flows through the aspirator valve to the catalytic convertor.

The aspirator valve prevents exhaust gases from flowing into the fresh air stream, at the air cleaner when the solenoid is grounded. If the aspirator valve malfunctions, a popping noise could be heard during cold start throttle stabs.



AFU0015

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

N71AP04AA

The exhaust gas recirculation (EGR) system lowers the nitrogen oxide (NOx) emission level. When the air/fuel mixture combustion temperature is high, a large quantity of nitrogen oxides (NOx) is generated in the combustion chamber. Therefore, this system recirculates part of emission gas from the exhaust port of the cylinder head to the combustion chamber through the intake manifold to decrease the air/fuel mixture combustion temperature, resulting in reduction of NOx.

The EGR flow rate is controlled by the EGR valve so as not to decrease the driveability.

The EGR system contents:

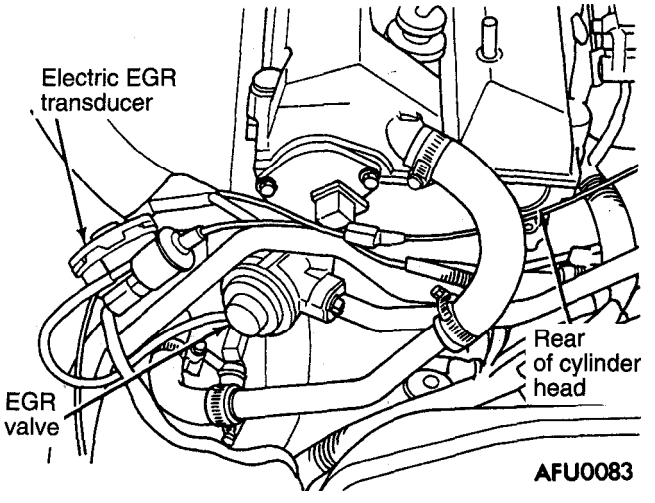
- EGR tube
- EGR valve
- Electronic EGR transducer (EET)
- Connecting hoses

OPERATION

The electronic EGR transducer (EET) contains an electrically operated solenoid and a back-pressure transducer. The PCM operates the solenoid. The PCM determines when to energize the solenoid. Exhaust system back-pressure controls the transducer.

When the PCM energizes the solenoid, vacuum does not reach the transducer. Vacuum flows to the transducer when the PCM energizes the solenoid. When exhaust system back-pressure becomes high enough, it fully closes bleed valve in the transducer. When the PCM energizes the solenoid and back-pressure closes the transducer bleed valve, vacuum flows through the transducer to operate the EGR valve.

Energizing the solenoid, but not fully closing the transducer bleed hole (because of low back-pressure), varies the strength of vacuum applied to the EGR valve. Varying the strength of the vacuum changes the amount of EGR supplied to the engine. This provides the correct amount of exhaust gas recirculation for different operating conditions.



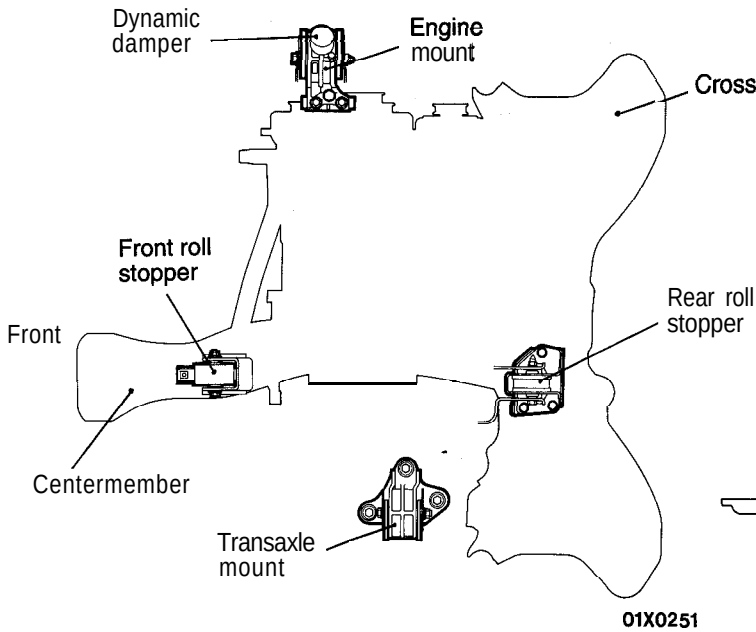
MOUNT

N71AU00AA

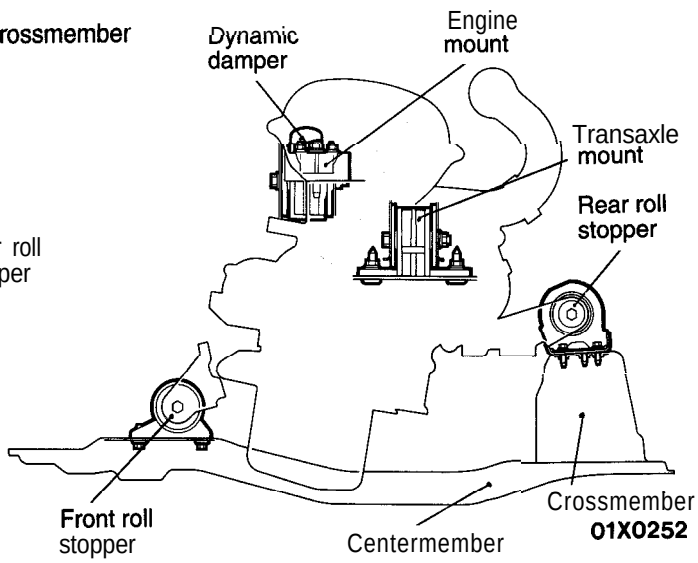
The engine mounts use a principal axis inertia support system.
This support method on the principal axis inertia is a structure that supports the top of the engine and top of the transaxle to effectively control engine vibration.

FEATURES

- The mount elements are arranged near the roll axes of the engine and transaxle so that the rolling moment can be limited and vibrations can be reduced during idling.
- The front and rear roll stopper brackets have been relocated to the transaxle housing. As a result, the bracket has been made shorter and more rigid, which contributes to less vibration and noise.
- Each insulator with internal hollows has outstanding vibration absorbing characteristics.
- Brackets cast from aluminum are used for the engine mounts and transaxle mounts so as to reduce booming noise.
- Conventional arrangement of the engine and transaxle has been reversed to mount the engine on R.H. side of the vehicle and the transaxle on the L.H. side, resulting in reversal of the positions of the respective mounts.



01X0251



01X0252

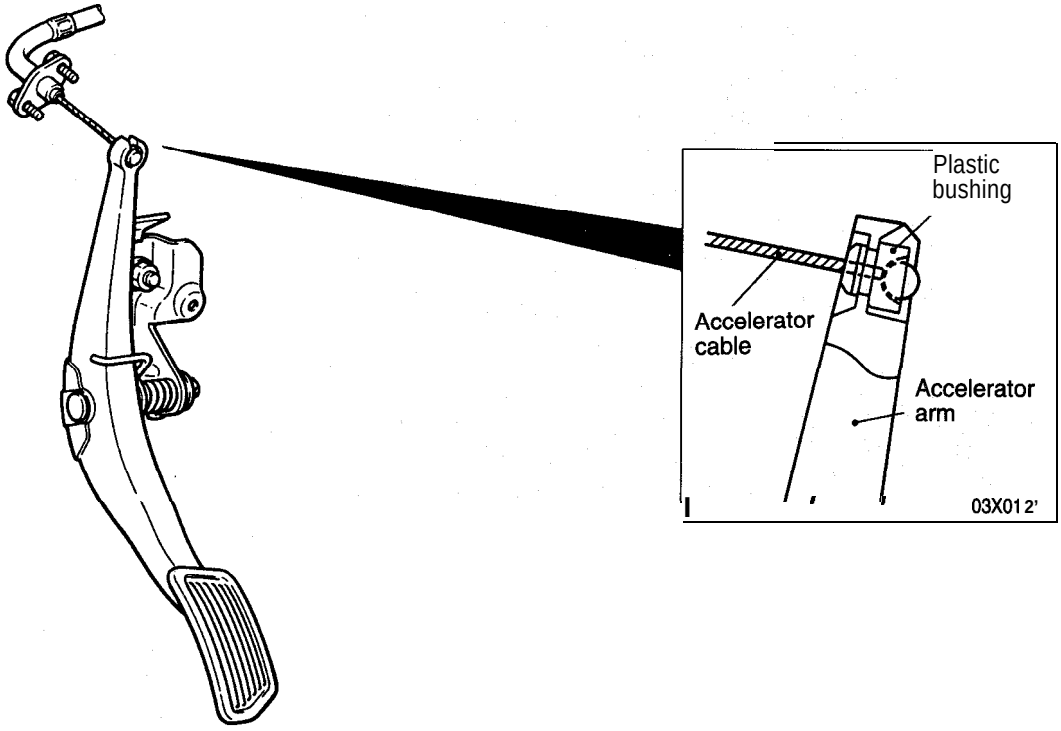
ACCELERATION SYSTEM

N71AW00AA

ACCELERATOR PEDAL AND ACCELERATOR CABLE

The accelerator system is a cable and suspended pedal combination.

The accelerator pedal side end of the cable is provided with a plastic bushing which effectively suppresses the noise that would result from direct contact of the cable and the accelerator arm.

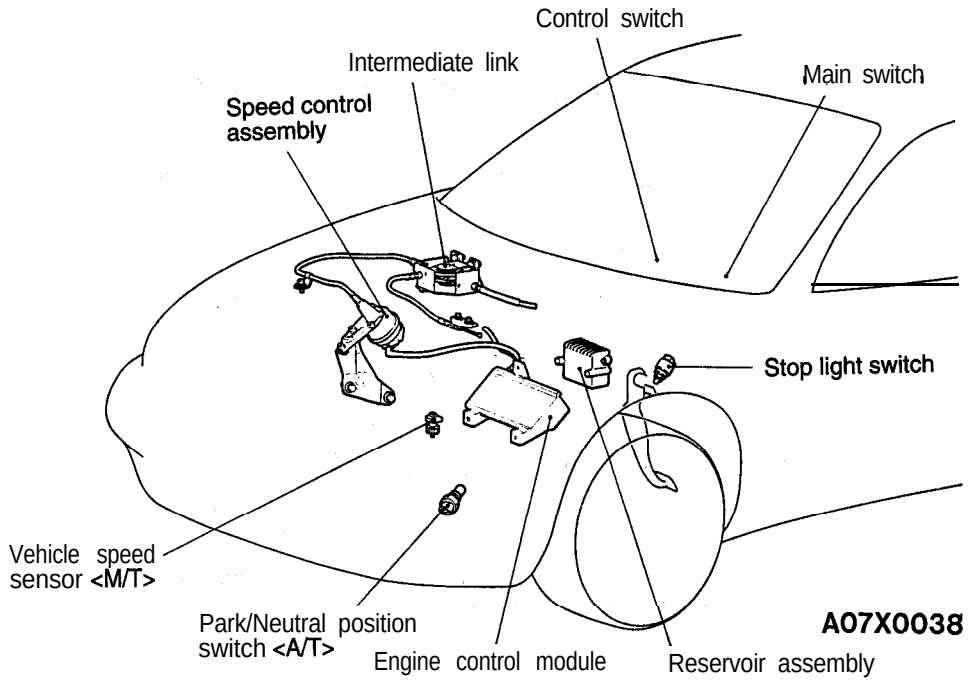


07X0013

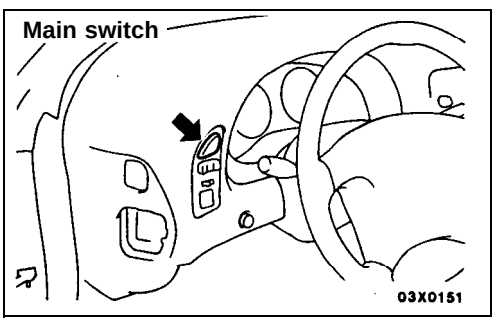
AUTO-CRUISE CONTROL SYSTEM

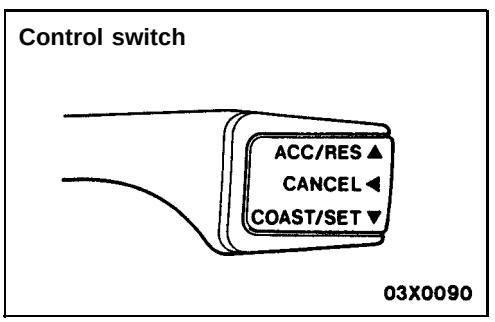
N71AW01AA

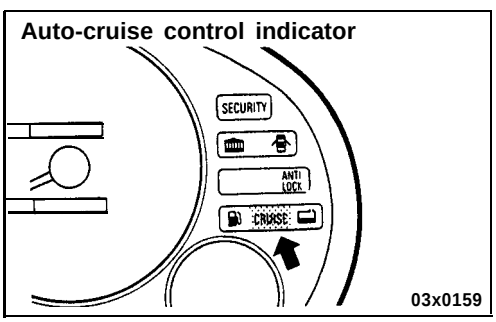
By using the auto-cruise control, the driver can drive at the speed he likes [in a range of approximately 56 to 137 km/h (35 to 65 mph)] without depressing the accelerator pedal.
The actuator system consists of a reservoir assembly and a speed control assembly. The actuator is operated by intake manifold vacuum.
The control unit is incorporated in the engine control module. Transmission of information including vehicle speed and engine speed is accomplished in the inside of the module.



07X0038







ENGINE <TURBO>

GENERAL INFORMATION

N71BA01AA

This 4G63-DOHC engine with turbocharger is essentially the same as the one currently used for Eclipse.

MAJOR SPECIFICATIONS

Items	Specifications
Total displacement cm³ (cu.in.)	1,997 (121.9)
Bore x Stroke mm (in.)	85.0 (3.35) x 88.0 (3.46)
Compression ration	8.5
Combustion chamber	Pentroof type
Camshaft arrangement	DOHC
Valve timing Intake Open Close Exhaust Open Close	 21° BTDC 51° ABDC 57” BBDC 15” ATDC
Fuel system	Electronic control multipoint fuel injection
Rocker arm	Roller type
Lash adjuster	Equipped

COOLING SYSTEM

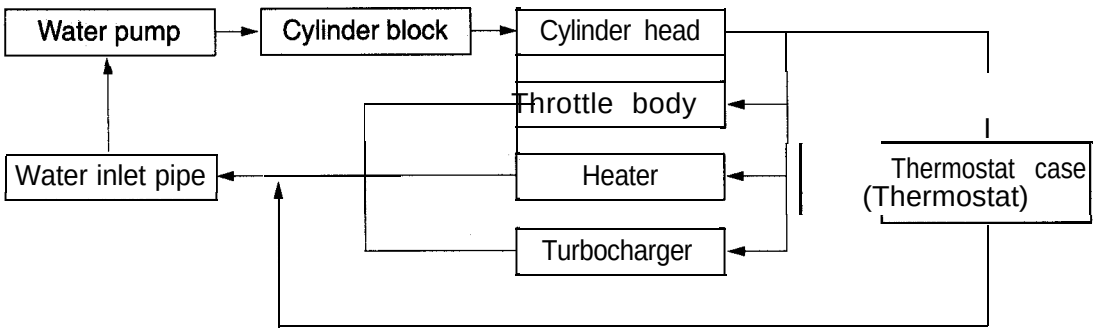
N71BD00AA

The cooling system is of the water-cooled, forced circulation type with the following features:

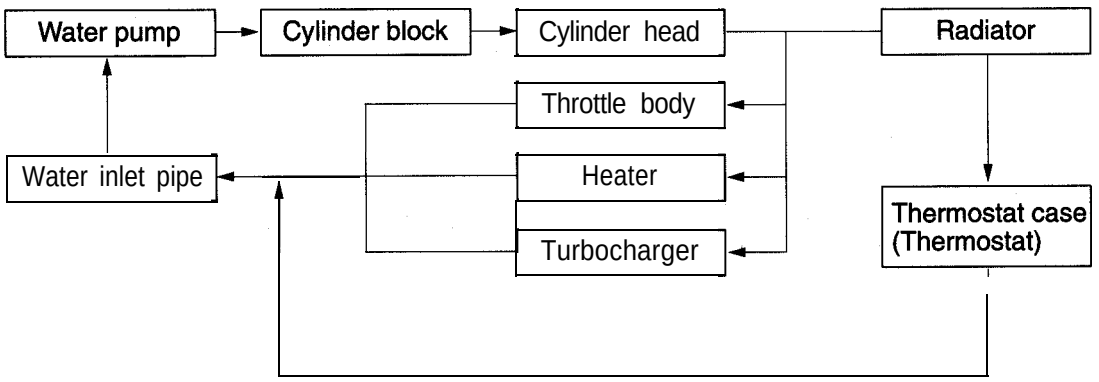
- A small-size, high-performance radiator has been adopted for better cooling efficiency and less weight.
- Reduction in size of the automatic transaxle oil cooler had resulted in a lowered radiator position, which has permitted the “slant nose” design of the body.
- The cooling fan control has been integrated into the centralized control by the engine control module for better cooling efficiency, better fuel consumption, less noise, and better acceleration. (For detailed information on the controls, refer to P.1-76.)
- The system uses an “inlet coolant temperature method” which is achieved by locating the thermostat at the coolant inlet side of the engine.

COOLANT FLOW

When engine is cold (Thermostat closed):



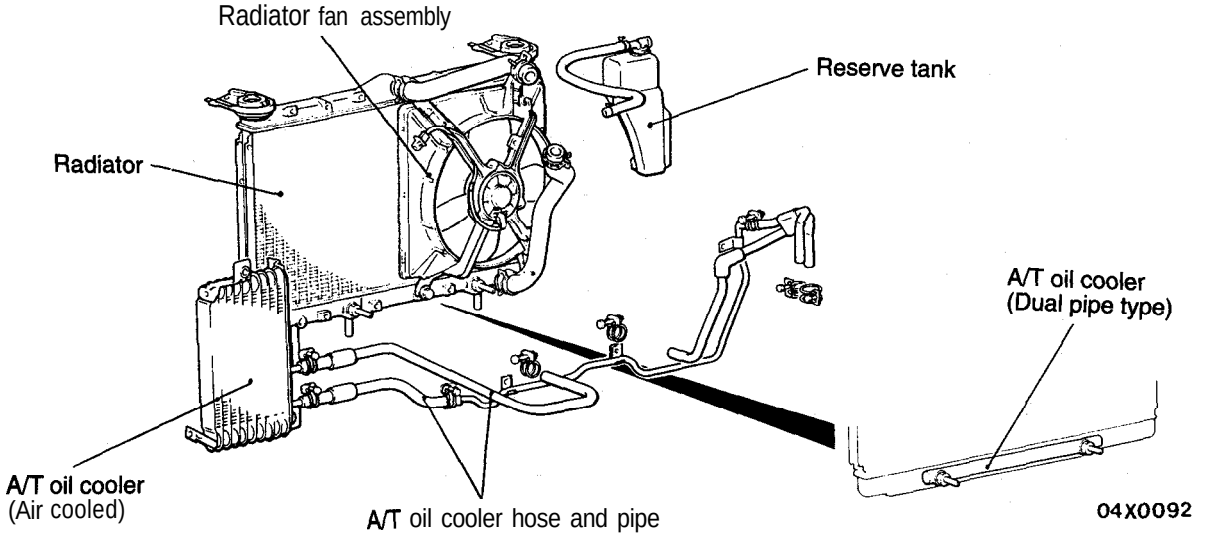
When engine is hot (Thermostat open):



SPECIFICATIONS

Items	Specifications
Cooling method	Water-cooled pressurized, forced circulation with electrical fan
Radiator	
Type	Pressurized corrugated fin type
Thermostat	Wax pellet type with jiggle valve
Water pump	
Type	Impeller of centrifugal type
Drive method	Drive belt

CONSTRUCTION



INTAKE AND EXHAUST

INTAKE MANIFOLD AND EXHAUST MANIFOLD N71BE00AA

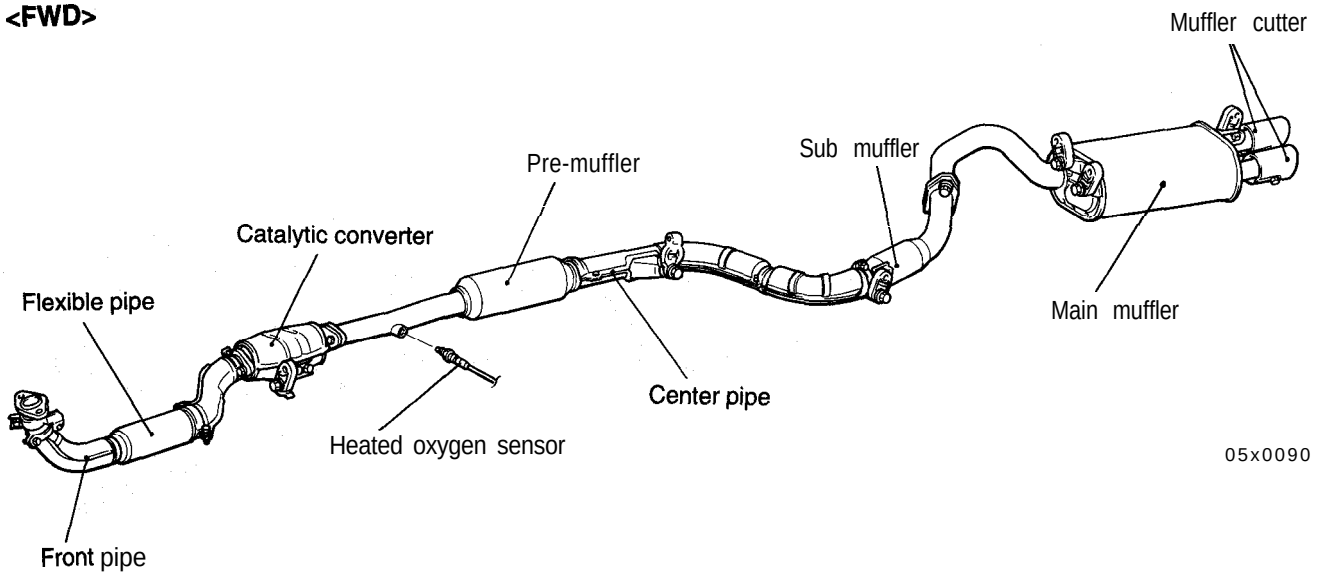
The intake and exhaust manifolds are basically the same as the once currently used.

EXHAUST PIPE N71BE01AA

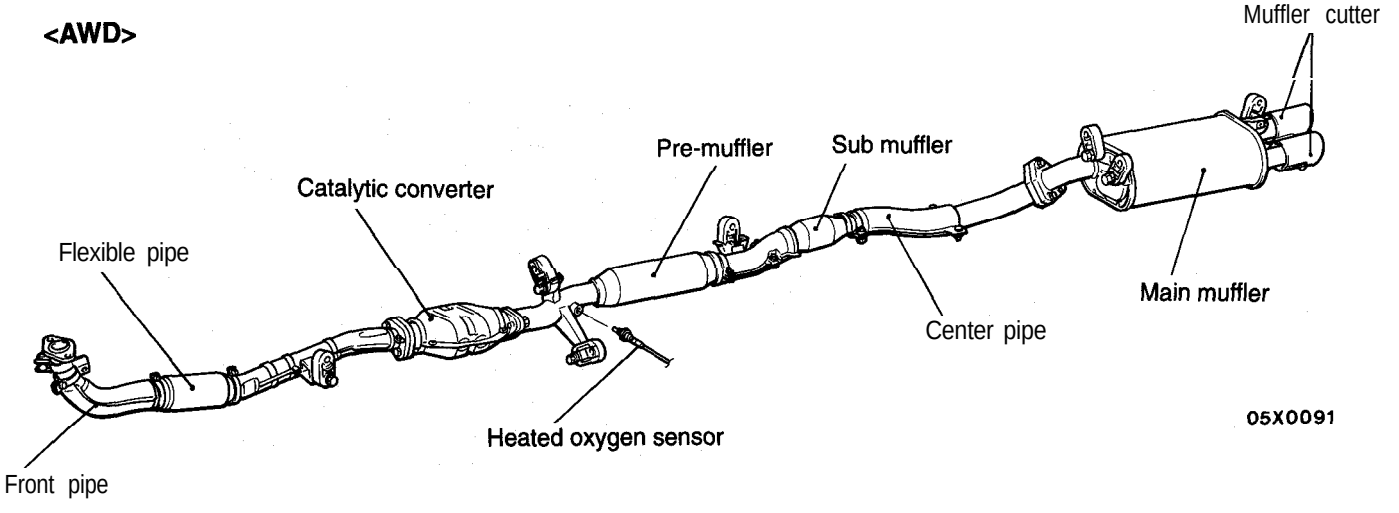
The exhaust pipe consists of three parts: a front pipe, a center pipe, and a main muffler with muffler cutter. It is mounted on the body via rubber hangers to minimize vibration transmission from the exhaust system to the body. A large main muffler, sub muffler and pre-muffler reduce exhaust noise.

CONSTRUCTION

<FWD>



<AWD>

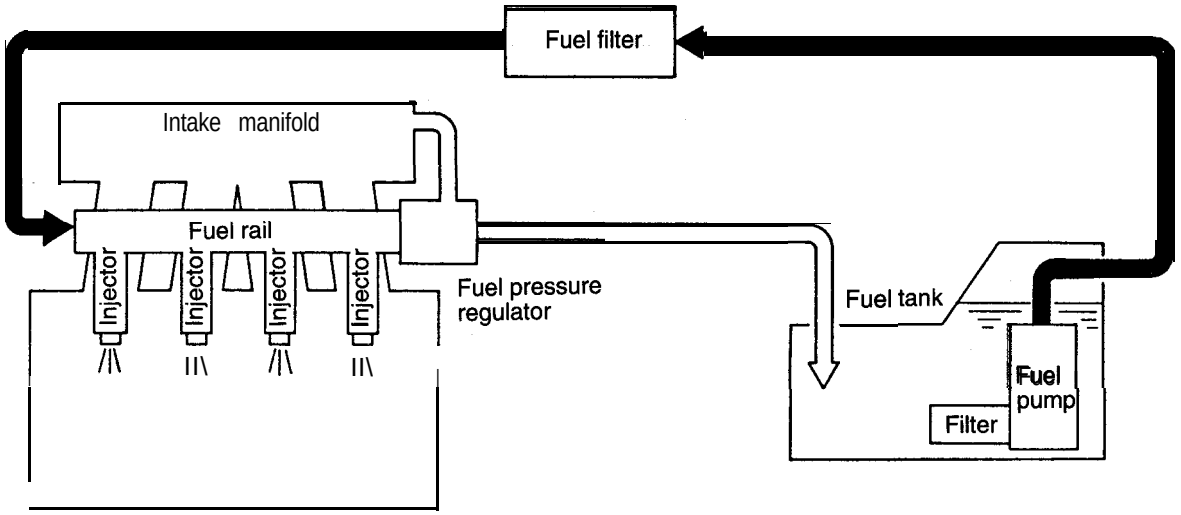


FUEL SYSTEM

N71 BF00AA

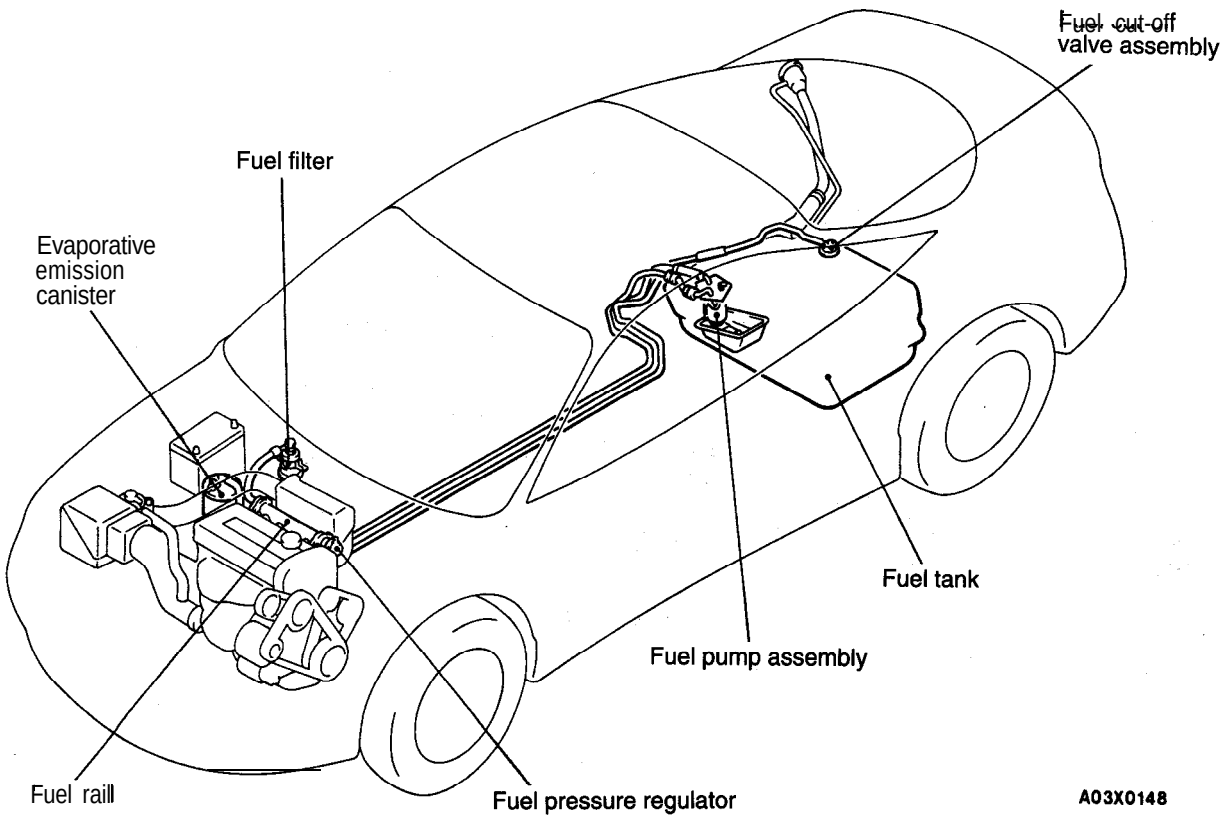
The fuel system of the 4G63 engine consists of electromagnetic fuel injectors, a fuel rail, a fuel pressure regulator, an electric motor-driven fuel pump, fuel filter and fuel tank.

FUEL FLOW DIAGRAM



03A0009

CONFIGURATION DIAGRAM



A03X0148

FUEL TANK

N71BF01AA

<FWD>

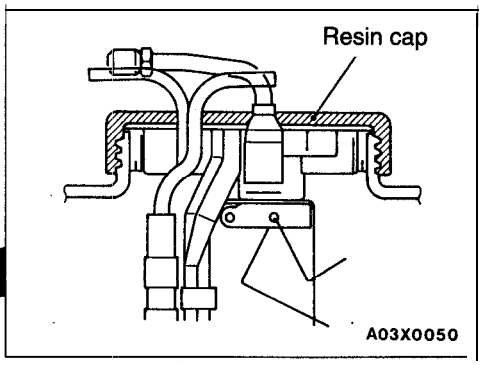
The fuel tank is the same as the one of the 420A engine. (Refer to P. 1-12.)

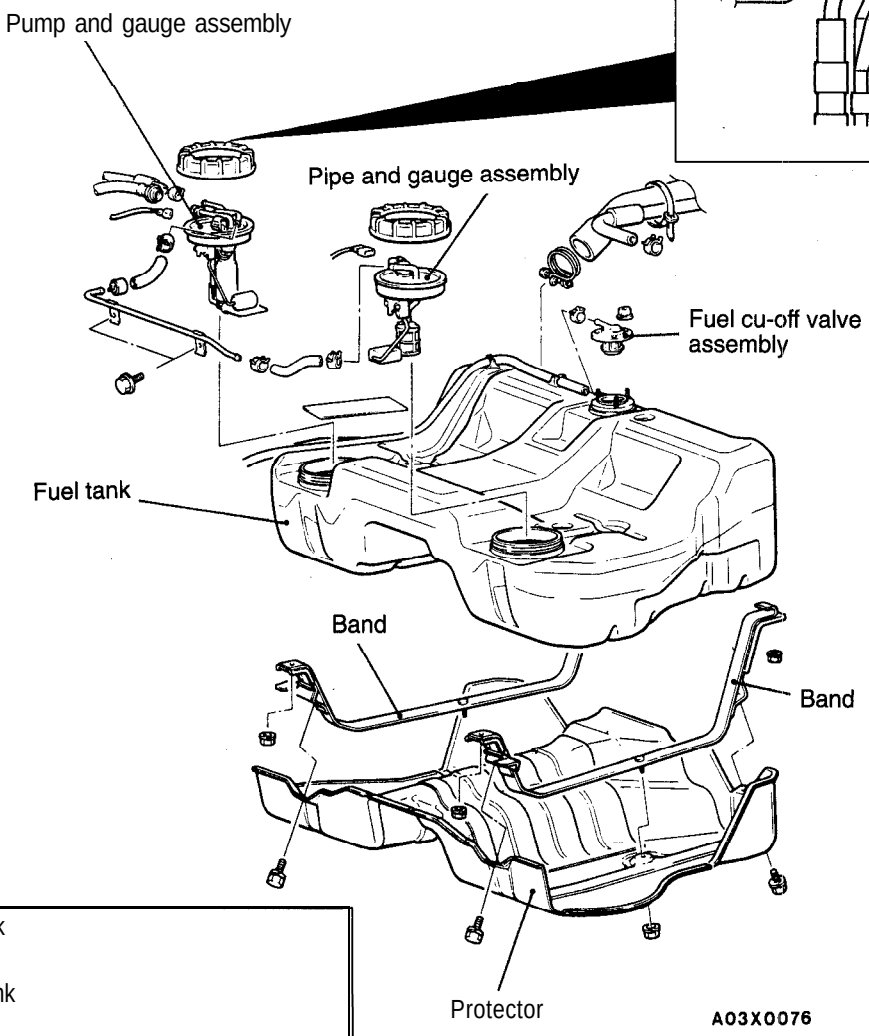
<AWD>

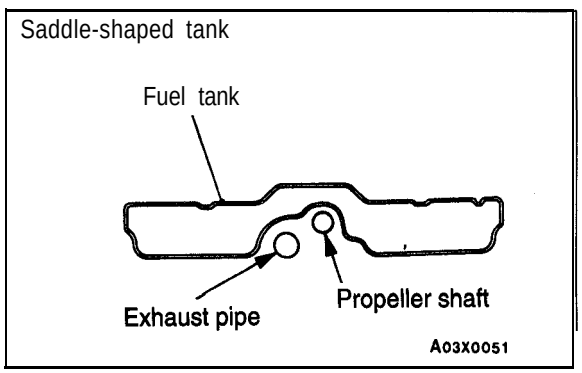
The fuel tank is made from a high density polyethylene (HDPE) material and blow-formed into an integral tank.
The tank has an internally installed pump and gauge assembly and pipe and gauge assembly. In addition, a fuel cut-off valve assembly is provided to prevent the leakage of the fuel that would occur when the vehicle rolls over.

Features <AWD>

- Light weight – 20% weight reduction as compared with a steel tank
- Increased tank capacity due to improved space efficiency
- Highly rust-resistant
- Use of a resin cap for better serviceability
- Saddle-shaped tank striding across the exhaust and power transmission systems for effective use of the space under the body







CONTROL SYSTEM

N71 BKOOAA

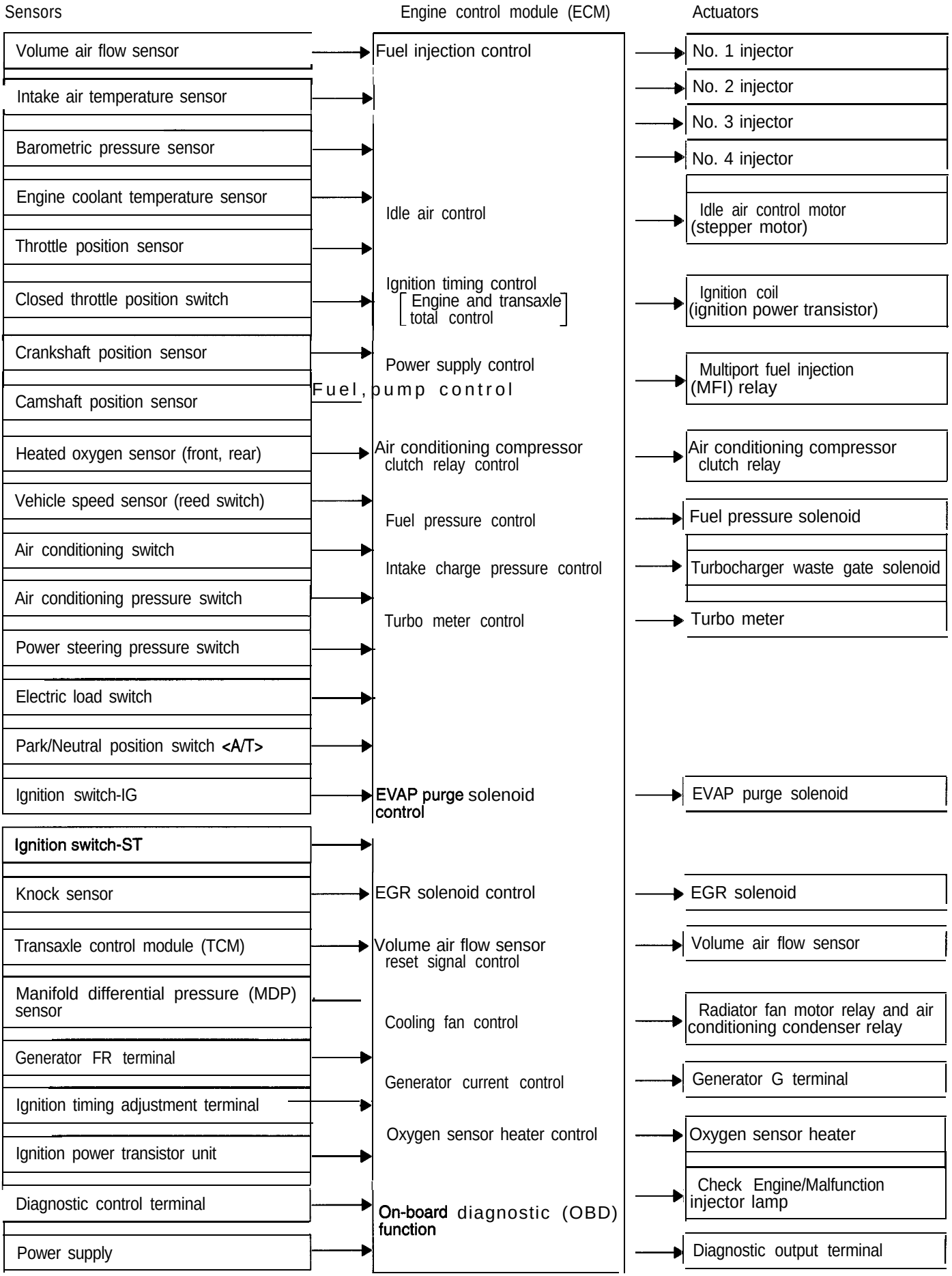
GENERAL INFORMATION

Except the following improvements, the MFI system is essentially the same as the one used on the 1994 4G63 2.0-liter DOHC engine.

Major improvements	Remarks
ECU control of the generator is adopted.	Improves idling speed stability electric loads.
ECM control of radiator fan and condenser fan is adopted.	Basically the same as the one introduced on the 1994 Galant.
Diagnostic system conforming to OBD-II is adopted.	
Manifold Difference Pressure (MDP) sensor added to detect changes in manifold vacuum.	This supports OBD-II EGR monitoring.

SYSTEM BLOCK DIAGRAM

N71BK00AB



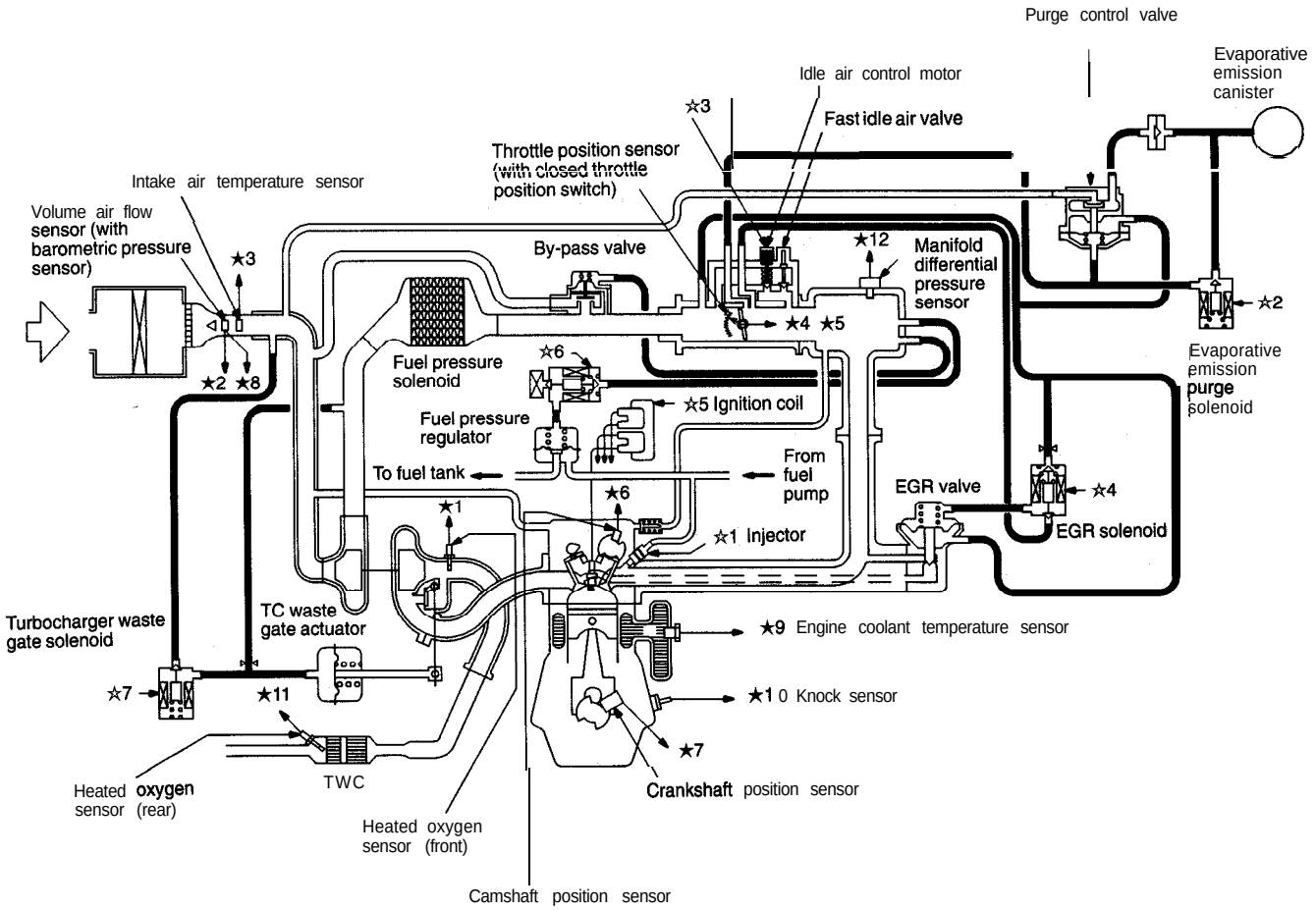
SYSTEM DIAGRAM

N71BK00AC

- ★1 Heated oxygen sensor (Front)
- ★2 Volume air flow sensor
- ★3 Intake air temperature sensor
- ★4 Throttle position sensor
- ★5 Closed throttle position switch
- ★6 Camshaft position sensor
- ★7 Crankshaft position sensor
- ★8 Barometric pressure sensor
- ★9 Engine coolant temperature sensor
- ★10 Knock sensor
- ★11 Heated oxygen sensor (Rear)
- ★12 Manifold differential pressure sensor
- Power supply
- Vehicle speed sensor
- A/C switch
- Park/Neutral position switch <A/T>
- Power steering pressure switch
- Ignition switch-ST

⇨ Engine control module (ECM) ⇨

- a1 injector
- ☆2 Evaporative emission purge solenoid
- a3 Idle air control motor
- ☆4 EGR solenoid
- ☆5 Ignition coil, ignition power transistor
- ☆6 Fuel pressure solenoid
- a7 Turbocharger waste gate solenoid
- Fuel pump relay
- Multiport fuel injection (MFI) relay
- Air conditioning compressor clutch relay
- Check engine/Malfunction indicator lamp
- Diagnostic output

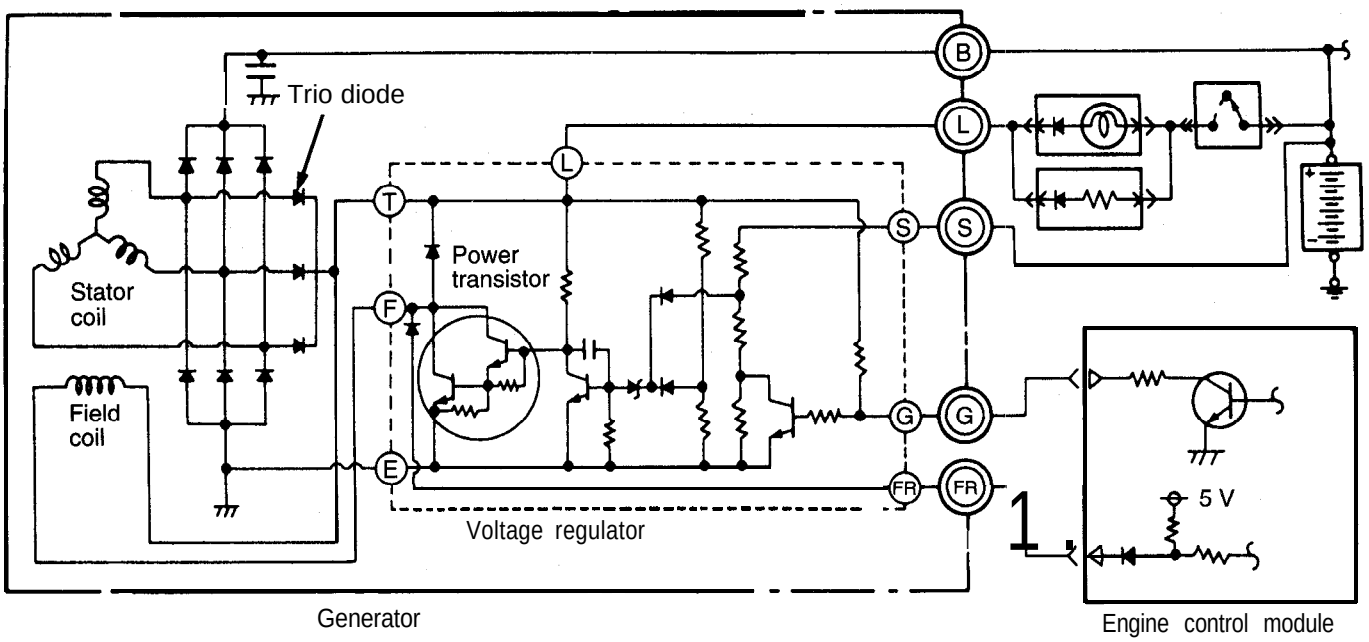


6FU2068

SENSORS

N71BK01AA

GENERATOR FR TERMINAL



1 FU0887

Terminal FR of the generator inputs the ON/OFF state of the generator field coil to the engine control module. In response to this signal, the engine control module senses the generator output current, and drives the ISC servo according to the output current (electric load). This prevents a change in idling speed that may otherwise be caused by the electric load.

* The generator generates power when the power transistor in the voltage regulator is caused to be ON to supply a current (field current) to the field coil. When the power transistor is caused to be OFF, the power generated by the generator rapidly decreases. The size of the generator output current, therefore, depends on the ratio that the power transistor is ON (ON duty). The voltage at terminal FR is low when the power transistor is ON, and high when the power transistor is OFF. Therefore, the ON duty of the power transistor in the voltage regulator or the generator output current can be sensed by calculating the ratio that the voltage at terminal FR is low.
When the generator output voltage reaches the regulated voltage (approx. 14.4V), the voltage regulator switches the power transistor from ON to OFF. When the output voltage falls below the regulated voltage, the voltage regulator switches the power transistor from OFF to ON. In this manner, the generator output voltage is maintained constant.

ACTUATORS AND CONTROL

N71BK20AA

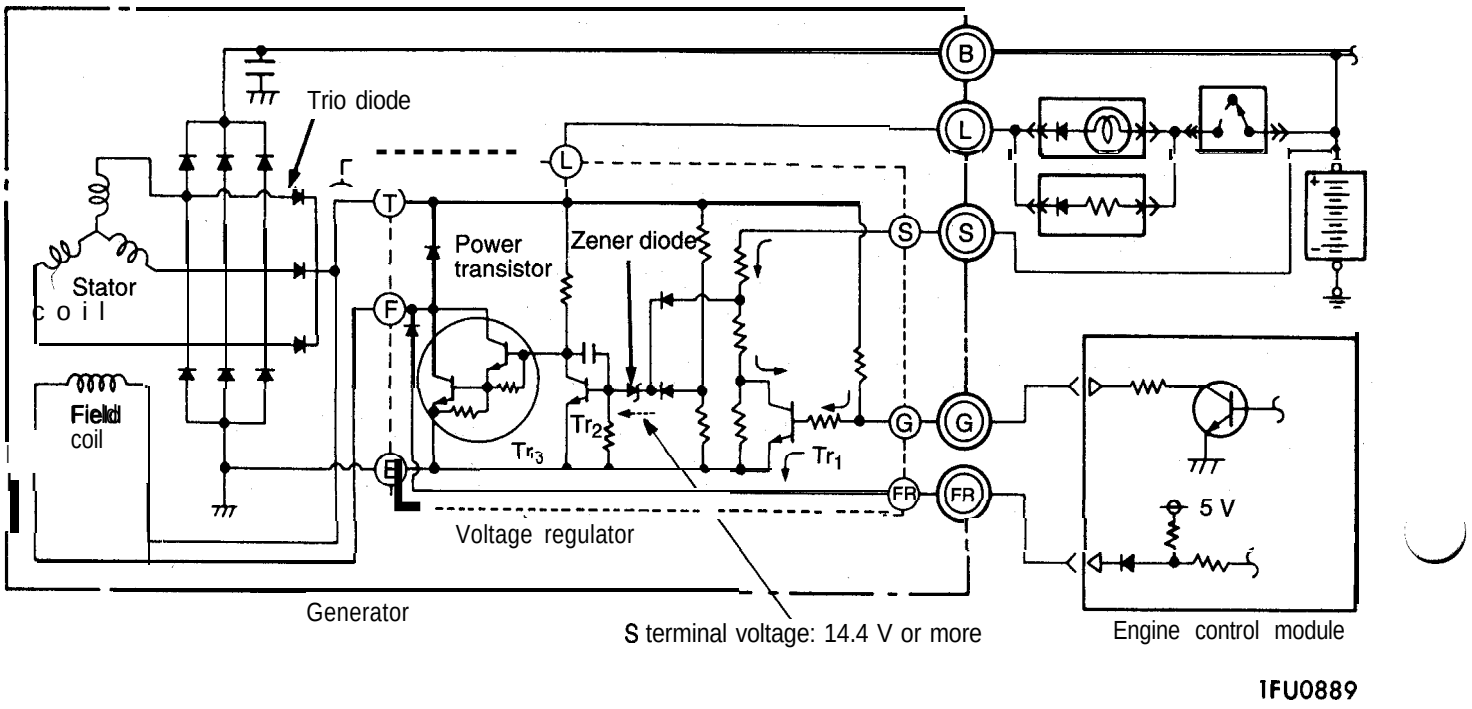
FAN MOTOR RELAY (RADIATOR AIR CONDITIONING CONDENSER)

This relay controls the radiator fan and air conditioning condeser fan based on signals from the engine control module.

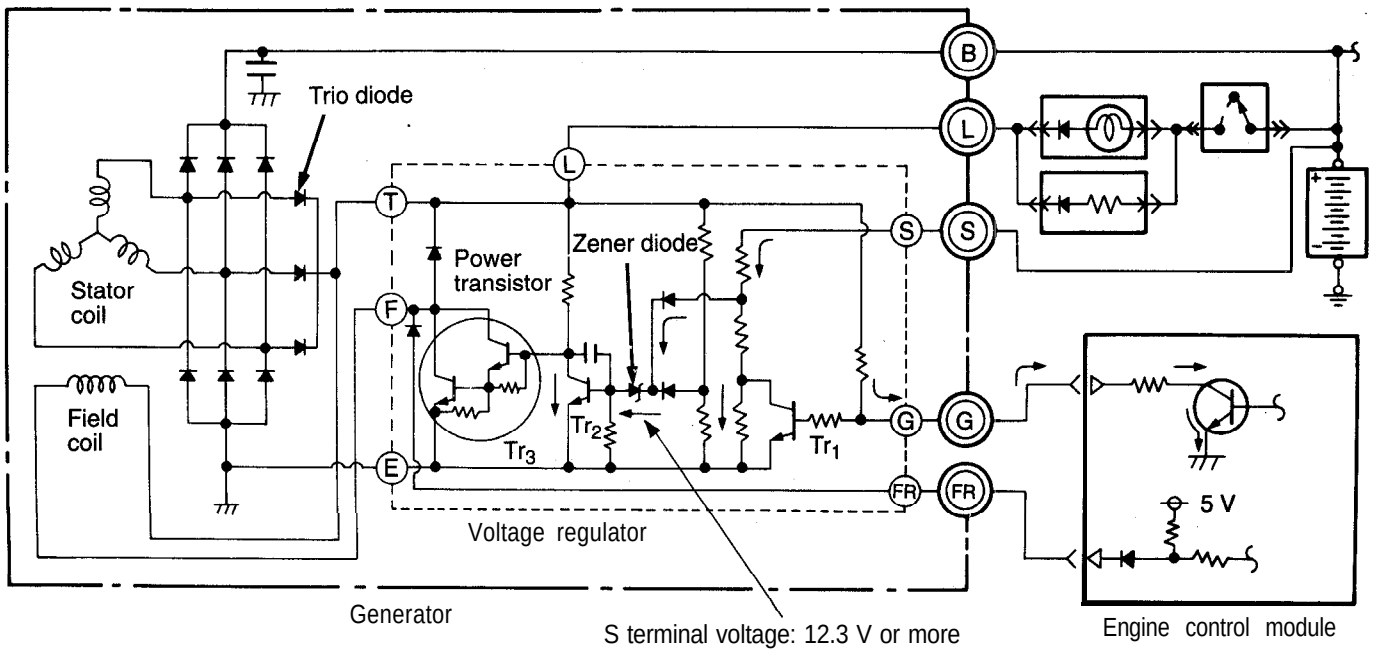
GENERATOR G TERMINAL

N71 BK28AA

The engine control module limits the generator output current by duty control of the continuity between generator terminal G and the ground.



When there is no continuity between generator terminal G and the ground (let this be 100% duty), transistor No. 1 (Tr_1) stays in the always ON state. When the voltage at generator terminal S reaches 14.4 V, the power transistor is forced to OFF to adjust the generator output voltage to 14.4 V. This operation is the same as that of the conventional generator.



When generator terminal G is short-circuited to the ground (let this be 0% duty), the Tr_1 stays in the always OFF state. In this case, when the voltage at generator terminal S reaches 12.3 V, the power transistor is forced to OFF to adjust the output voltage to 12.3 V. Since the voltage is lower than charged battery voltage, practically no current flows from the generator.

COOLING FAN CONTROL

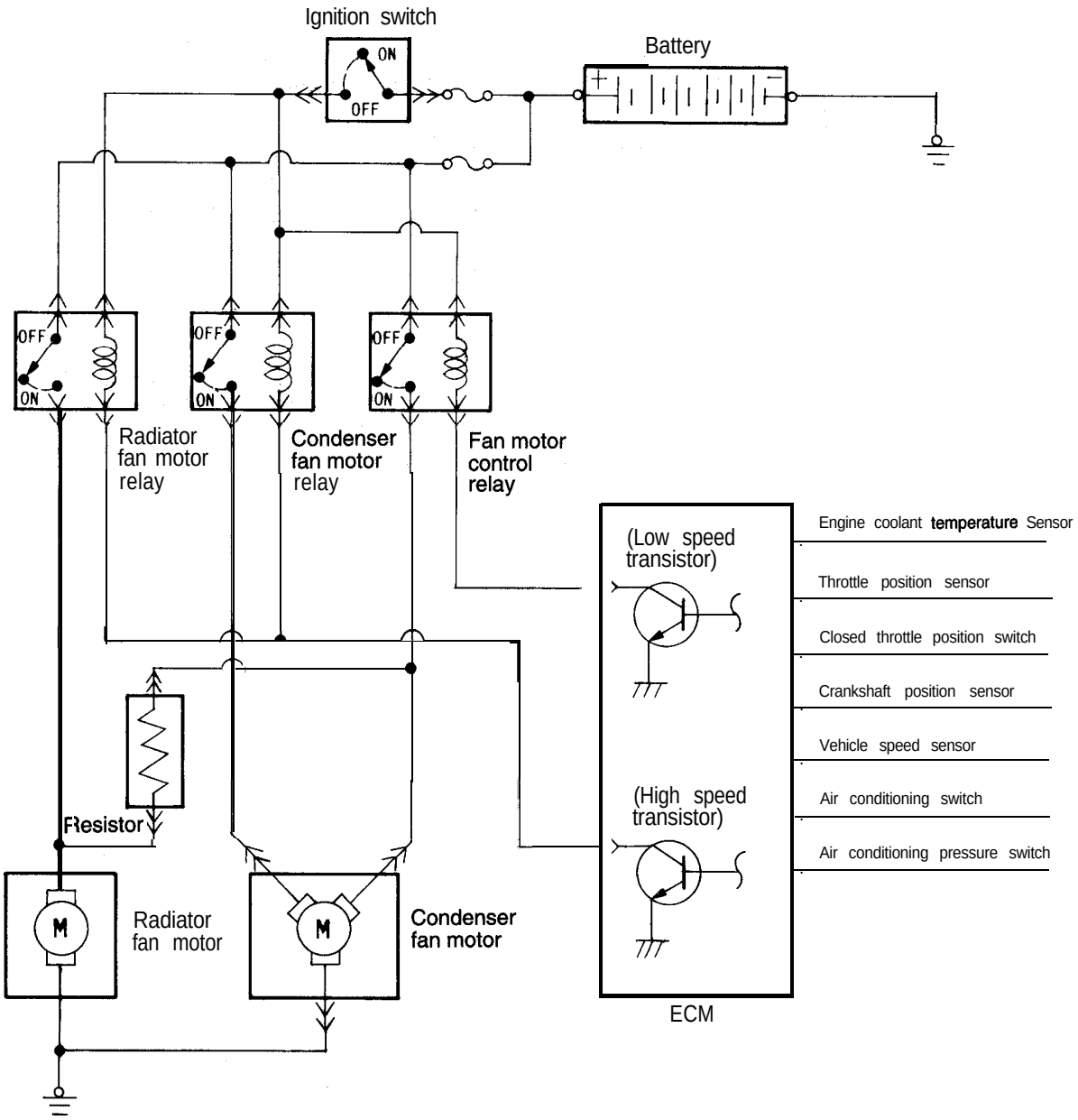
N71BK60AA

This sytem is similar to the one introduced on the 1994 Galant.

Two transistors inside the engine control module control the radiator fan and the air conditioning condenser fan motor according to the engine coolant temperature and the vehicle speed. When the air conditioning switch and air conditioning pressure switch are ON, the fan motor rotate at high speed regardless of the engine coolant temperature and vehicle speed.

- When the engine coolant temperature is faulty, the fan motors (radiator and condenser) are driven at high speed.

  The engine control module also controls the fan suitable to the various driving conditions – cruising, accelerating and decelerating, etc.



9FU0356

GENERATOR CURRENT CONTROL

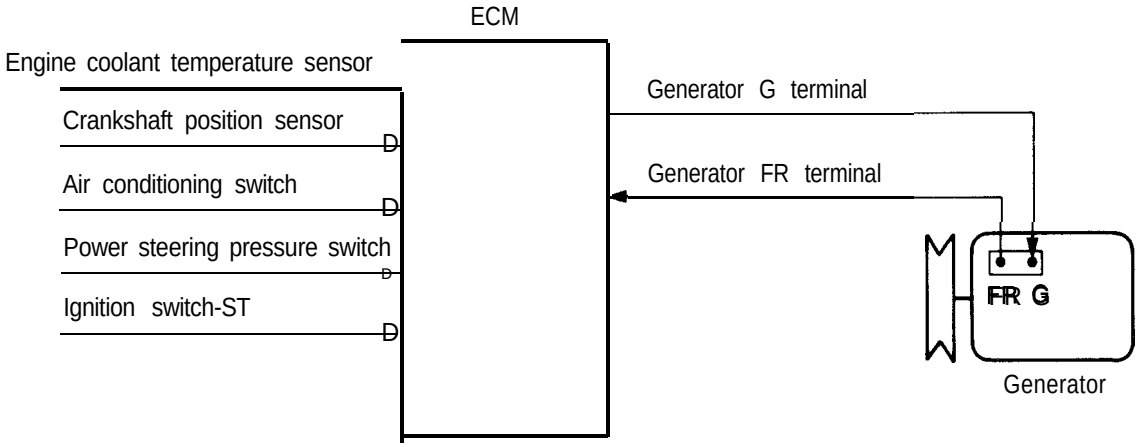
N71BK61AA

During the period the engine is in operation, the engine ECM achieves duty control of the continuity between generator terminal G and the ground. (In this case, the OFF duty of terminal G is controlled to equal the ON duty of the power transistor in the voltage regulator.)
Operation of the headlights causes a sudden increase in current consumption, but the engine ECM suppresses a sudden increase in the generator output current, thereby preventing the sudden increases in electric load from abruptly reducing the engine speed while the engine is running at idle. (During the period before the generator generates enough power, the battery current is additionally supplied to the headlights, etc.) During the period of approximately 0.5 seconds after the power steering pressure switch has been set to ON and also during the period of approximately 0.5 seconds after the selector lever has been changed over from the N range to the D range, the engine ECM controls generator terminal G in terms of 30% OFF duty to suppress generation of power by the generator.

Under the following conditions, however, this control is not achieved.

- High engine speed
- Engine coolant ternperature 50°C or lower
- Air conditioner switch ON
- More than 0.5 seconds after the power steering pressure switch has been set to ON
- More than 0.5 seconds after the selector lever has been changed over from “N” to “D”
- Three seconds or less after the engine has been started

When a high signal at generator terminal FR lasting for more than 20 seconds is input to the engine ECM during operation of the engine, the engine ECM determines that the generator terminal FR circuit has been open-ciircuited and stores diagnostic trouble code (No. P1500) in memory, and places generator terminal G in the always OFF state.



1FU0907

DIAGNOSTIC SYSTEM

DESCRIPTION OF OBD-II SYSTEM

N71BK70AA

The engine control module (ECM) monitors its input/output signals. Some signals are monitored all the time, and others only under specified conditions. When an irregularity has continued for a specified time from when the irregular signal is initially monitored, the engine control module judges that a fault has occurred.

After detecting a fault, the engine control module stores its diagnostic trouble code in memory when it re-detects the same fault in an operation following the next engine startup.
In regard to the items marked *, however, the engine control module stores the diagnostic trouble code of any of them the first time the module detects it.

There are 35 diagnostic items, and the diagnostic results can be read out with a scan tool.
Moreover, since memorization of the diagnostic trouble codes is backed up directly by the battery, the diagnostic results are memorized even if the ignition key is turned off. The diagnostic trouble codes will, however, be erased when the battery terminal or the engine control module connector is disconnected.
In addition, the diagnostic trouble code can be also be erased by turning the ignition switch to ON and sending the diagnostic trouble code erase signal from the scan tool to the engine control module.

NOTE
If the sensor connector is disconnected with the ignition switch turned on, the diagnostic trouble code is memorized. In this case, send the diagnostic trouble code erase signal from the scan tool to the engine control module and the diagnostic memory will be erased.

The 35 diagnostic items are provided as follows, and if plural items are activated, they are all indicated sequentially from the smallest code number.

NOTE
The diagnostic trouble code of ignition timing adjustment signal is outputted when terminal for ignition timing adjustment is grounded. Therefore, it is not abnormal that the code is outputted even when terminal for ignition timing adjustment is grounded for ignition timing adjustment.

The engine control module stores in memory not only the diagnostic trouble code of a fault but also the intra-module RAM data on the engine operating conditions that existed when it detected the fault. (The data is called freeze frame data.)
The data shows the engine operating conditions that existed when the engine control module detected the fault as well as those that existed when the module did not detect any fault.
However, when the engine control module detects a misfiring or fuel trim malfunction, it clears the existing data and stores the new data.
The data can be read by a scan tool and can be conveniently used in performing fault repetition tests for troubleshooting.
The data items to be stored in memory are shown below.

Data item	Unit
Engine coolant temperature	°C
Engine speed	r/min.
Vehicle speed	km/h
Long term fuel trim	%
Short term fuel trim	%
Fuel control state	• Open loop • Closed loop • Open loop – drive condition • Open loop – DTC set • Closed loop – O_2 (rear) trouble
Calculated load value	%
Diagnostic trouble code associated with the data in memory	–

Items indicated by Check Engine/Malfunction indicator lamp

NOTE

1. After detecting a fault, the engine control module (ECM) lights the Check Engine/Malfunction indicator lamp when it re-detects the same fault in an operation following the next engine start. In regard to the items marked *, however, the ECM lights the Check Engine/Malfunction indicator lamp the first time the ECM detects any of them.
2. After lighting the Engine Check/Malfunction indicator lamp, the ECM turns it off when the ECM does not detect the same fault in three consecutive operations (provided that the operations are inclusive of power train component monitor and that if the fault is a misfiring or fuel trim malfunction, it occurs at the second and subsequent times under much the same operating conditions as at the first time), each following an engine start.

Engine control module (ECM) malfunction	Injector circuit malfunction – cylinder 3
Volume air flow circuit malfunction	Injector circuit malfunction – cylinder 4
Barometric pressure circuit malfunction	Random misfire detected*
Intake air temperature circuit malfunction	Cylinder 1 misfire detected*
Engine coolant temperature circuit malfunction	Cylinder 2 misfire detected*
Throttle position circuit malfunction	Cylinder 3 misfire detected*
Excessive time to enter closed loop fuel control*	Cylinder 4 misfire detected*
O_2 sensor circuit malfunction (bank 1 sensor 1)	Crankshaft position sensor circuit malfunction
O_2 sensor heater circuit malfunction (bank 1 sensor 1)	Camshaft position sensor circuit malfunction
O_2 sensor circuit malfunction (bank 1 sensor 2)	Exhaust gas recirculation flow malfunction
O_2 sensor heater circuit malfunction (bank 1 sensor2)	Catalytic efficiency below tlhreshold (bank 1)
Fuel trim malfunction (bank 1)	Evaporative emission control system malfunction
Injector circuit malfunction – cylinder 1	Idle control system malfunction
Injector circuit malfunction – cylinder 2	Transmission*

Caution

When the Check Engine/Malfunction indicator lamp lights because of a fault in the ECM, no diagnostic trouble code can be read because of disruption of communications between the scan tool and ECM.

DIAGNOSTIC TROUBLE CODES

N71BK71AA

The diagnostic items are shown in the following table.

Diagnostic trouble code No.		Diagnostic items
General scan tool mode	Scan tool mode	
PO1 00	PO100	Volume air flow circuit malfunction
PO105	PO105	Barometric pressure circuit malfunction
PO110	PO110	Intake air temperature circuit malfunction
PO115	PO115	Engine coolant temperature circuit malfunction
PO1 20	PO120	Throttle position circuit malfunction
PO1 25	–	Excessive time to enter closed loop fuel control*
PO1 30	–	O_2 sensor circuit malfunction (bank 1 sensor 1)
PO1 35	–	O_2 sensor heater circuit malfunction (bank 1 sensor 1)
PO136		O_2 sensor circuit malfunction (bank 1 sensor 2)
PO141		O_2 sensor heater circuit malfunction (bank 1 sensor 2)
PO1 70	–	Fuel trim malfunction (bank 1)
PO201	PO201	Injector circuit malfunction – Cylinder 1
PO202	PO202	Injector circuit malfunction – Cylinder 2
PO203	PO203	Injector circuit malfunction – Cylinder 3
PO204	PO204	Injector circuit malfunction – Cylinder 4
PO300		Random misfire detected*
PO301	–	Cylinder 1 misfire detected*
PO302		Cylinder 2 misfire detected*
PO303		Cylinder 3 misfire detected*
PO304		Cylinder 4 misfire detected*
PO325	PO325	Knock sensor 1 circuit malfunction
PO335	PO335	Crankshaft position sensor circuit malfunction
PO340	PO340	Camshaft position sensor circuit malfunction
PO400	–	Exhaust gas recirculation flow malfunction
PO420		Catalyst efficiency below threshold (bank 1)
PO440	–	Evaporative emission control system malfunction
PO443		Evaporative emission control system purge control valve circuit malfunction
PO500	PO500	Vehicle speed sensor malfunction

NOTE:
*: ECM stores the DTC in memory at the first detection of the malfunction.

Diagnostic trouble code No.		Diagnostic items
General scan tool mode	Scan tool mode	
PO505	–	Idle control system malfunction
	PO600	A cable from transmission control module for transmission of torque reduction signal
PO700		Transmission*
P1300	P1300	Ignition timing adjustment circuit malfunction
P1400		Manifold Differential Pressure (MDP) sensor circuit malfunction
P1500	P1500	Generator FR terminal circuit malfunction

NOTE:
*: ECM stores the DTC in memory at the first detection of the malfunction.

SERVICE DATA REFERENCE TABLE N13AE08AC

There are two modes for reading service data, general scan tool mode and scan tool (MUT-II) mode. The service data readable in each mode is as follows.

Item No.	Inspection item	General scan tool mode	Scan tool mode
11	Heated oxygen sensor (Front)	X	X
12	Volume air flow sensor	X	X
13	Intake air temperature sensor	X	X
14	Throttle position sensor	X	X
16	Power supply voltage		X
18	Cranking signal (Ignition switch-ST)		X
21	Engine coolant temperature sensor	X	X
22	Crankshaft position sensor	X	X
2 4	Vehicle speed sensor	X	
25	Barometric pressure sensor		X
26	Closed throttle position switch		X
27	Power steering pressure switch		X
28	A/C switch		X
29	Park/Neutral position switch <A/T>		X
33	Electrical load switch		X
41	Injectors		X
44	Ignition coils and ignition power transistor		X
45	Idle air control (stepper) position		X
49	A/C compressor clutch relay		X

Item No.	Inspection item	General scan tool mode	Scan tool mode
59	Heated oxygen sensor (Rear)	X	X
81	Long term fuel trim – Bank 1	X	
82	Short term fuel trim – Bank 1	X	
87	Calculated load value	X	
88	Fuel control state	X	–
95	Manifold differential pressure sensor	X	X

ACTUATOR TEST REFERENCE TABLE

N71BK73AA

Item No.	Inspection item	Drive contents
01	Injectors	Cut fuel to No. 1 injector
02		Cut fuel to No. 2 injector
03		Cut fuel to No. 3 injector
04		Cut fuel to No. 4 injector
07	Fuel pump	FueLpump operates and fuel is recirculated.
08	Evaporative emission purge solenoid	Solenoid valve turns from OFF to ON.
09	Fuel pressure solenoid	Solenoid valve turns from OFF to ON.
10	EGR solenoid	Solenoid valve turns from OFF to ON.
12	Turbocharger waste gate solenoid	Solenoid valve turns from OFF to ON.
17	Basic ignition timing	Set to ignition timing adjustment mode
20	Radiator fan (Hi) Condenser fan (Hi)	Drive the fan motors (radiator and condenser).
21	Radiator fan (Hi) Condenser fan (Low)	Drive the fan motors (radiator and condenser).

MAIN MONITORS

N71BK40AA

CATALYST MONITORING

(1) Monitoring method

- Conversion efficiency is monitored on the FTP (Federal Test Procedure) basis.
- Calculate a frequency ratio (R_F) of output signals, oscillating from lean to rich or vice versa, from the front and rear O_2 sensors according to the following equation.

$$R_F = \frac{\text{Output signal frequency of rear } O_2 \text{ sensor}}{\text{Output signal frequency of front } O_2 \text{ sensor}}$$

(2) Malfunction criteria

If R_F becomes larger than the predetermined value, a catalyst malfunction is indicated.

MISFIRE MONITORING

(1) Monitoring method

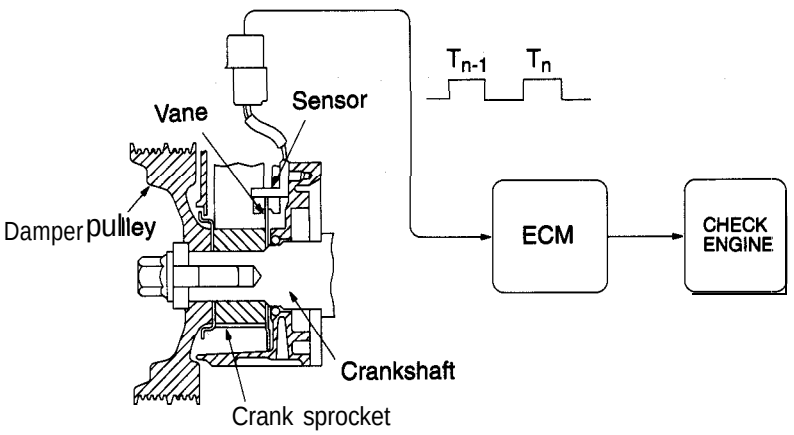
Fluctuation of crankshaft speed is monitored.

(2) Malfunction criteria

If the fluctuation of the crankshaft rotation is larger than the predetermined value, an engine misfire is indicated.

But the determination of misfire is masked under some conditions like rough-road driving to avoid false diagnostic trouble codes.

(3) System figure



6FU2103

OXYGEN SENSOR MONITORING

(1) Monitoring method

Detect the response time of front O_2 sensor output signals when air-fuel ratio is changed intentionally from lean to rich or rich to lean under the hot steady state condition.

(2) Malfunction criteria

If the response time value is larger than the predetermined value, an O_2 sensor malfunction is indicated.

EGR SYSTEM MONITORING

(1) Monitoring method

Operate EGR valve intentionally in the area of deceleration and detect the change of the EGR gas flow signal.

(2) Malfunction criteria

If the change of the EGR gas flow signal is smaller than the predetermined value, an EGR system malfunction is indicated.

FUEL SYSTEM MONITORING

(1) Monitoring method

- A/F feedback compensation value is monitored.

(2) Malfunction criteria

If the A/F feedback compensation value is larger than the predetermined value, an fuel system malfunction is indicated.

OTHER SYSTEM MONITORS

(1) Refer to Group, 13 — Troubleshooting in the Service manual.

ENGINE ELECTRICAL

N71BX01AA

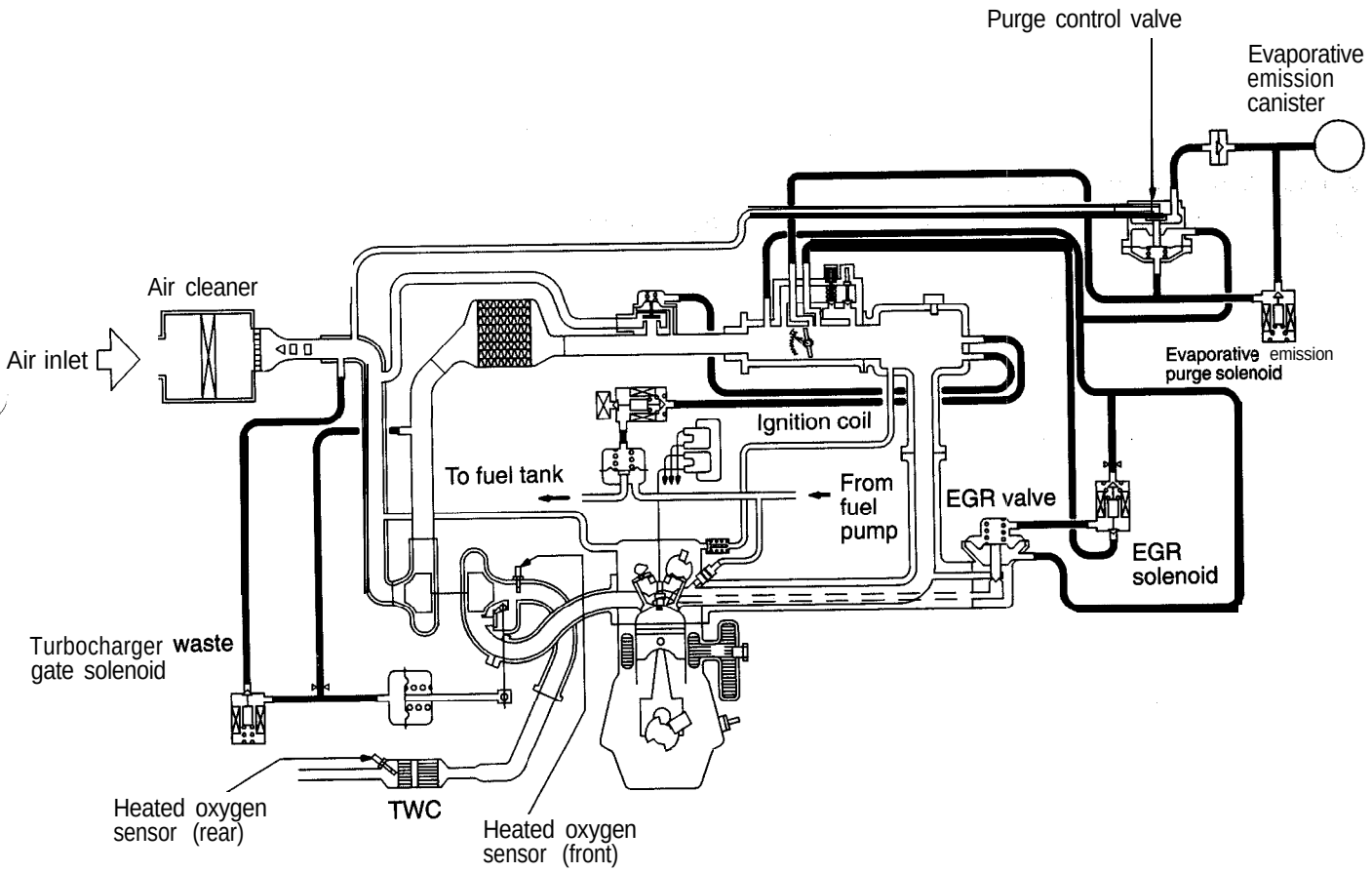
The generator, starter motor and ignition system are basically the same as the current ones.

EMISSION CONTROL SYSTEM

GENERAL INFORMATION

N71BP00AA

- The manifold pressure sensor is adopted to monitor the EGR system.
- Other features of the system are essentially the same as the ones of the current system.



6FU2101

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

N71BK04AA

The exhaust gas recirculation (EGR) system lowers the nitrogen oxide (NOx) emission level. When the air/fuel mixture combustion temperature is high, a large quantity of nitrogen oxides (NOx) is generated in the combustion chamber. Therefore, this system recirculates part of emission gas from the exhaust port of the cylinder head to the combustion chamber through the intake manifold to decrease the air/fuel mixture combustion temperature, resulting in reduction of NOx.

The EGR flow rate is controlled by the EGR valve so as not to decrease the driveability.

The EGR system contents:

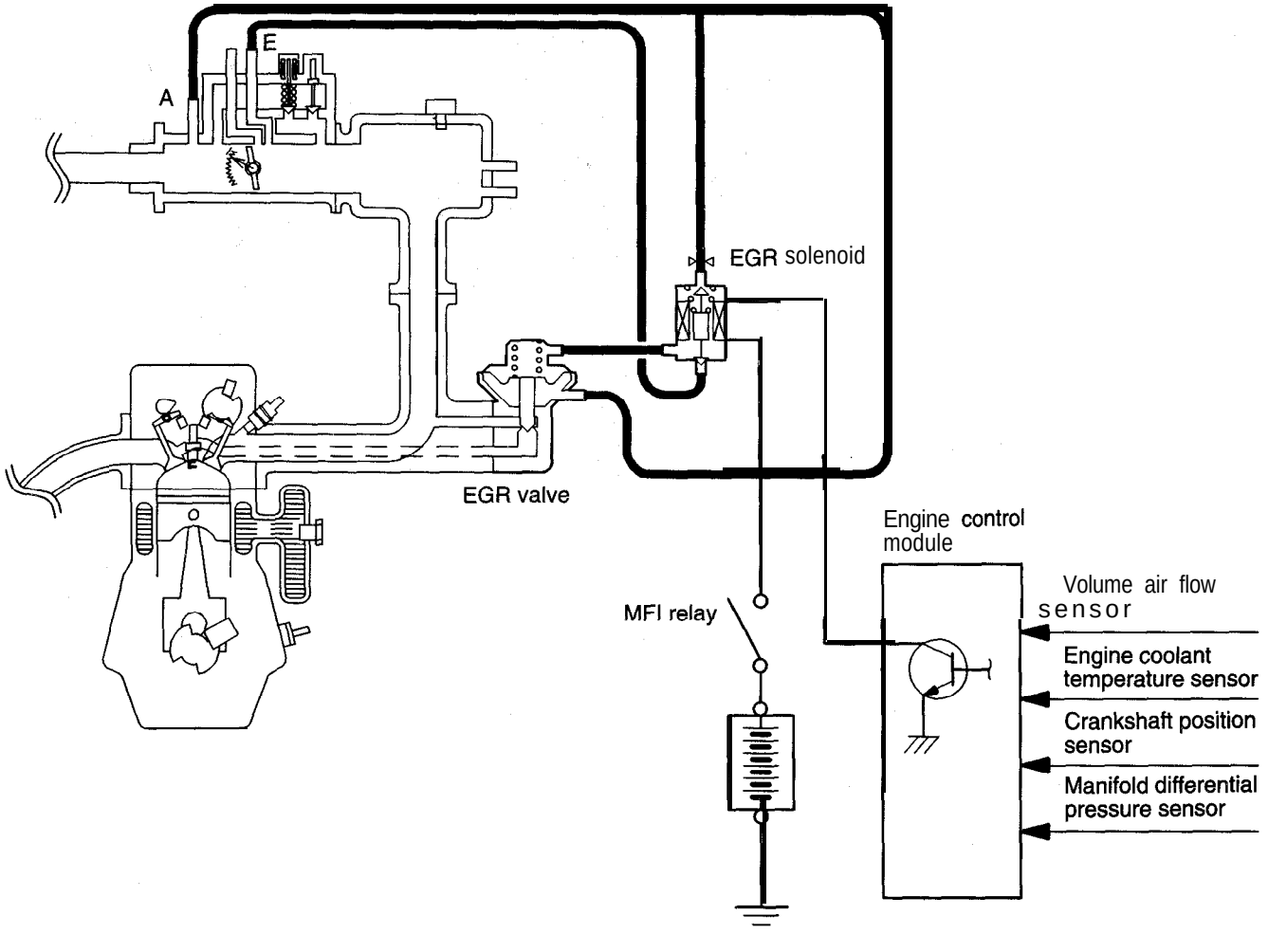
- EGR valve
- EGR solenoid
- Connecting hoses

OPERATION

When the engine coolant temperature is low, when the engine is at idle or when a wide open throttle operation is performed, the EGR valve is kept closed, achieving no EGR.

In normal vehicle operation performed after warming up of the engine, the EGR valve is opened to carry out EGR.

The engine control module checks the operation of the EGR system and, if a trouble is detected, lights the Check Engine/Malfunction indicator lamp to warn the driver of the trouble.

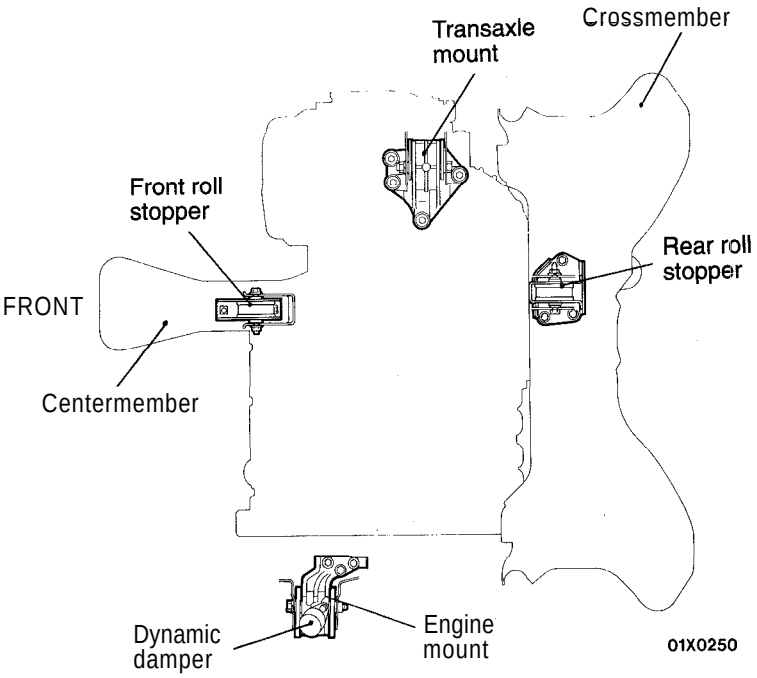


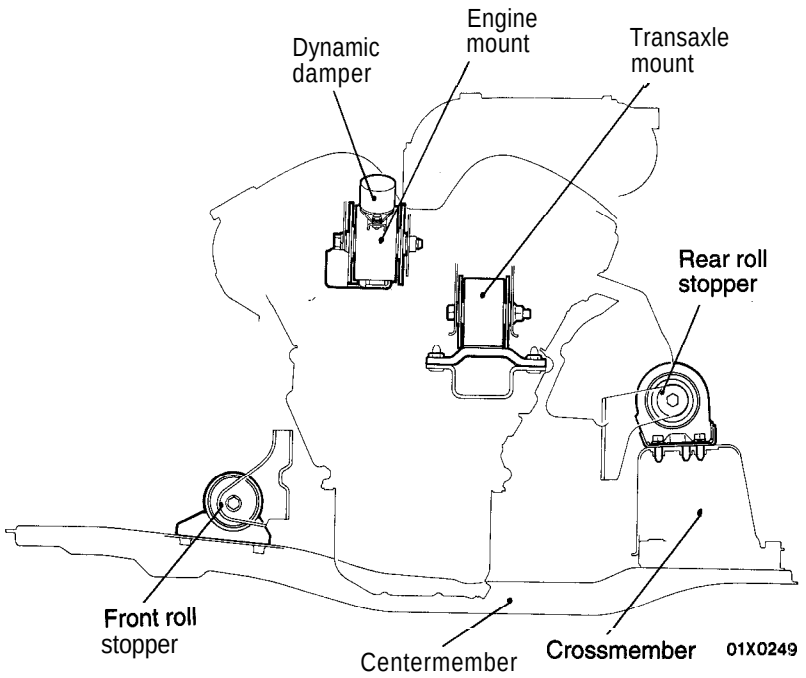
6EM0464

MOUNT

N71 BU00AA

The mounts are basically the same as used on 420A engine except that the arrangement of the engine and transaxle is reversed from that on 420A engine.





ACCELERATION SYSTEM

N71 BW00AA

ACCELERATOR PEDAL AND ACCELERATOR CABLE

The accelerator pedal and accelerator cable are the same as used on 420A engine. (Refer to P.1-62)

AUTO-CRUISE CONTROL SYSTEM

N71BW01AA

By using the auto-cruise control, the driver can drive at the speed he likes [in a range of approximately 40 to 200 km/h (25 to 124 mph)] without depressing the accelerator pedal.

CONTROL SYSTEM

The throttle position sensor signal is used in addition to the conventional vehicle speed sensor as the input signal to bring about the following improvements in control.

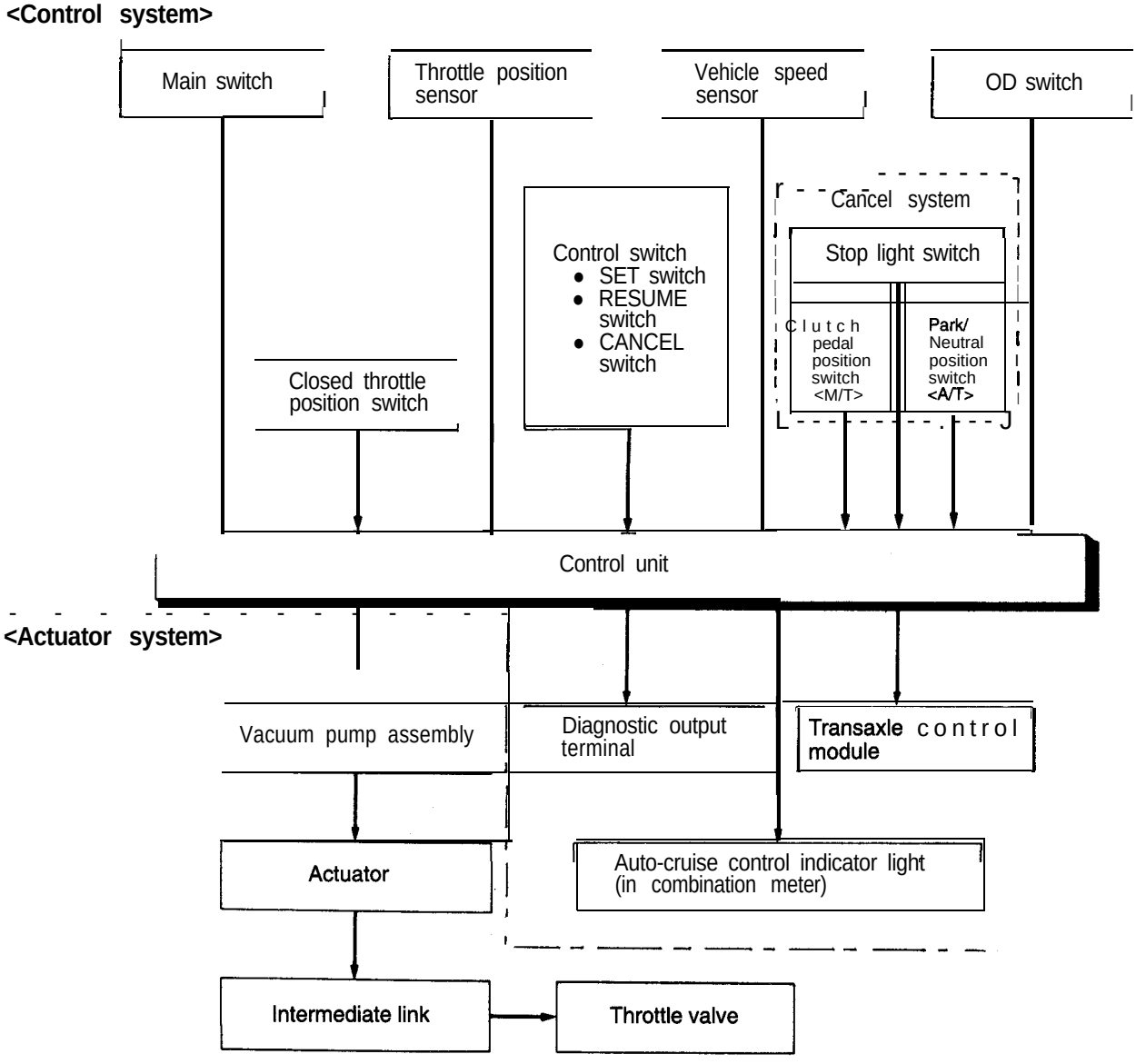
(1) The amount of actuator control varies according to vehicle speed and throttle opening not only for an expansion of conformity to differences in engine output but also for better response.

(2) On A/T models, overdrive is released (4-speed → 3-speed) when climbing inclines and the system judges the return time by vehicle speed and throttle opening to prevent hunting between 3-speed and 4-speed.

ACTUATOR SYSTEM

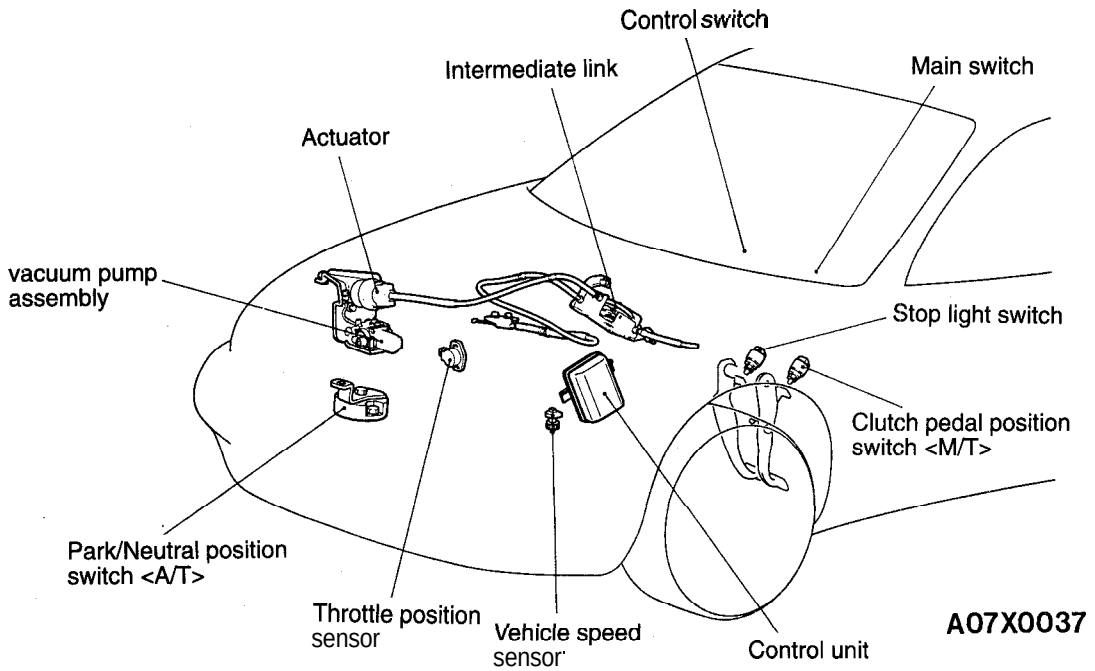
The actuator system consists of the motor-driven vacuum pump, actuator and intermediate link. The vacuum pump and actuator are in different locations.

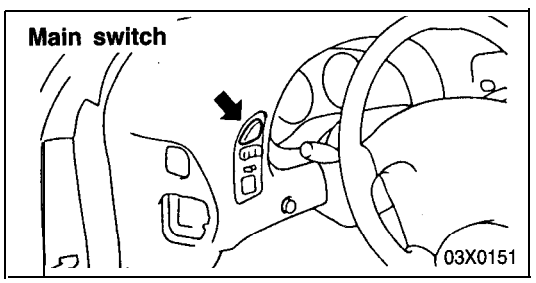
System Block Diagram

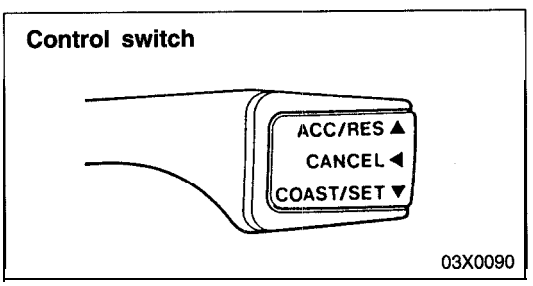


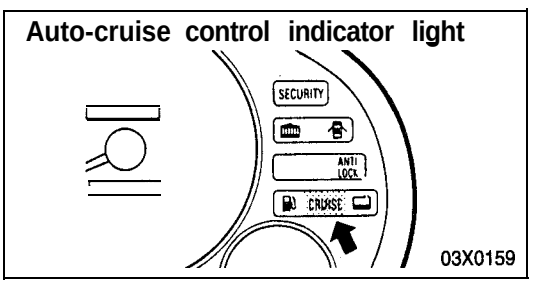
03E0007

Components and Functions







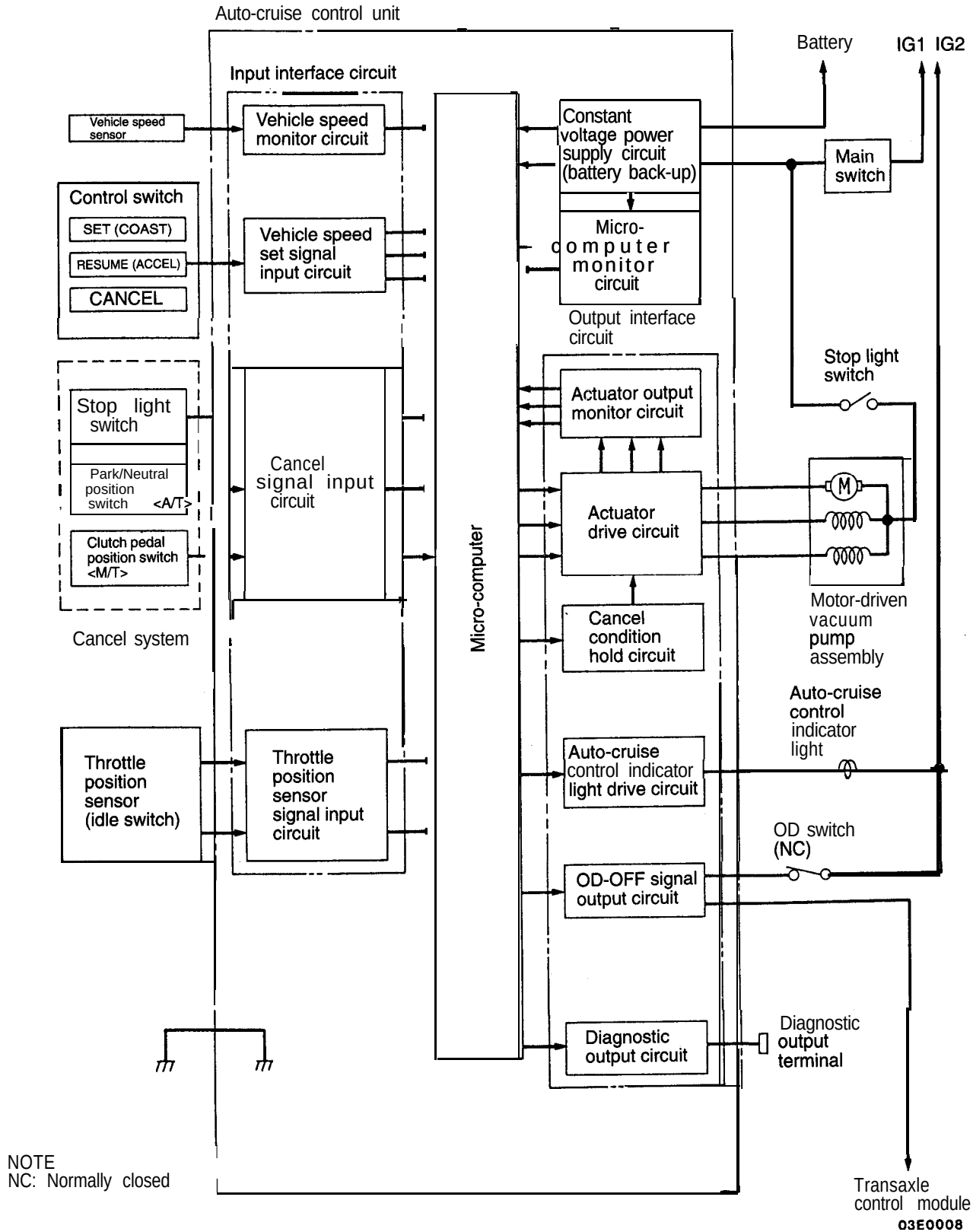


Components		Function
Vehicle speed sensor		It generates a pulse signal proportional to vehicle speed (revolving speed of the transaxle output gear).
Control unit		It receives signals from the vehicle speed sensor and each switch, and uses a micro-computer to control all functions of the auto-cruise control.
Actuator system		It drives the motor-driven vacuum pump according to signals from the control unit and adjusts the throttle valve via the intermediate link to the set opening.
Main switch		Switch for cruise control power.
Control switch	SET (COAST) switch	Vehicle speed is set with the SET (COAST) switch and RESUME (ACCEL) switch.
	RESUME (ACCEL) switch	
	CANCEL switch	It is used to cancel the setting of the cruise speed
Cancel system	Stop light switch	It outputs a signal to cancel cruise control
	Clutch pedal position switch <M/T>	
	Park/Neutral position switch <A/T>	
Throttle position sensor		It generates an analog voltage proportional to throttle opening.
Idle switch		Based on the valve of throttle position sensor voltage when the idle switch goes from ON to OFF, it varies throttle position sensor voltage to compensate for fluctuations.
Diagnostic output terminal		If the scan tool or a voltmeter is connected, diagnostic test mode and input check codes from the control unit can be read.
Auto-cruise control indicator light		It is in the combination meter and lights up when the auto-cruise control functioning.

AUTO-CRUISE CONTROL UNIT

The control unit is made up of the input interface circuit, micro-computer, constant voltage power supply circuit, micro-computer monitor circuit and output interface circuit. Signals from the vehicle speed sensor, throttle position sensor and each switch are input into the control unit. It processes them according to the program in the micro-computer memory and outputs control signals to the actuator. It also outputs system diagnostic test code results and conditions of input signals to the diagnostic output terminal.

Control Logic and Block Diagram



NOTE
NC: Normally closed

POWER TRAIN

CONTENTS

N72ZA00AA

AUTOMATIC TRANSAXLE 35
- Construction and Function <F4AC1> 40
  - Electronic Control System 73
  - Hydraulic Control System 53
  - Transaxle.. 40
- Sectional View 37
- Specifications 35
- Transaxle Control 99

CLUTCH 2
- Clutch Control 3
- Inter-lock Switch 4
- Specifications 2

FRONT AXLE 104
- Features 104
- Specifications 104

MANUAL TRANSAXLE 5
- Construction and Operation <F5MC1> 9
  - Power Flow 10
  - Power Train Component 18
  - Shift System 31
  - Synchronizer 29
  - Transaxle Case 9
- Sectional View 8
- Specifications 5
- Transaxle Control 34

PROPELLER SHAFT 103
- Construction Diagram 103
- Specifications 103

REAR AXLE <AWD> 106
- Differential 107
- Differential Support 108
- Features 108

REAR AXLE <FWD> 105
- Features 105

CLUTCH

N72ZB00AA

The clutch is a dry single-disc, diaphragm type; hydraulic pressure is used for clutch control,

The automatic centering type release bearing has been adopted.

SPECIFICATIONS

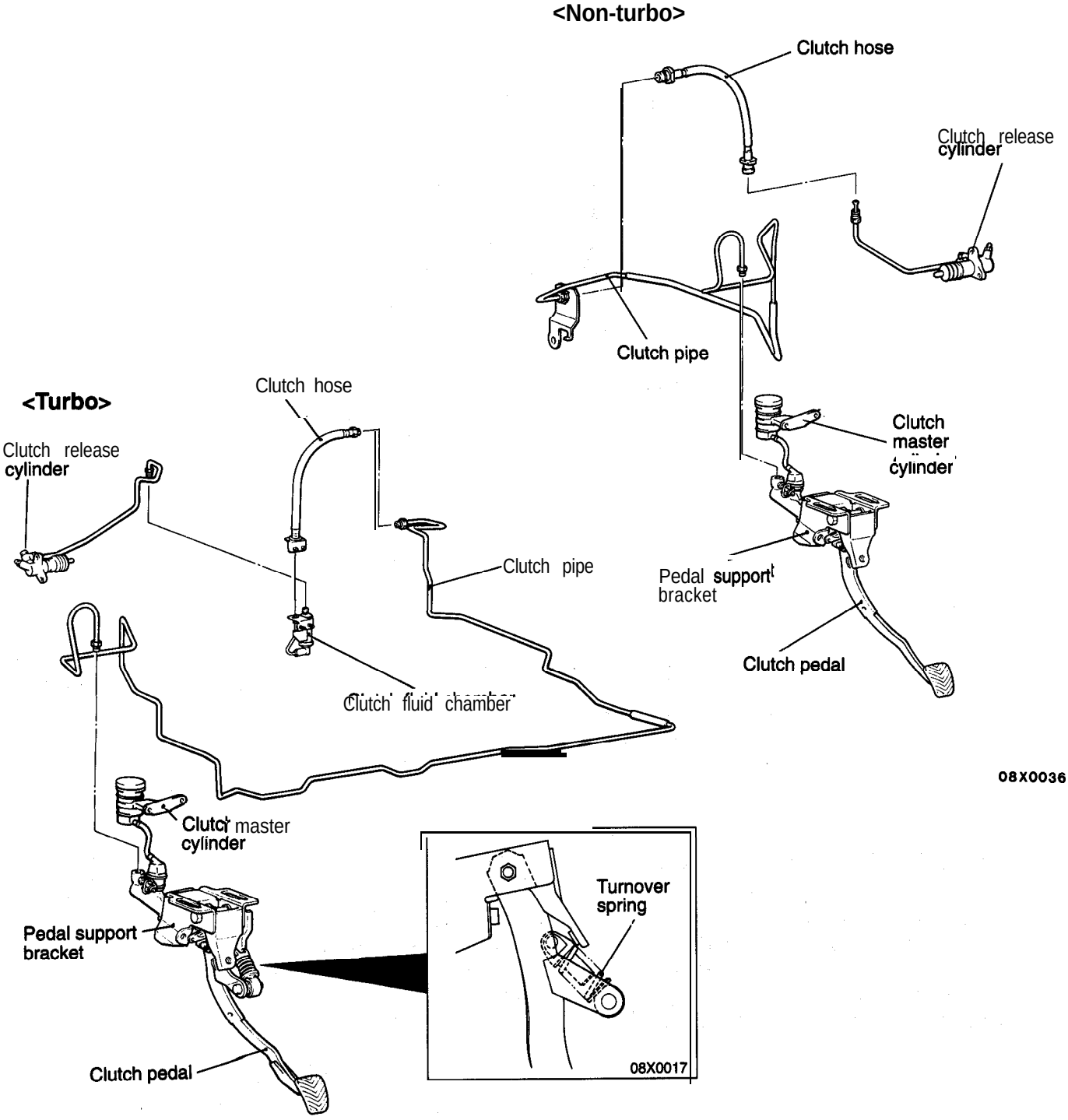
Items		Non-turbo	Turbo
Clutch operating method		Hydraulic type	
Clutch disc type		Single dry disc type	
Clutch disc facing diameter O.D. x I.D.	mm (in.)	228 x 150 (9.0 x 5.9)	225 x 150 (8.9 x 5.9)
Clutch cover type		Diaphragm spring strap drive type	
Clutch cover setting load	N (lbs.)	4,400 (989)	6,174 (1,388)
Clutch release cylinder I.D.	mm (in.)	22.23 (7/8)	20.64 (13/16)

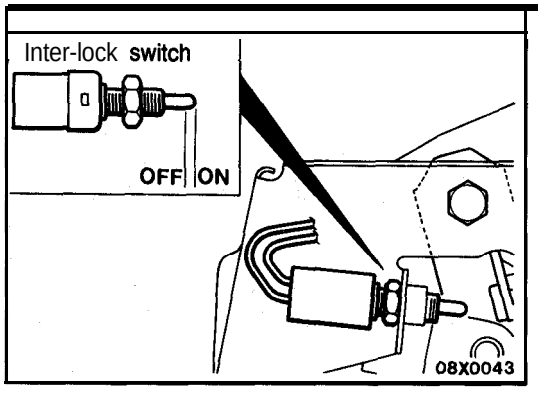
CLUTCH CONTROL

N72ZB01AA

A hydraulic system has been adopted for the control of the clutch. It offers the following features.

- **<Turbo>**
  A clutch fluid chamber and a compression type turnover spring have been adopted for better pedal feeling and less foot pressure.
- In order to prevent sudden movement of the vehicle when the engine is started, an inter-lock switch has been equipped (within the pedal support bracket)
- <Turbo>
  The clutch switch for the auto-cruise control system has been equipped at the pedal support bracket.



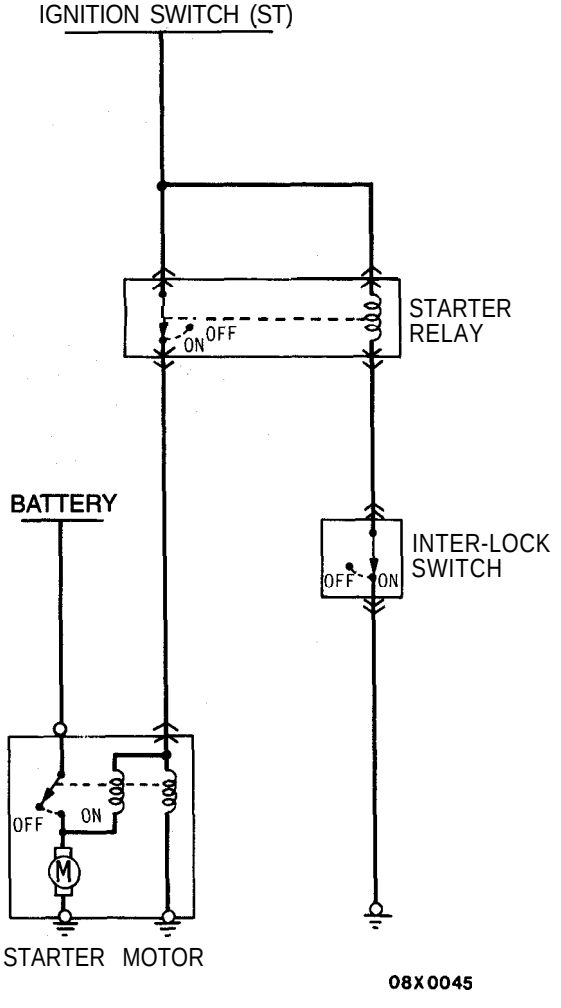


INTER-LOCK SWITCH

N72ZB02AA

The inter-lock switch is a switch provided in order to prevent sudden movement of the vehicle when the engine is started. Thus, the starter motor will not be switched ON unless the clutch pedal is depressed, thereby switching OFF the inter-lock switch.

NOTE
The inter-lock switch is normally ON; it is switched OFF when the clutch pedal is depressed.



If the Clutch Pedal is Not Depressed:

Because the inter-lock switch is switched ON when the ignition switch is switched to the START position, electricity flows from the coil of the starter relay, through the inter-lock switch, to ground. As a result, the contacts of the starter relay separate, switching it OFF, and the starter motor is therefore not activated.

When the Clutch Pedal is Depressed:

The inter-lock switch is switched OFF when the clutch pedal is depressed. If the ignition switch is then switched to the START position at this time, the flow of electricity to the coil of the starter relay will be interrupted, the contacts of the starter relay will close, switching it ON, and the starter motor will be activated.

MANUAL TRANSAXLE

N72ZC00AA

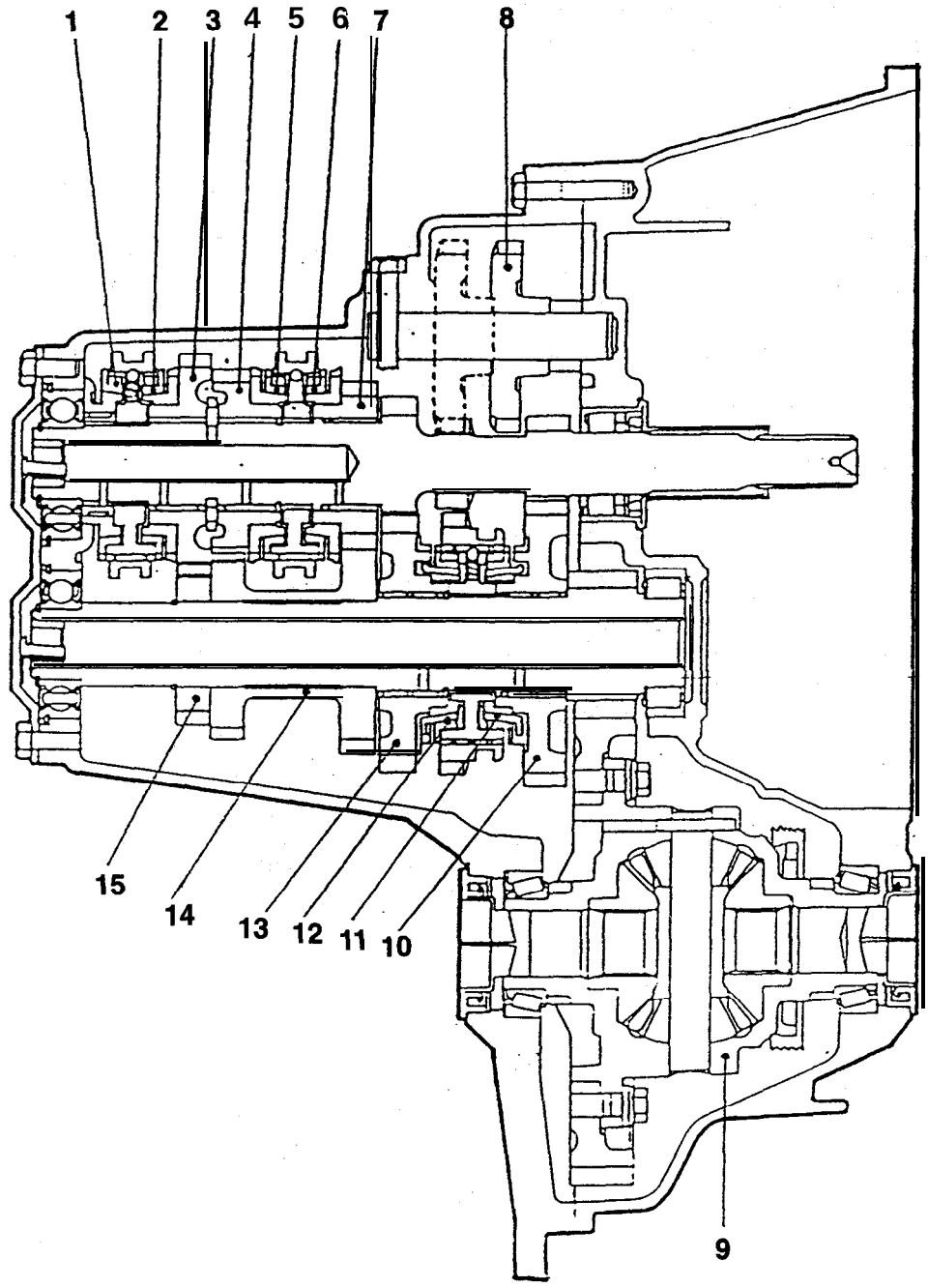
Three types of manual transaxle, F5MC1, F5M33, and W5M33 have been provided.
F5MC1 is a newly developed small and light-weight transaxle produced by Chrysler Corporation, while F5M33 and W5M33 transaxles are essentially the same as the conventional ones.

SPECIFICATIONS

Drive type	FWD		AWD
Transmission model	F5MC1-1-QQAF	F5M33-2-SPZT	W5M33-2-NPZT
Engine model	Non-turbo	Turbo	Turbo
Transmission type	5-speed, constant mesh	5-speed, constant mesh	5-speed, constant mesh
Gear ratio (number of teeth) 1st 2nd 3rd 4th 5th Reverse	 3.538 (46/13) 2.125 (34/16) 1.360 (34/25) 1.029 (35/34) 0.810 (30/37) 3.417 (41/12)	 3.090 (34/11) 1.833 (33/18) 1.217 (28/23) 0.888 (24/27) 0.741 (23/31) 3.166 (38/12)	 3.083 (37/12) 1.684 (32/19) 1.115 (29/26) 0.833 (25/30) 0.666 (22/33) 3.166 (38/12)
Reduction ratio (number of teeth) Primary Secondary Transfer	 3.944 (71/18)	 1.208 (29/24) 3.437 (55/16)	 1.275 (37/29) 3.866 (58/15) 1.090 (24/22)
Reverse brake	Provided	Provided	Provided
Speedometer gear ratio	28/35	29/36	29/36

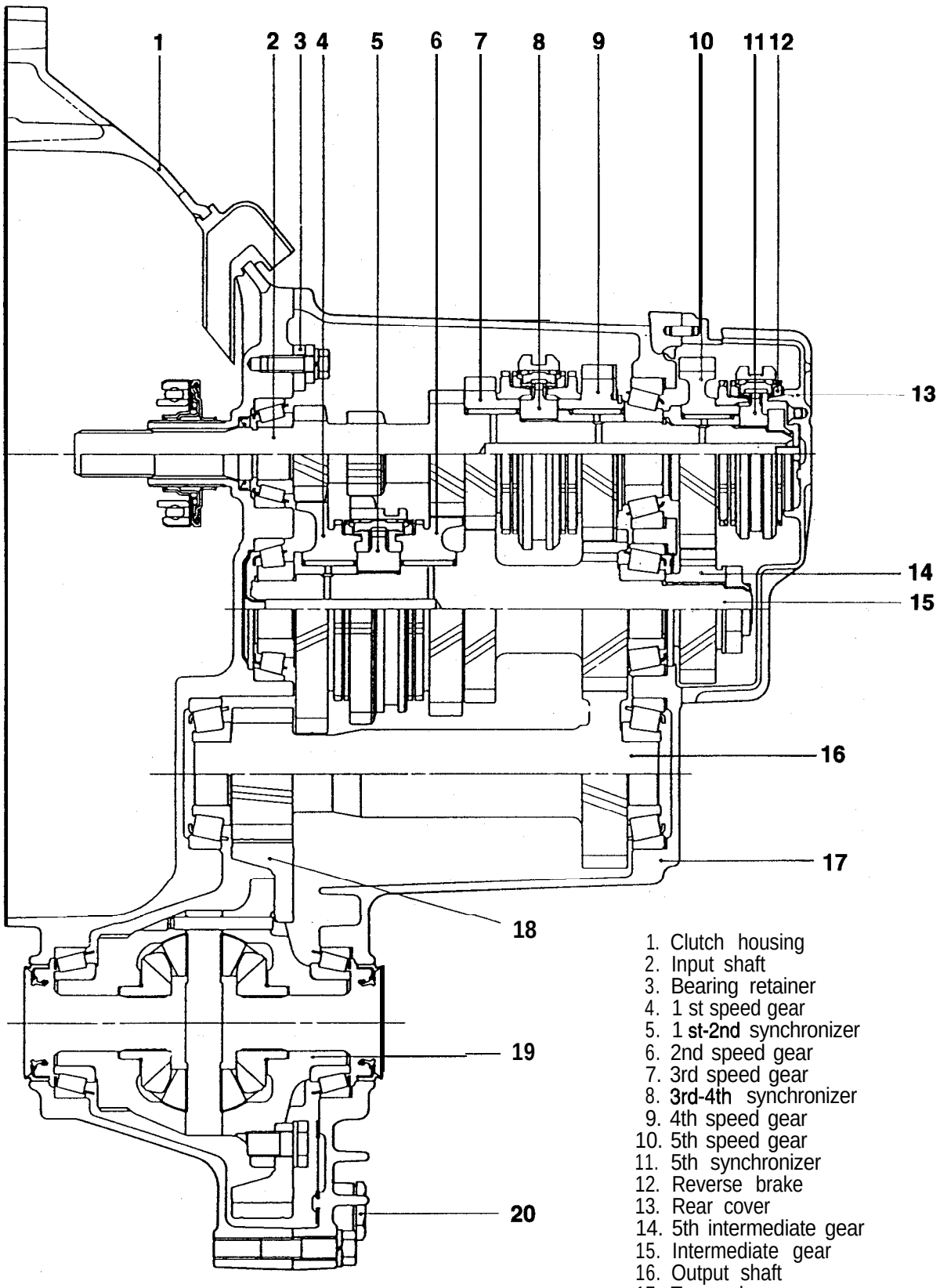
SECTIONAL VIEW

F5MC1 <FWD – 5M/T>



1. Reverse brake
2. 5th synchronizer
3. 5th speed gear
4. 4th speed gear
5. 4th synchronizer
6. 3rd synchronizer
7. 3rd speed gear
8. Reverse idler gear
9. Differential
10. 1 st speed gear
11. 1 st synchronizer
12. 2nd synchronizer
13. 2nd speed gear
14. 3rd/4th gear
15. 5th gear

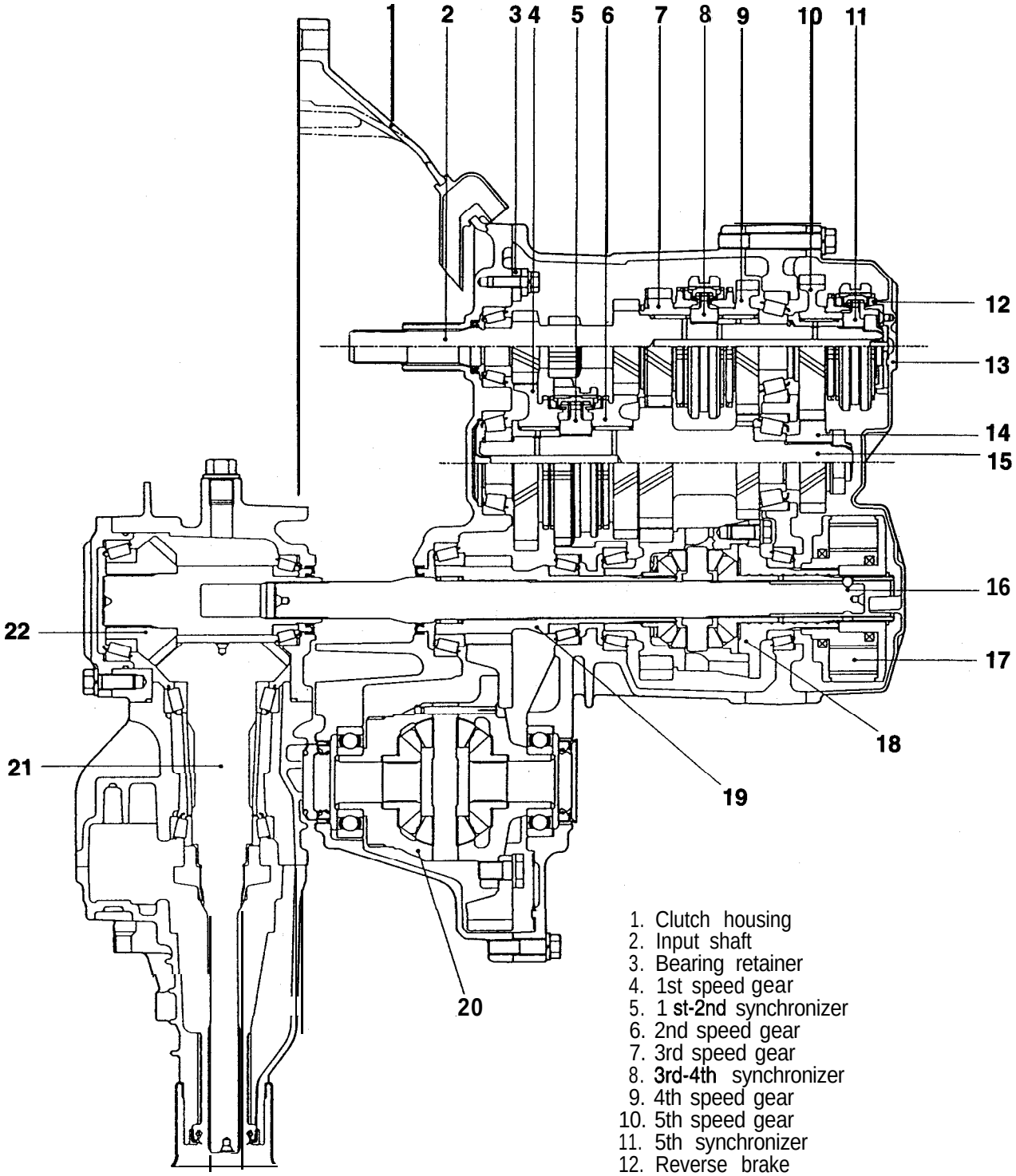
F5M33 <FWD – 5M/T>



1. Clutch housing
2. Input shaft
3. Bearing retainer
4. 1 st speed gear
5. 1 st-2nd synchronizer
6. 2nd speed gear
7. 3rd speed gear
8. 3rd-4th synchronizer
9. 4th speed gear
10. 5th speed gear
11. 5th synchronizer
12. Reverse brake
13. Rear cover
14. 5th intermediate gear
15. Intermediate gear
16. Output shaft
17. Transaxle case
18. Differential drive gear
19. Differential
20. Drain plug

TFM0111

W5M33 <AWD – 5M/T>



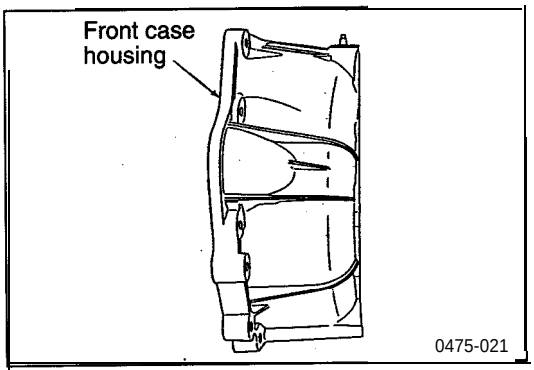
1. Clutch housing
2. Input shaft
3. Bearing retainer
4. 1st speed gear
5. 1 st-2nd synchronizer
6. 2nd speed gear
7. 3rd speed gear
8. 3rd-4th synchronizer
9. 4th speed gear
10. 5th speed gear
11. 5th synchronizer
12. Reverse brake
13. Rear cover
14. 5th intermediate gear
15. Intermediate gear
16. Center shaft
17. Viscous coupling
18. Center differential
19. Front output shaft
20. Front differential
21. Driven bevel gear
22. Drive bevel gear

CONSTRUCTION AND OPERATION <F5MC1>

N72ZC01AA

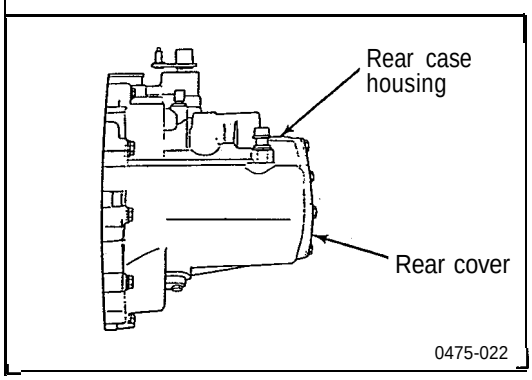
Transaxle Case

The transaxle case assembly consists of front case housing, rear case housing and rear cover. Front case housing and rear case housing are made of cast aluminum.



FRONT CASE HOUSING

The clutch housing and front case are a one-piece aluminum casting for reduced weight. The clutch housing encloses the mechanical clutch assembly.



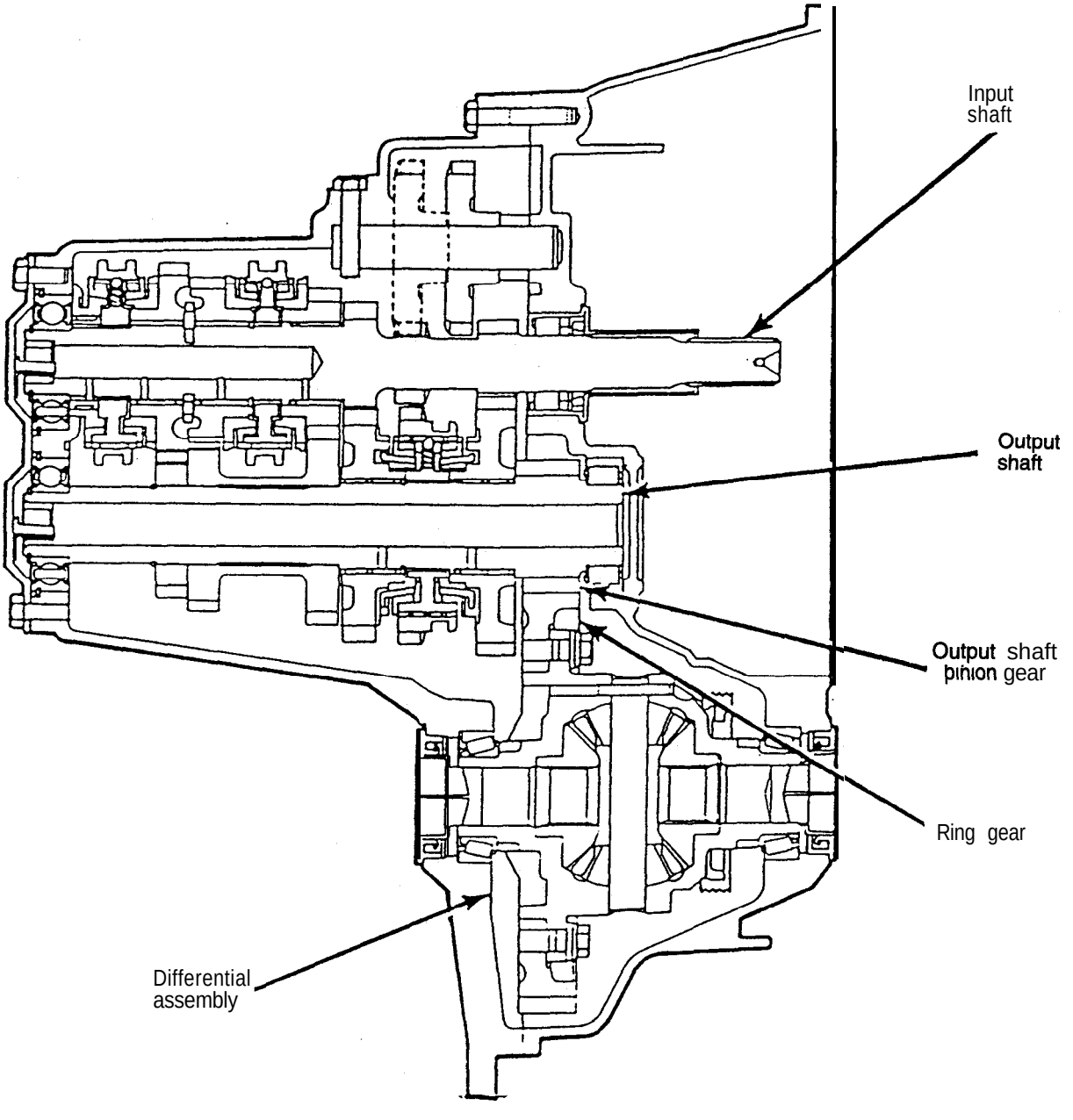
REAR CASE HOUSING

The rear case housing encloses the rear of the transaxle, and is made of cast aluminum.

Power Flow

N72ZC02AA

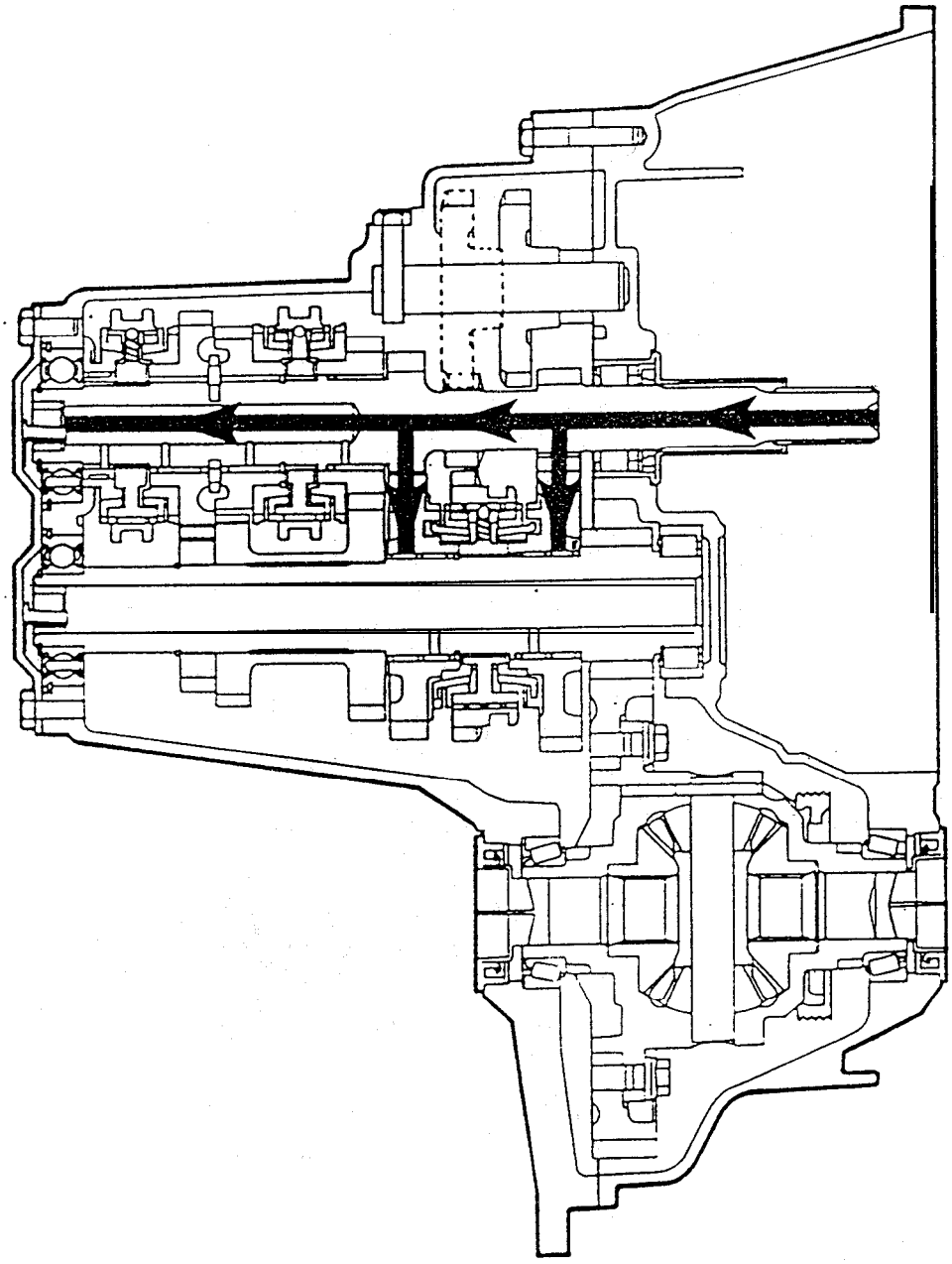
The F5MC1 transaxle is a fully synchronized (except reverse), constant mesh transaxle. "Constant Mesh" means that all of the forward gears are constantly in mesh with each other. This eliminates the need to move gears together for engagement like reverse. The gears turn whenever the input shaft is supplying power; however, none of the gears transmits torque until a synchronizer is engaged. When the synchronizer engages a speed gear, power is transferred to the output shaft, then out to the wheels. Power flows from the input shaft, to the output shaft, across the appropriate synchronizer, to the differential assembly, then out to the halfshafts.



0475-061

NEUTRAL

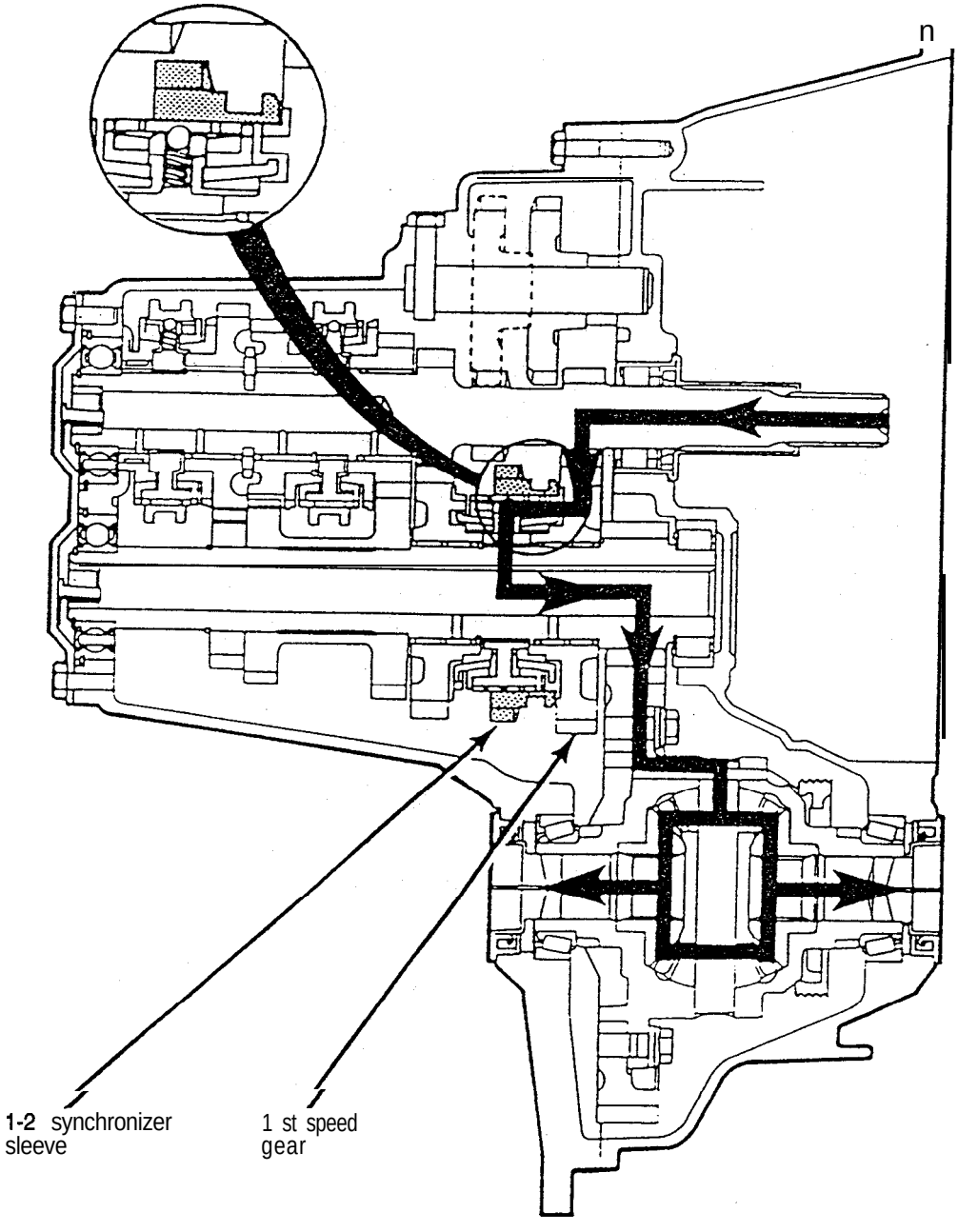
The input shaft supplies input power. First and second gears turn, but none of the synchronizers are engaged with speed gears. Because the synchronizers are not engaged with any of the gears, power is not transferred to the output shaft.



0475-062

FIRST GEAR

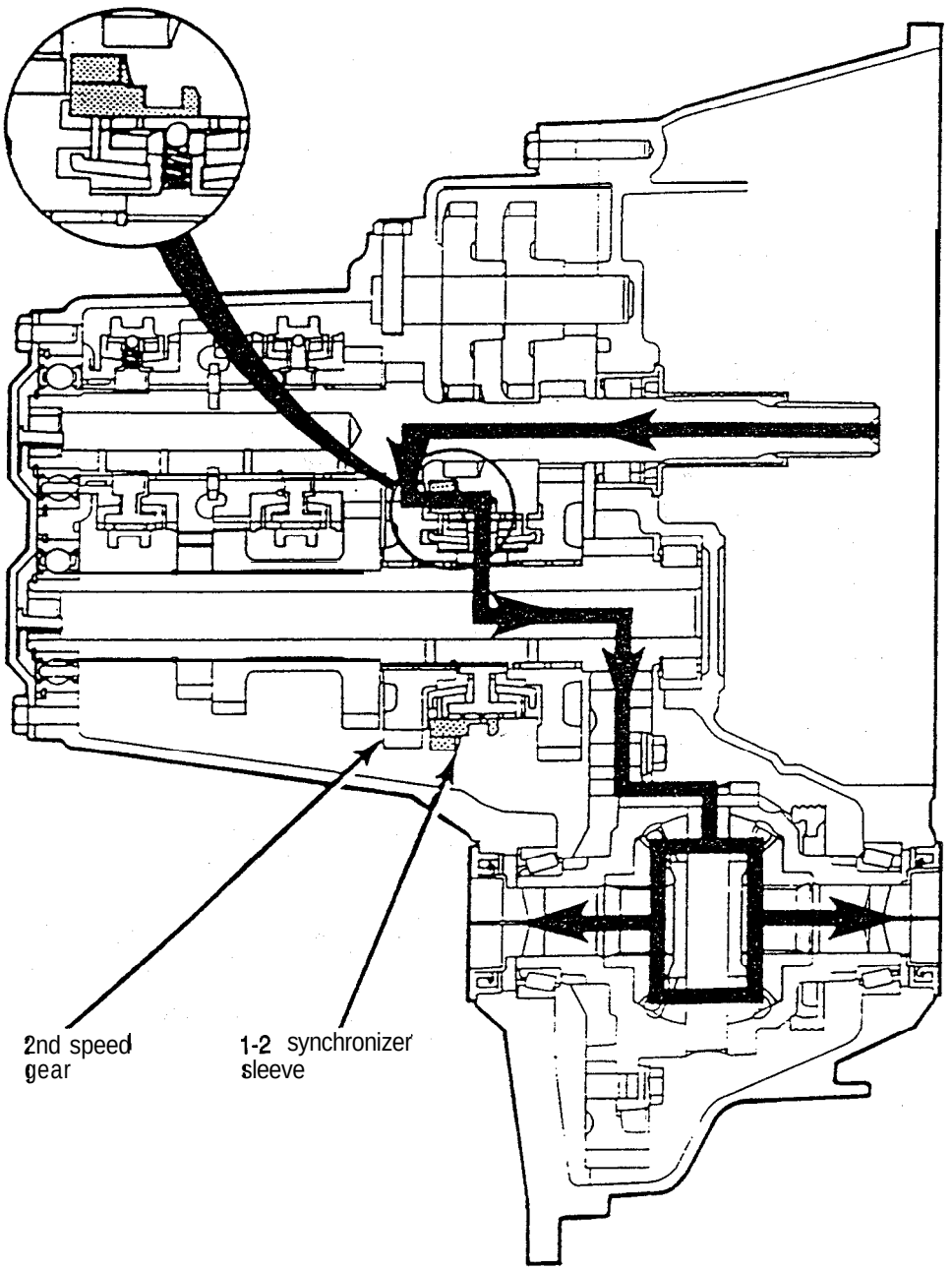
The 1-2 synchronizer sleeve moves forward to engage the clutch teeth on the first-speed gear. The power coming in the input shaft goes through the first-speed gear and into the synchronizer sleeve. The sleeve turns the synchronizer hub and output shaft. The output shaft pinion gear turns the differential ring gear. All other gears are freewheeling. The gear ratio for first is 3.54:1.



0475-063

SECOND GEAR

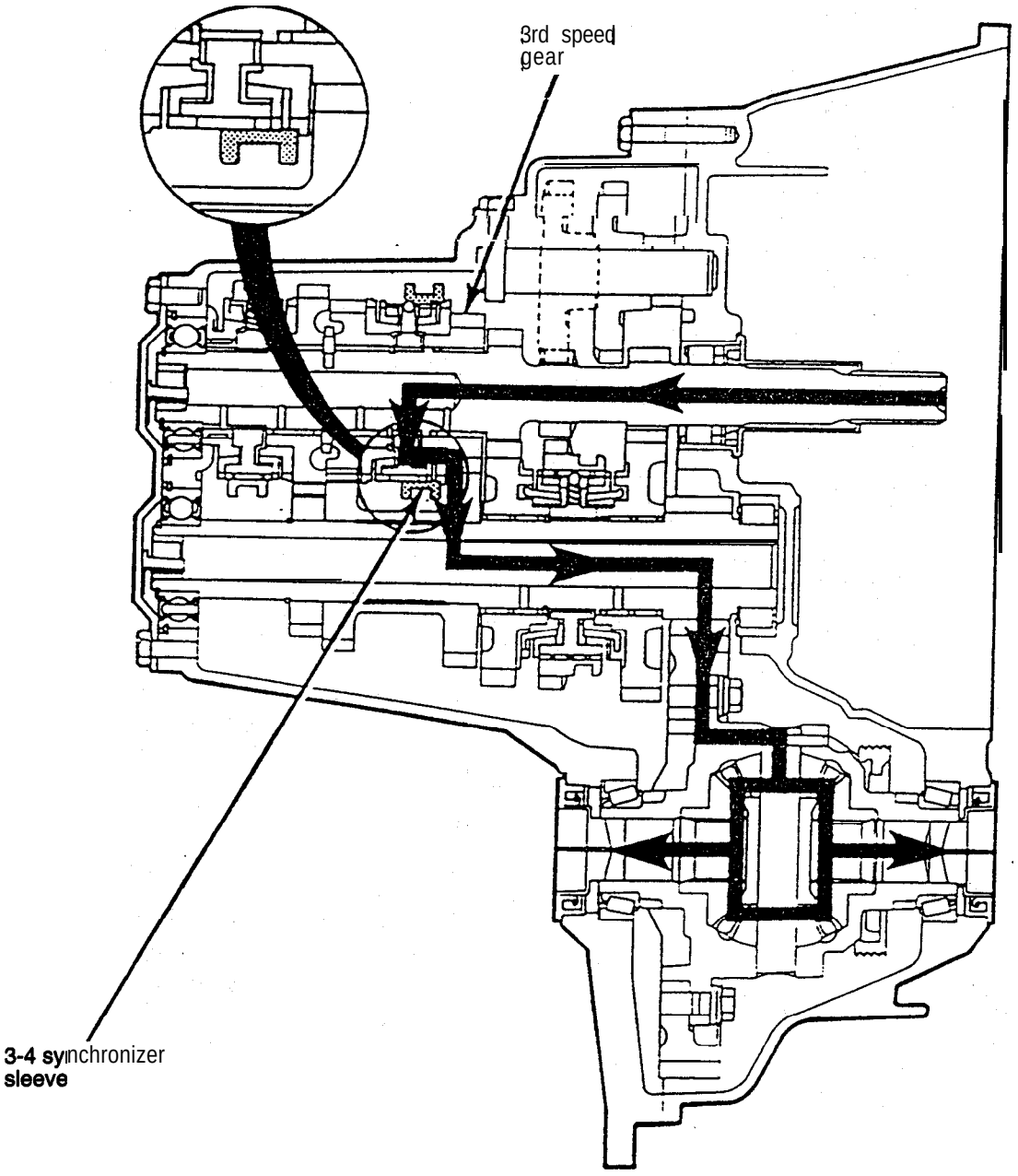
The 1-2 synchronizer sleeve moves rearward to engage the clutch teeth on the second-speed gear. The power coming in the input shaft goes through the second-speed gear and into the synchronizer sleeve. The sleeve turns the synchronizer hub and the output shaft, The output shaft pinion gear turns the differential ring gear. The gear ratio for second is 2.13:1.



0475-064

THIRD GEAR

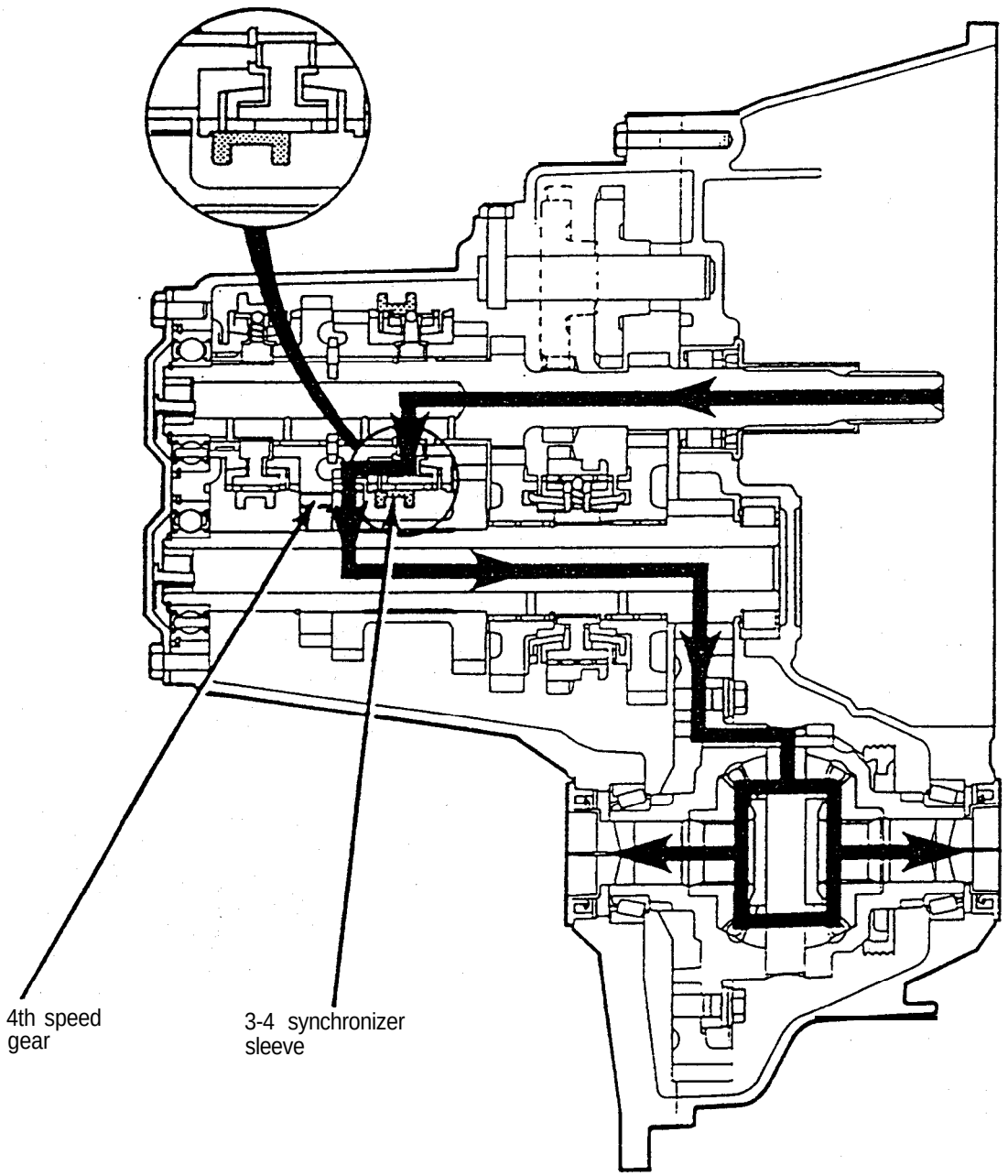
The 3-4 synchronizer sleeve moves forward to engage the third-speed gear clutch teeth. Input power goes through the input shaft, into the 3-4 synchronizer hub. The hub turns the synchronizer sleeve, third speed gear and the output shaft. The output shaft pinion gear turns the differential ring gear. The gear ratio for third is 1.36:1



0475-065

FOURTH GEAR

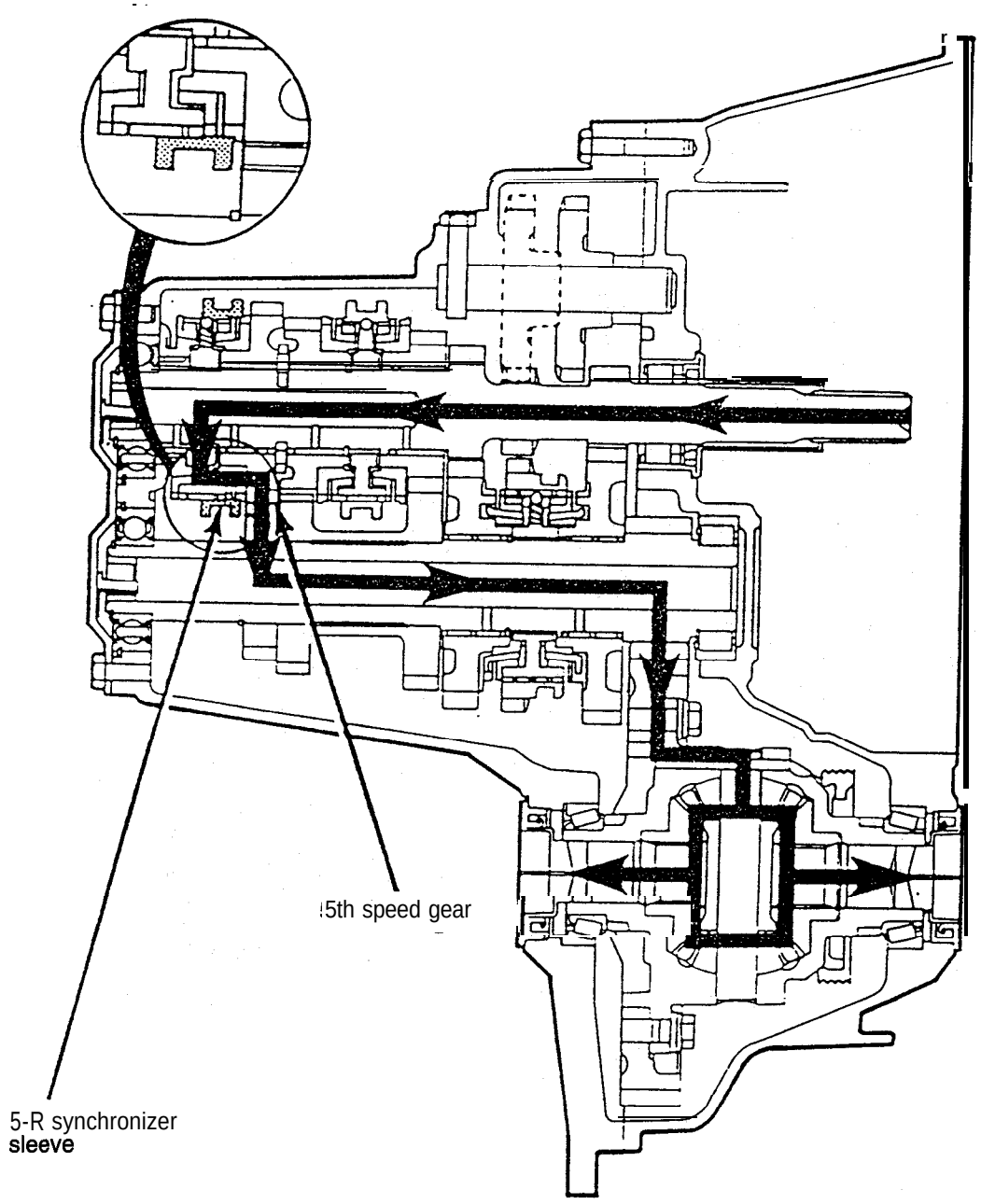
The 3-4 synchronizer sleeve moves rearward to engage the fourth-speed gear clutch teeth. Input power goes through the input shaft, into the 3-4 synchronizer hub. The hub turns the synchronizer sleeve, fourth speed gear and the output shaft. The output shaft pinion gear turns the differential ring gear. The gear ratio for fourth is **1.03:1**



0475-066

FIFTH GEAR

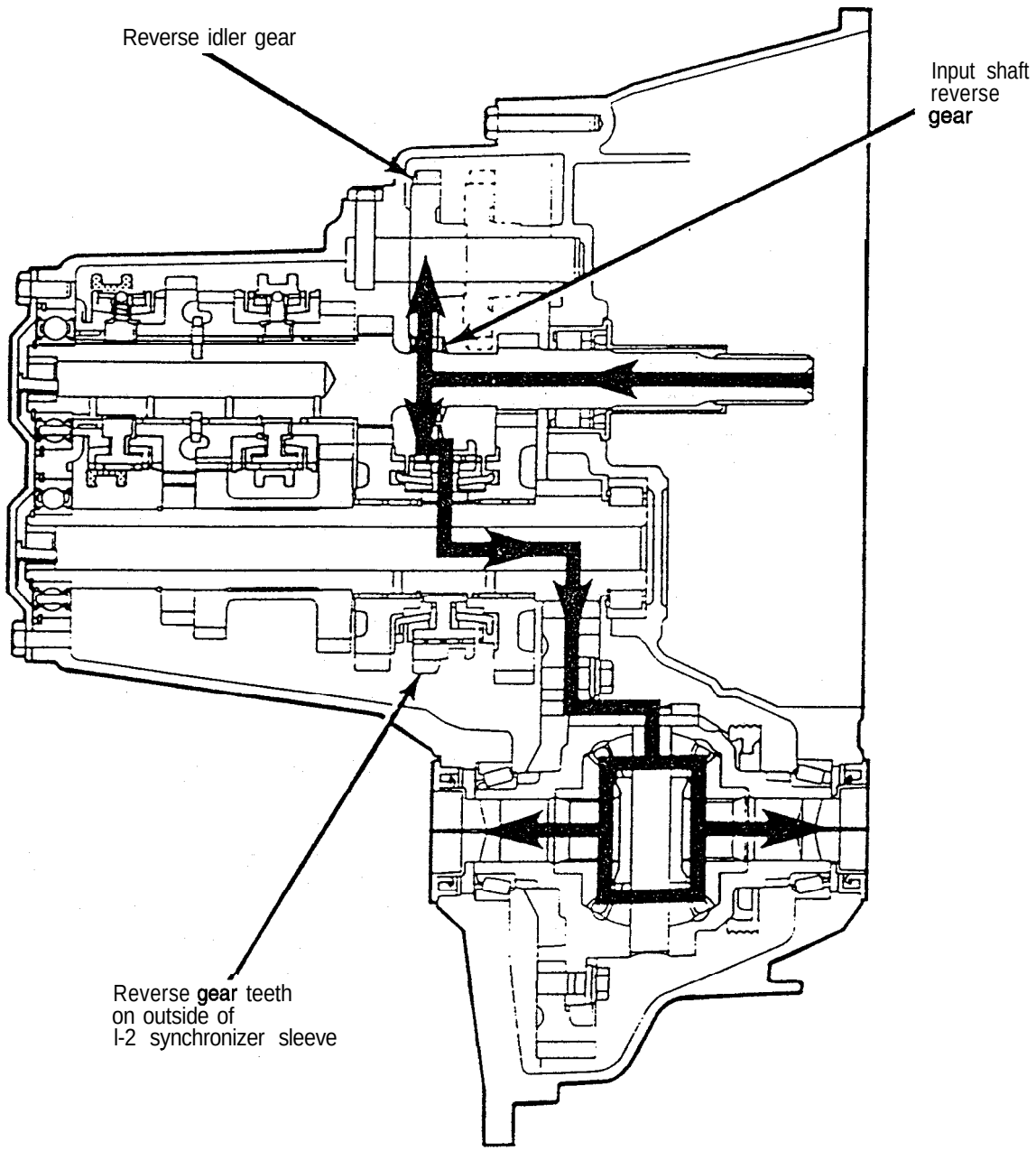
The 5-R synchronizer sleeve moves forward to engage the fifth-speed gear clutch teeth. Input power goes through the input shaft, into the 5-R synchronizer hub. The hub turns the synchronizer sleeve, the fifth speed gear and the output shaft. The output shaft pinion gear turns the differential ring gear. The gear ratio for fifth is 0.81 :1



0475-067

REVERSE GEAR

The 5-R synchronizer sleeve and the reverse idler gear move rearward and engages with both input shaft reverse gear and the gear teeth around the outside of the l-2 synchronizer sleeve. Input power goes through the input shaft, across the reverse idler gear, and into the 1-2 synchronizer sleeve. The sleeve turns the synchronizer hub and output shaft. The output shaft pinion gear turns the differential ring gear in the reverse direction. The gear ratio for reverse is 3.42:1.



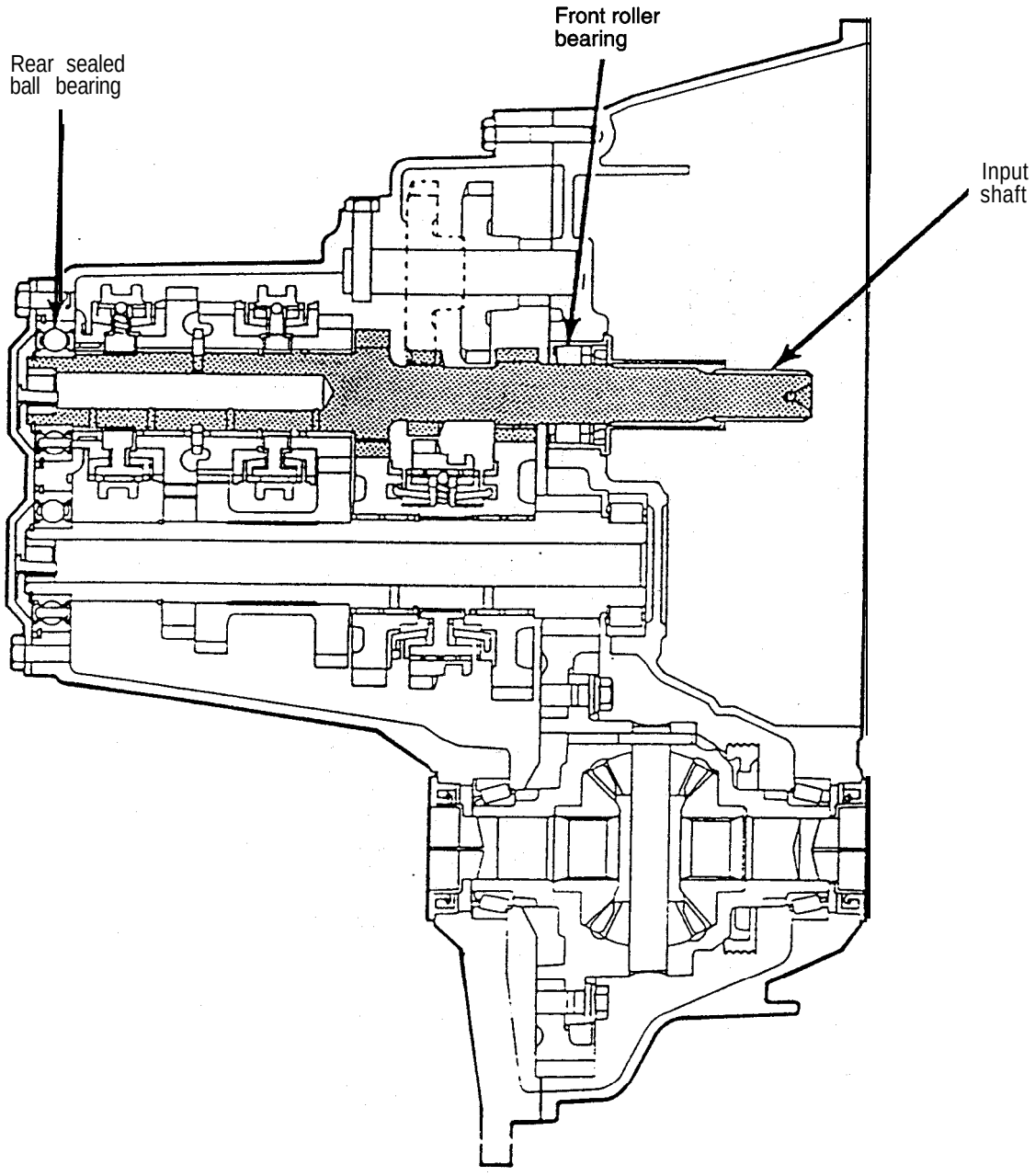
0475-068

Power Train Component

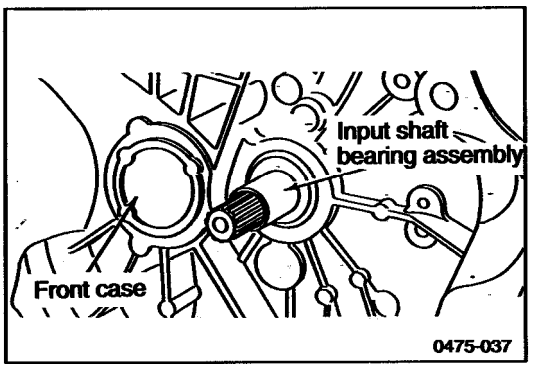
N72ZC03AA

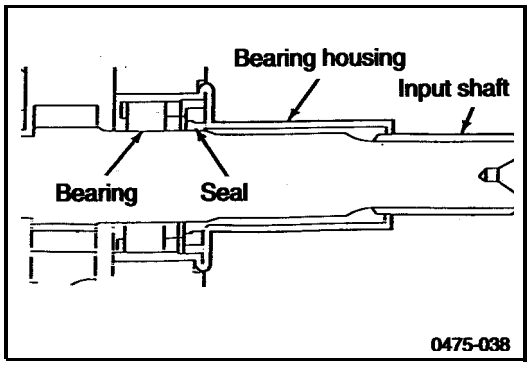
INPUT SHAFT

The front of the shaft is supported by a roller bearing in the front transaxle case housing. The rear of the shaft is supported by a sealed ball bearing in the rear case.



0475-056



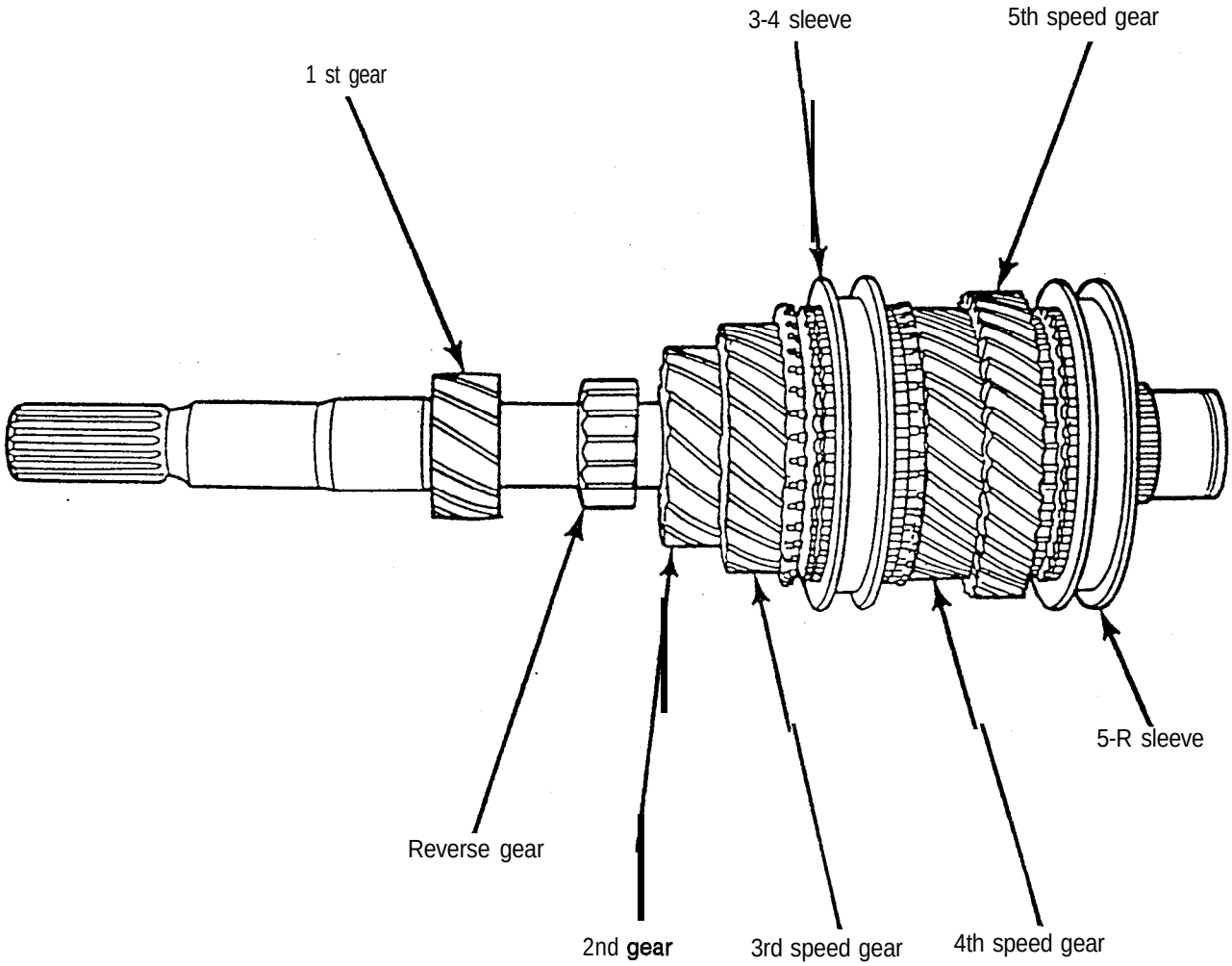


Input Shaft Bearing Assembly

An input shaft bearing assembly is pressed into the front case of the transaxle. The assembly consists of the bearing housing, bearing, and seal. The seal prevents transmission fluid leakage into the clutch disc area. Individual components are not serviceable, if any of the components fail the entire assembly must be replaced. The clutch release bearing rides on the smooth round surface of the retainer during clutch operation. Grease is not required on the retainer where the release bearing rides.

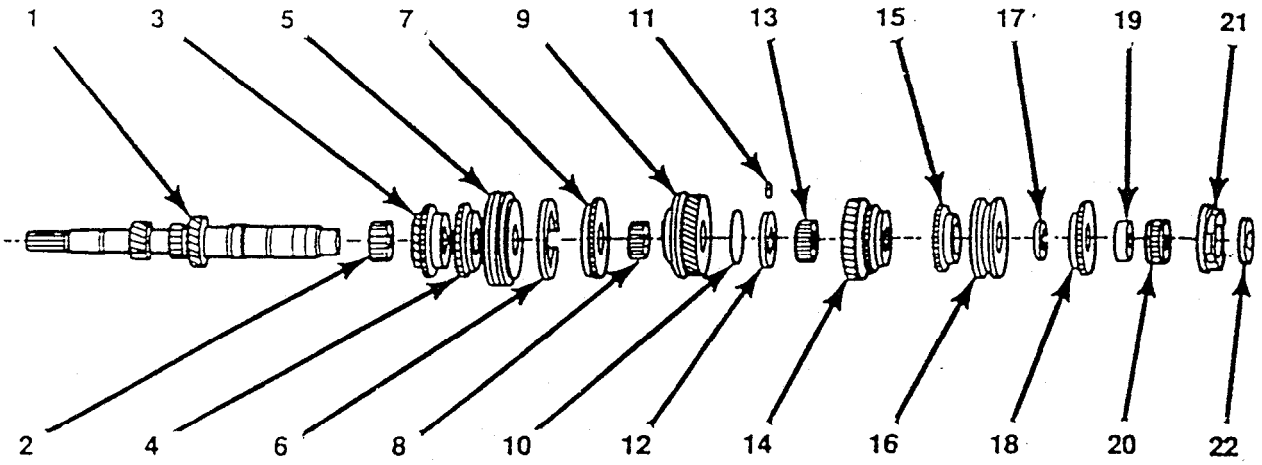
Input Shaft Assembly

The input shaft transmits engine torque to the transaxle. The assembly consists of the input shaft, 3-4 and 5-R synchronizer assemblies, third, fourth and fifth speed gears, snap rings, caged needle bearings and thrust washers.



0475-039

First, second and reverse gears are machined on the shaft. Third, fourth and fifth speed gears ride on caged needle bearings that rotate on the shaft journals. All of the forward gears are helical-type gears, and are in constant mesh with the output shaft gears. The speed gears all have clutch teeth and cones, which are used to equalize shaft speeds during shifts. The clutch teeth engage with the synchronizer sleeves and the cones engage with the stop rings during a shift.

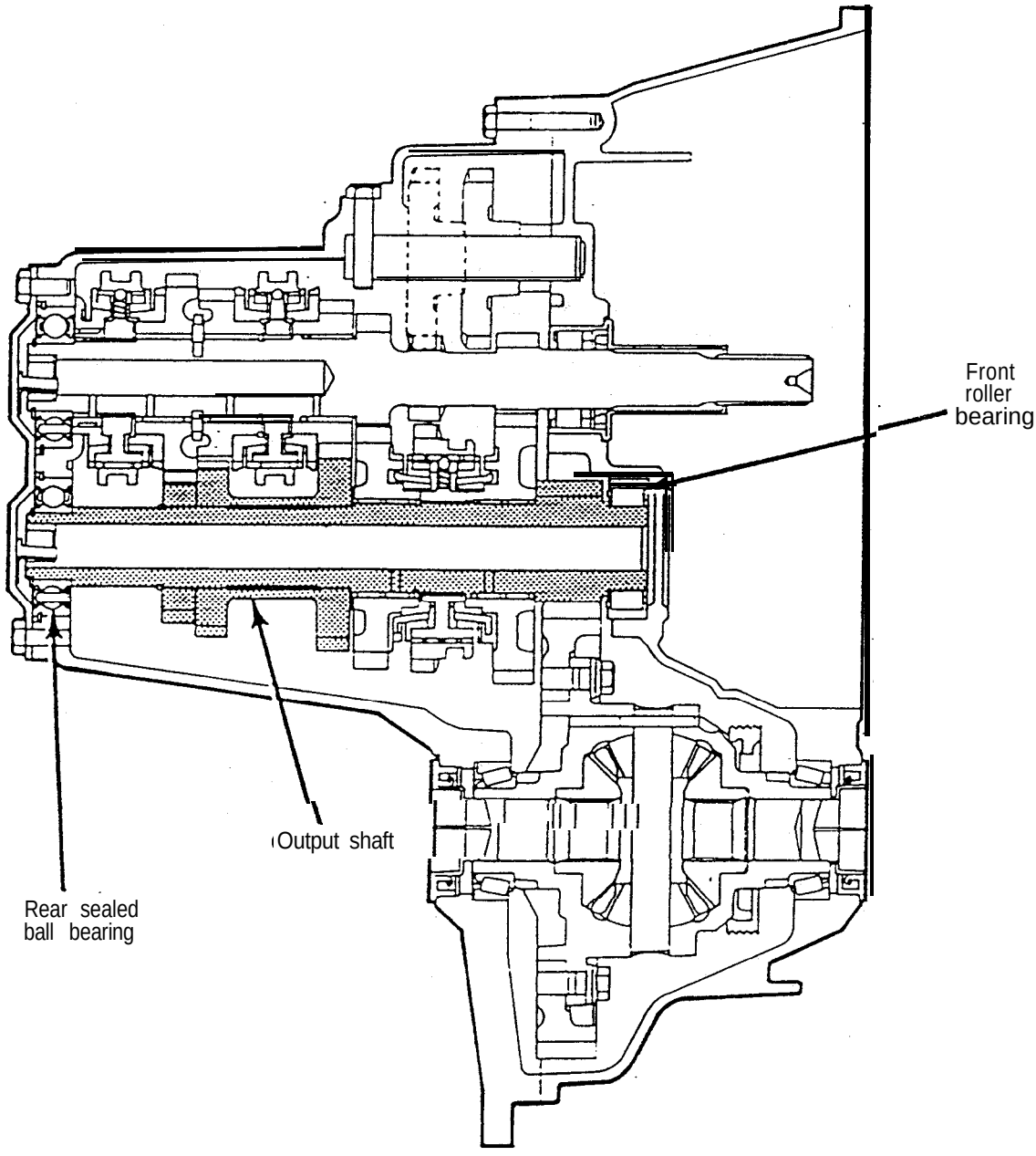


1. Input shaft
2. Third gear bearing
3. Third speed gear
4. Third stop ring
5. 3-4 synchronizer
6. 3-4 synchronizer snap ring
7. Fourth stop ring
8. Fourth gear bearing
9. Fourth speed gear
10. Retaining ring
11. Anti-spin pin
12. Thrust washer (2-piece)
13. Fifth gear bearing
14. Fifth speed gear
15. Fifth stop ring
16. 5-R synchronizer
17. 5-R synchronizer snap ring
18. Reverse stop ring
19. Reverse brake bearing race
20. Reverse brake bearing
21. Reverse brake friction cone
22. Thrust washer

0475-040

OUTPUT SHAFT

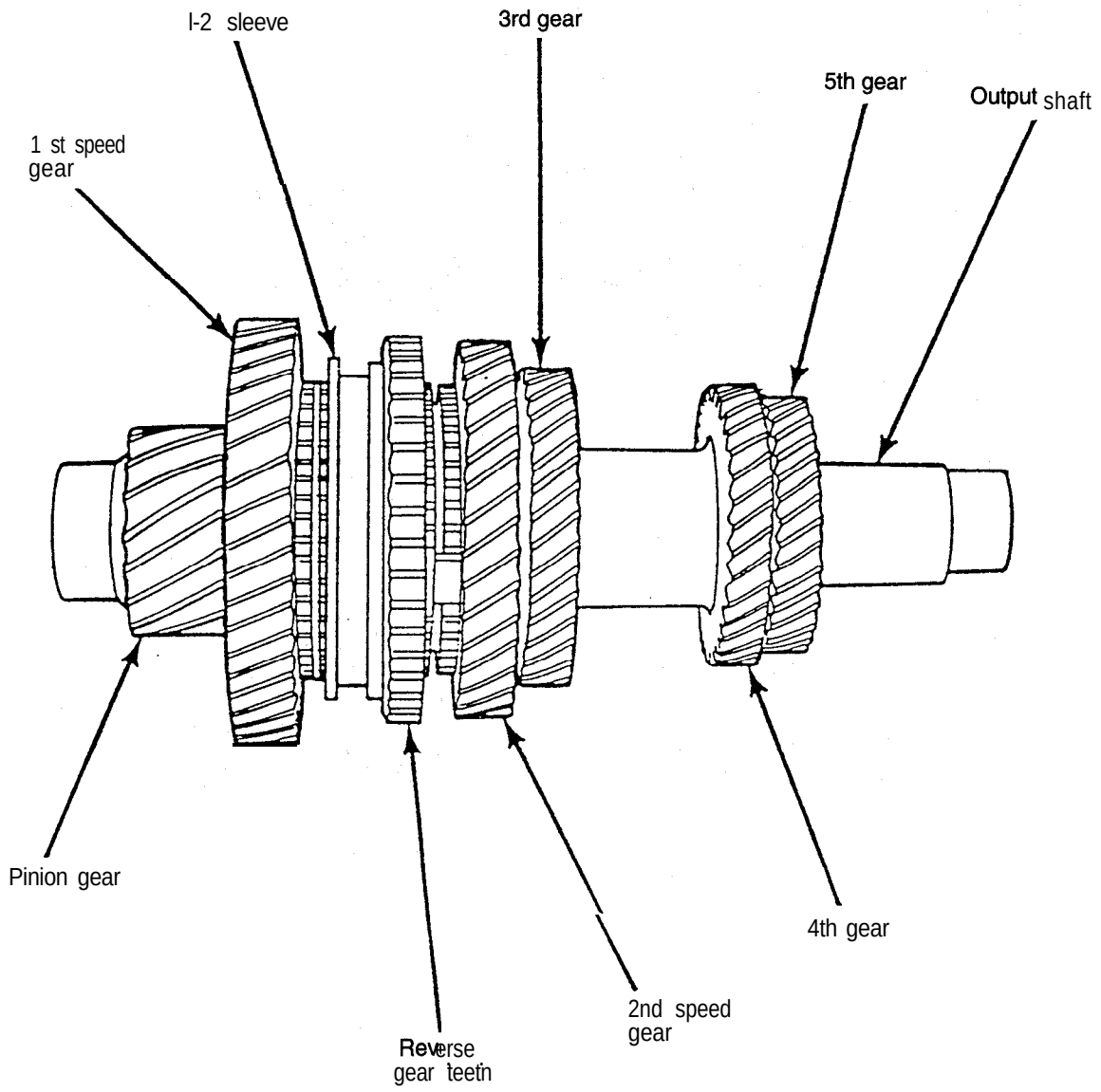
The front of the output shaft is supported by a roller bearing that rides in the front transaxle case housing. The rear of the output shaft is supported by a sealed ball bearing in the rear case.



0475-057

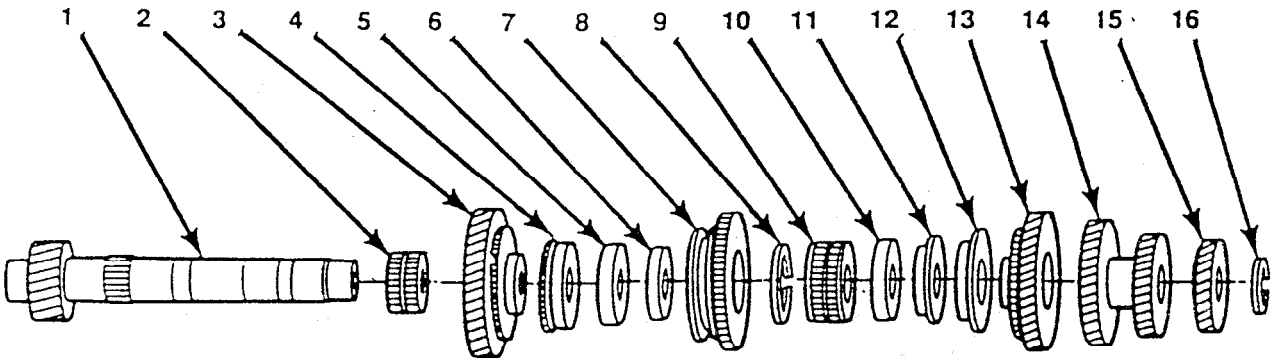
Output Shaft Assembly

The output shaft assembly transmits torque from the input shaft to the differential ring gear. The front of the output shaft rides in a caged roller bearing supported by the front case. The rear of the shaft is supported by a sealed ball bearing located in the rear case.



0475-041

The assembly consists of the output shaft, l-2 synchronizer assembly, first and second speed gears, snap rings and needle bearings. First and second-speed gears use caged needle bearings that rotate on the shaft journals. Third, fourth and fifth gears are heated and pressed on the output shaft. Individual components are not serviceable because of the heat and press operations, if any of the components fail the entire assembly must be replaced.

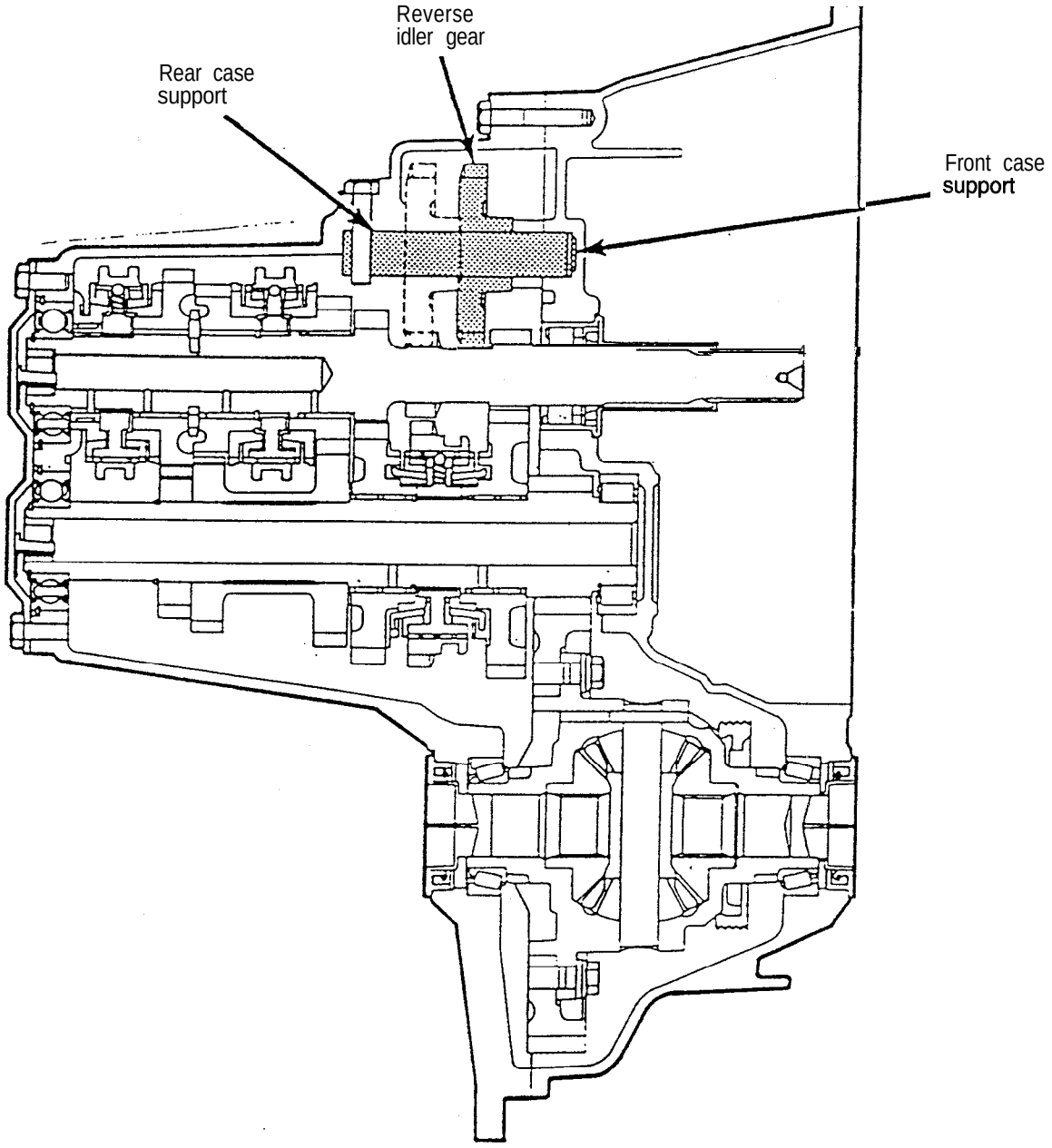


1. Output shaft
2. First gear bearing
3. First speed gear
4. First gear stop ring
5. Outer cone
6. Inner cone
7. l-2 synchronizer
8. l-2 synchronizer snap ring
9. Second gear bearing
10. Inner cone
11. Outer cone
12. Second gear storing
13. Second speed gear
14. Third and fourth gears
15. Fifth gear
16. Fifth gear snap ring

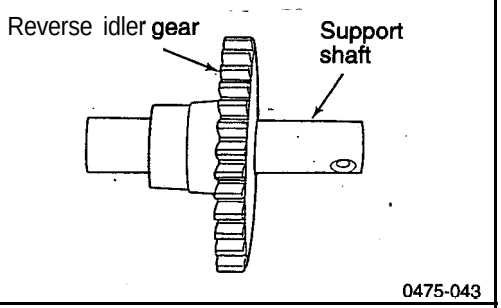
0475-042

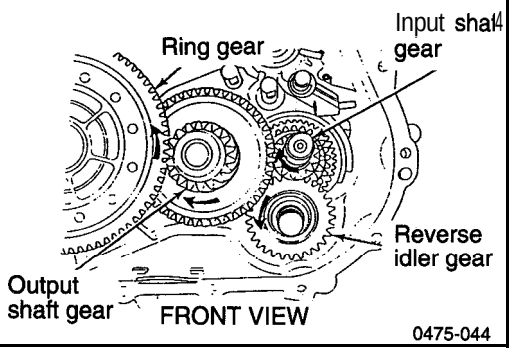
REVERSE IDLER

The reverse idler gear shaft is supported by the front and rear cases.



0475-058



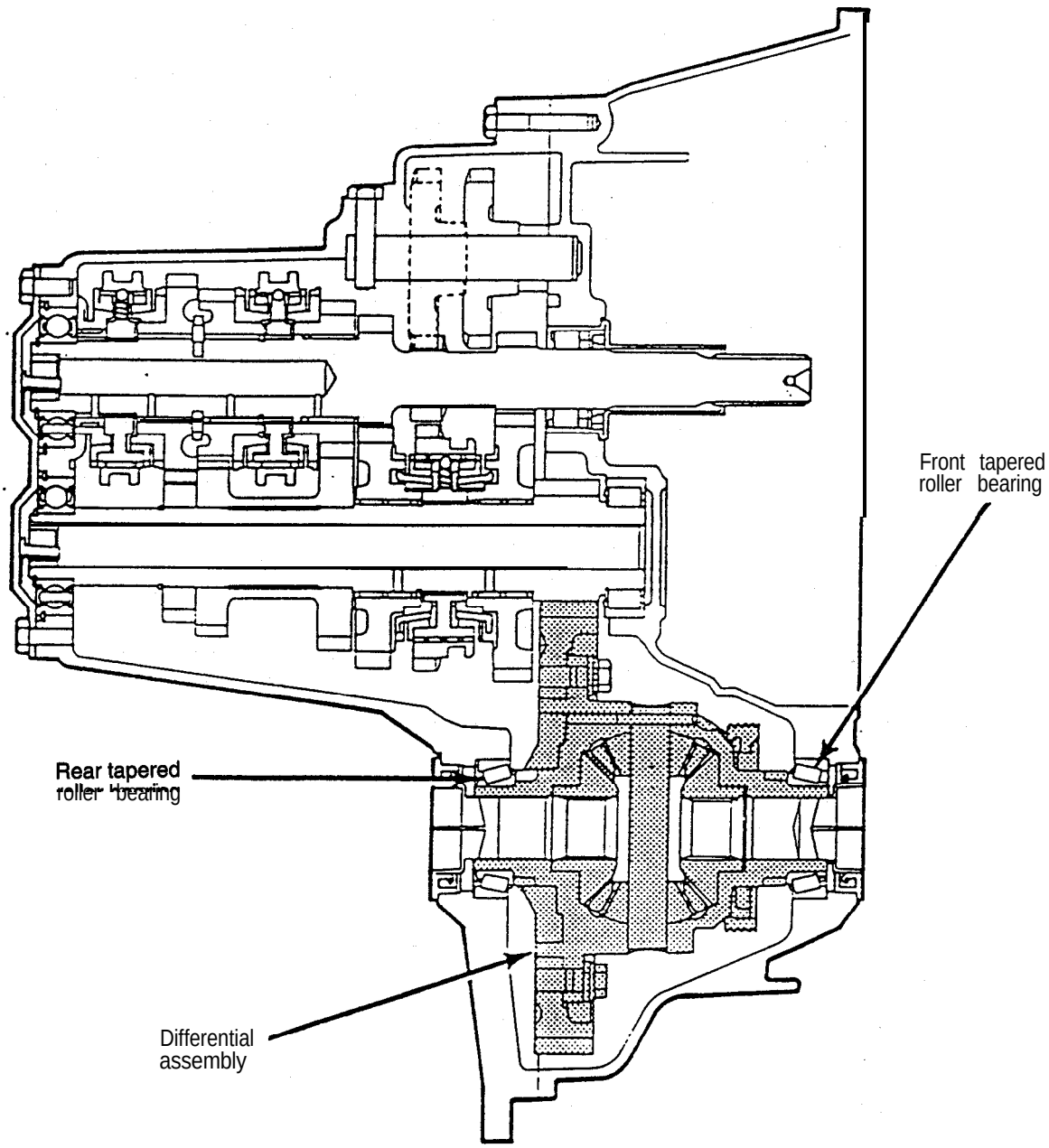


Reverse Idler Gear

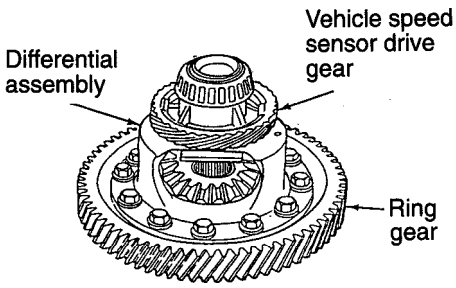
The reverse idler gear slides into mesh with the input shaft reverse gear and the gear teeth around the 1-2 synchronizer sleeve. The idler gear allows the output shaft to turn in the opposite direction for reverse operation. The gear is supported by a shaft that is held in the front and rear **cases.**

DIFFERENTIAL ASSEMBLY

The differential assembly is supported by two tapered roller bearings, one in the front case housing and the other in the rear case housing.



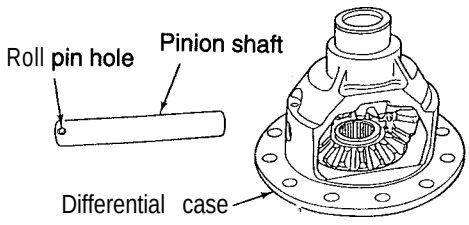
0475-059



0475-051

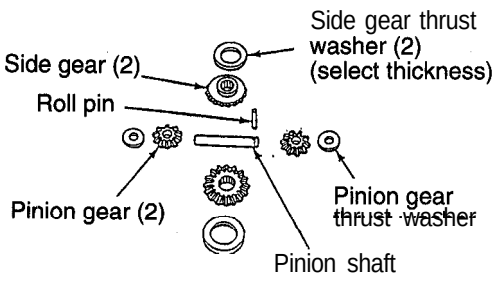
Differential

The F5MC1 differential assembly is similar to previous transaxles, except the vehicle speed sensor drive gear is mounted on the differential case. The ring gear is an open center design and is bolted to the differential case. The pinion gear of the output shaft is in constant mesh with the ring gear which provides torque to the differential.



0475-052

The differential case transfers torque from the ring gear to the differential side gears. The differential case is mounted between the front and rear case housings and supported by two tapered roller bearings. The outer bearing races are pressed into the front and rear transaxle case housings. The outer race mounted in the front transaxle case uses a selectable shim behind it for differential bearing preload adjustment.



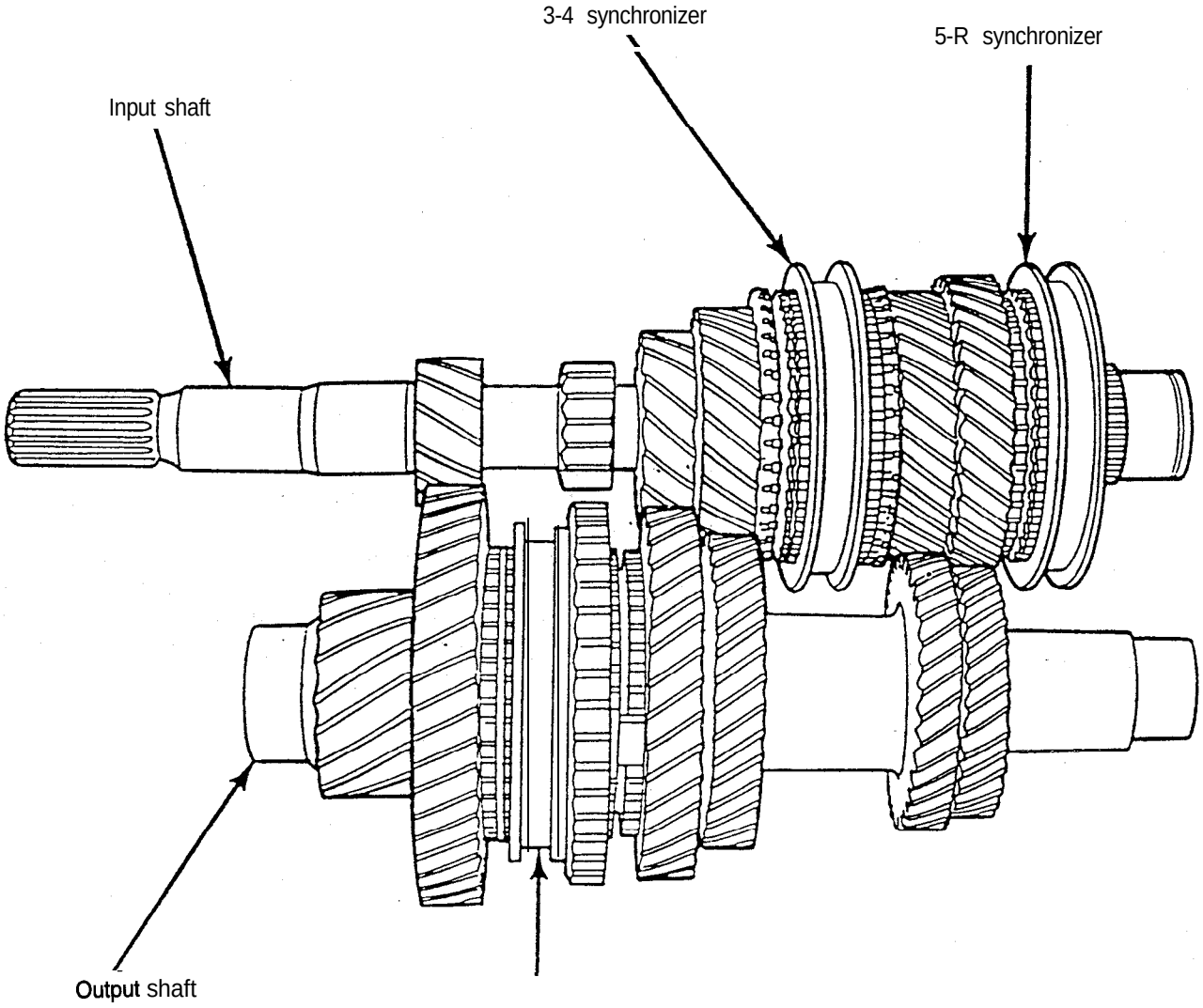
0475-053

The differential allows the wheels to turn at different speeds while the same amount of torque is applied to both. The differential contains two sets of gears, the pinion gears and the side gears. The pinions are meshed with the side gears and turn on the pinion shaft which is held in the case by a roll pin. The side gears are splined to the halfshafts and transfer torque to the wheels. The side gear clearance must be adjusted by using selectable side gear thrust washers.

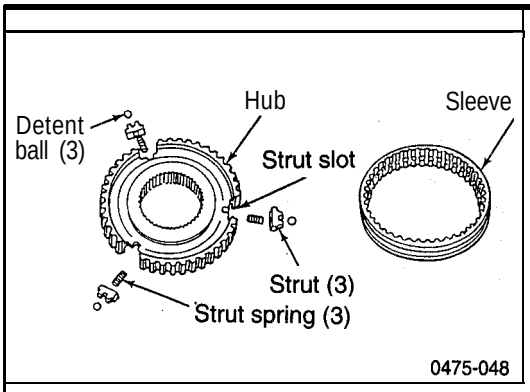
Synchronizer

N72ZC04AA

Three synchronizer assemblies are used in the F5MC1 transaxle. The 3-4 and 5-R synchronizers are mounted on the input shaft assembly and the 1-2 synchronizer is mounted on the output shaft assembly.

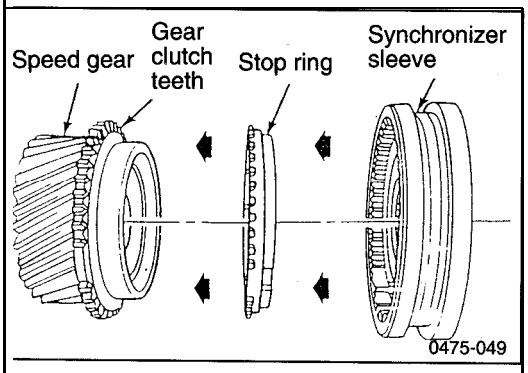


0475-047

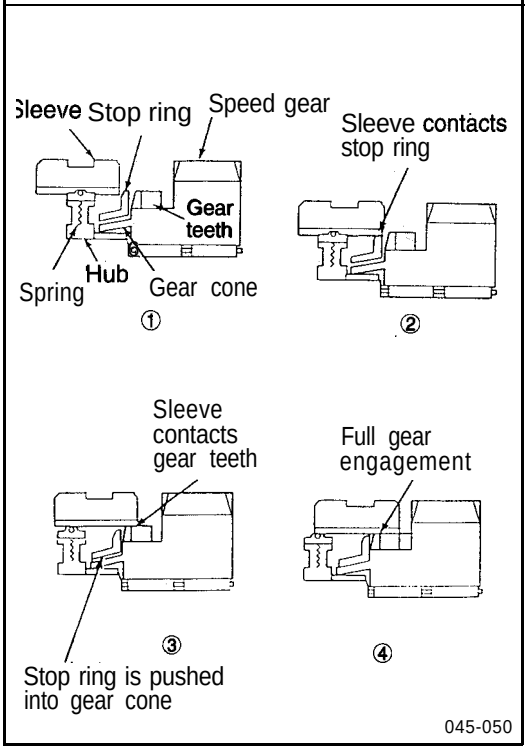


SYNCHRONIZER COMPONENTS

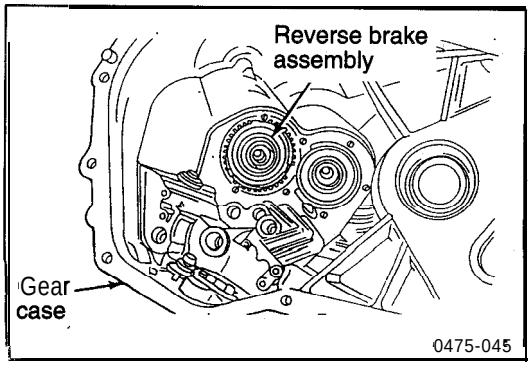
The synchronizer assemblies contain a sleeve, hub, struts, springs and detent balls. The sleeve has inner splines that slide on the hub and an outer radial slot that engages the shift fork. The hub has inner splines that engage the shafts and outer splines that the sleeve rides on. The outer hub splines have three slots, cut lengthwise, for the struts.



Stop rings are located between the synchronizer and the speed gears. The stop ring acts as a clutch to bring both the shaft and speed gear to the same speed, without gear clash. During a shift, the sleeve slides on the hub and over the stop ring to engage the gear clutch teeth. When the sleeve and the stop ring touch, they immediately begin to equalize speeds, or synchronize.

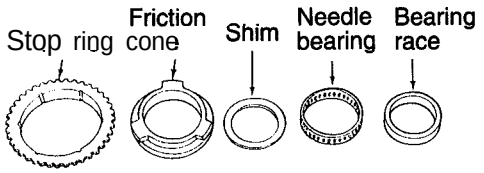


The balls are held against the sleeve by the synchronizer springs. The struts slide in the hub slots during a shift. The synchronizer springs use a detent ball to center the strut in the synchronizer sleeve. Before the sleeve and stop ring contact each other, the struts engage lugs on the stop ring, pushing the stop ring onto the gear cone. The sleeve teeth then block against the stop ring teeth until the gears synchronize. The slots in the hub are slightly larger than the lugs on the stop ring allowing the ring to turn when it contacts the gear. The turning of the stop ring is often referred to as “clocking.”



REVERSE BRAKE

A reverse brake assembly is used to stop input shaft rotation through a friction cone which is locked to the transaxle case. The brake is located in the rear case behind the input shaft 5-R synchronizer. The brake prevents the reverse idler gear from clashing with the input and output shaft gears.



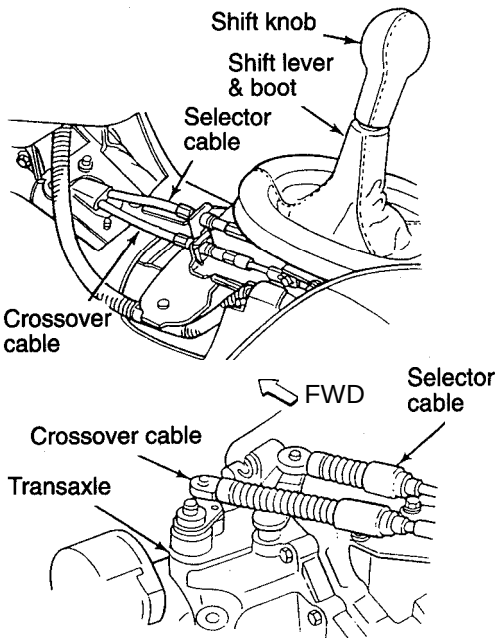
0475-046

The assembly looks and functions much like a synchronizer. It consists of a stop ring, friction cone, shim, needle bearing and bearing race.
If a shift to reverse is attempted before the clutch completely spins down (stops turning) the brake will stop the input shaft before the idler gear engages any other gear. The friction cone has lugs that fit into the case and holds the cone stationary. The 5-R synchronizer sleeve engages with the stop ring.

Shift System

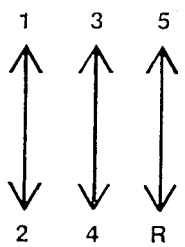
N72ZC05AA

The shift system is the link between the driver and the transaxle. The shifter assembly selects different gears by moving the shift forks. The shift system consists of the shift knob, lever, selector cable, crossover cable and transaxle shift levers.



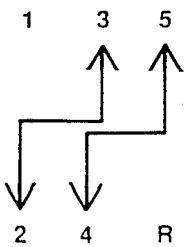
0475-025

Two transaxle shift shafts operate the shift selector assembly inside the transaxle. A selector shaft and a crossover shaft move the shift assembly during shifts. The selector shaft controls shifts into first and second, third and fourth, fifth and reverse. The arrows indicate selector shaft movement.

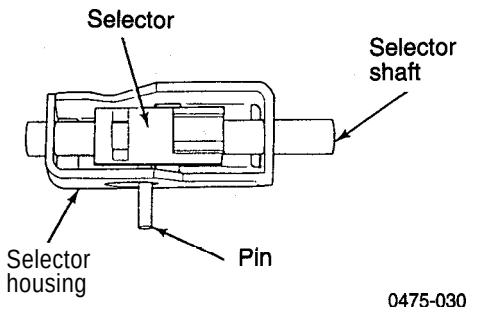


0475-028

The crossover shaft is used to move the shift assembly from one plane to another. The crossover shaft moves the shift assembly from side to side allowing for shifts between second and third, fourth and fifth. A bias spring is located around the crossover shaft. The bias spring returns the assembly to the 3-4 neutral position when the transaxle is in neutral and the shift lever is released.

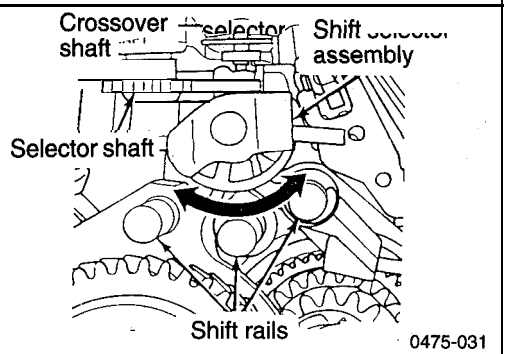


0475-029

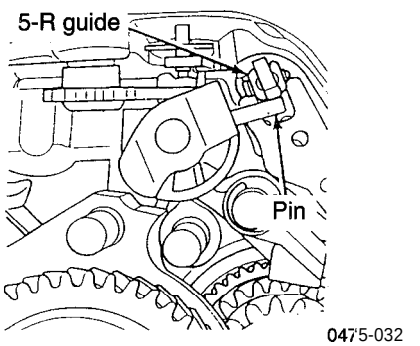


SHIFT SELECTOR ASSEMBLY

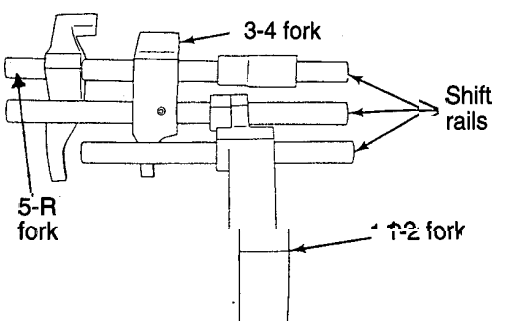
The shift selector assembly moves the appropriate shift fork based on the drivers selection. The assembly consists of the selector, shaft, housing, and pin.



The selector housing blocks the other shift forks and prevents a shift into two gears at the same time. The selector pivots in an arc to select the different shift forks.

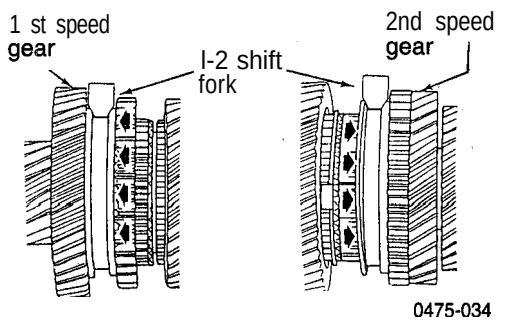


A shift from fifth-to-reverse is blocked by a 5-R guide (guides from 5th to 4th). The shift assembly has a pin sticking out of one side that engages the guide as it comes out of fifth gear. The guide pushes the pin and shift assembly away from reverse gear.

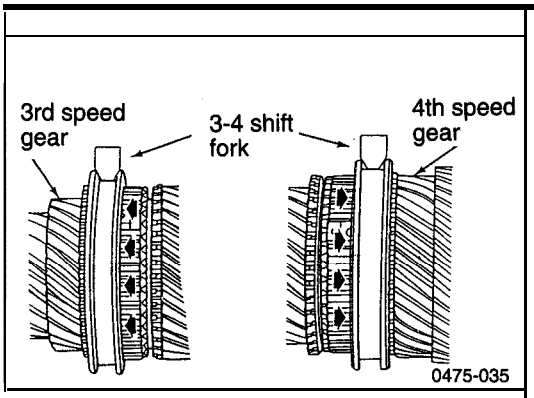


SHIFT RAILS AND FORKS

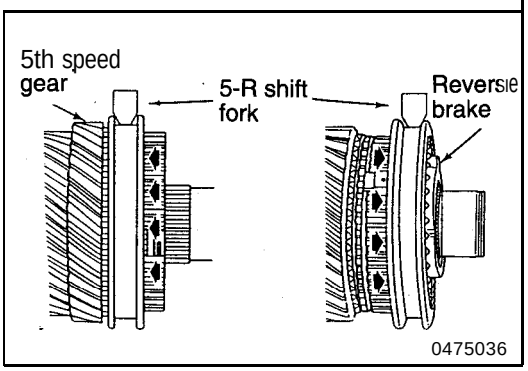
The F5MC1 uses three rail and fork assemblies. All of the shift forks have dual functions in that they control shifts into two different gears.



When the 1-2 shift fork moves to the front of the transaxle, first gear is obtained. When it moves to the rear of the transaxle, second gear is obtained.



When the 3-4 shift fork moves to the front of the transaxle, third gear is obtained. When it moves to the rear of the transaxle, fourth gear is obtained.



When the 5-R shift fork moves to the front of the transaxle, fifth gear is obtained. When the 5-R shift fork and the reverse shift fork move to the rear of the transaxle, reverse gear is obtained.

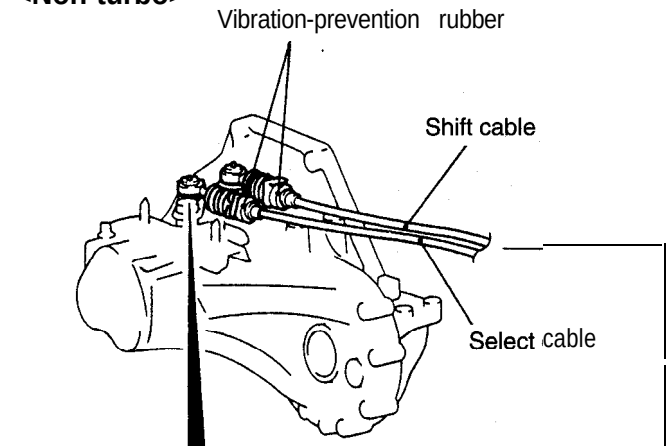
TRANSAXLE CONTROL

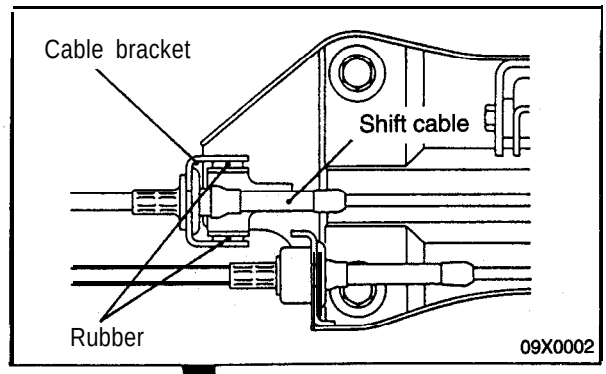
N72ZCIOAA

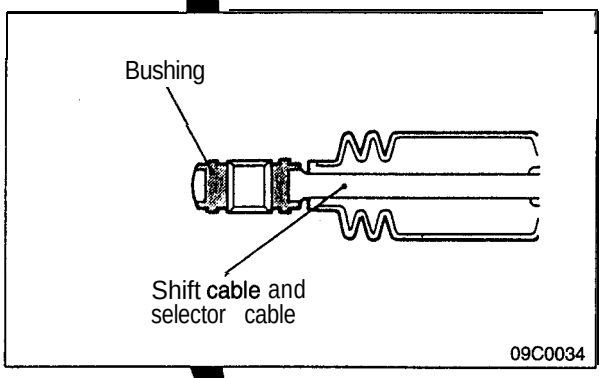
The shift cable and selector cable are equipped with bushings on their transaxle ends to absorb minute vibrations from the engine and transaxle.

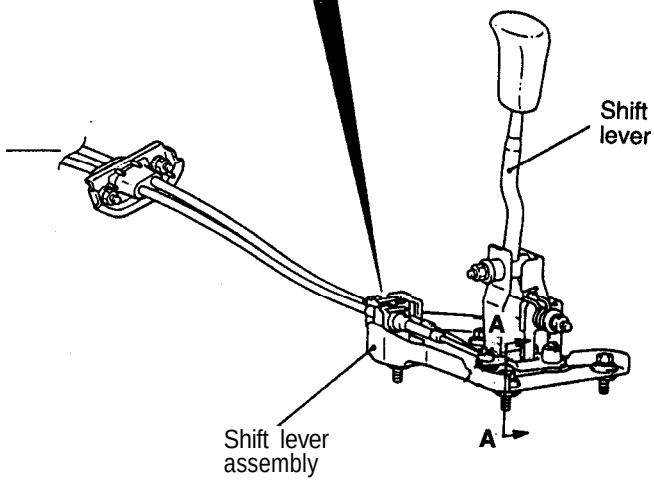
Also, the shift cable bracket on the shift lever end uses rubber to provides elastic support to the shift lever assembly thus minimizing vibration of the shift lever.

<Non-turbo>

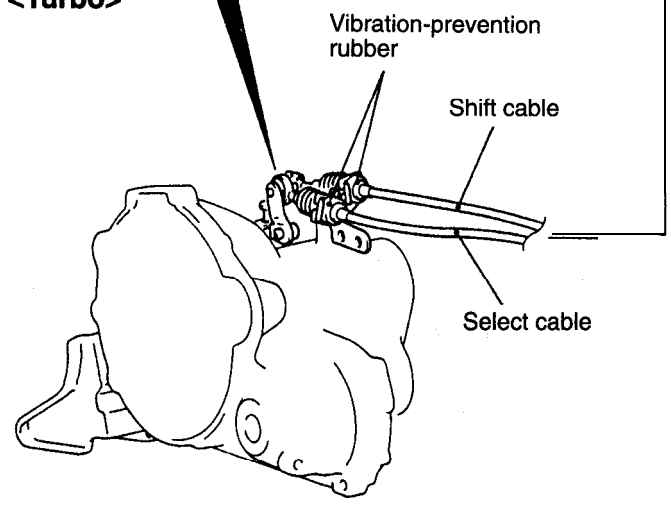


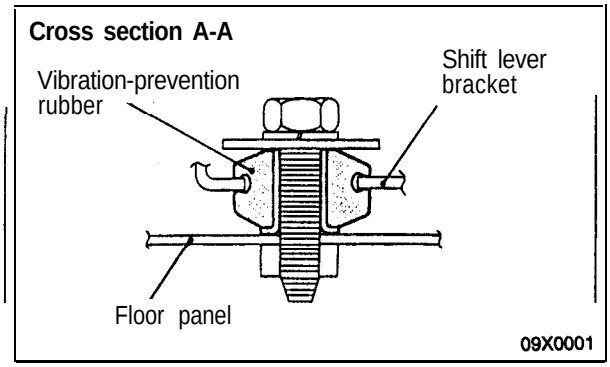






<Turbo>





AUTOMATIC TRANSAXLE

N72MOOAA

- The automatic transaxle comes in three models: F4AC1 for 420A-DOHC, F4A33 and W4A33 for 4G63-DOHC-T/C.
- F4AC1 is electronically controlled 4-speed automatic transaxle newly developed for 420A-DOHC and manufactured by Chrysler Corporation.
- F4A33 and W4A33 are essentially the same as the previous models.

SPECIFICATIONS

N72ZD01AA

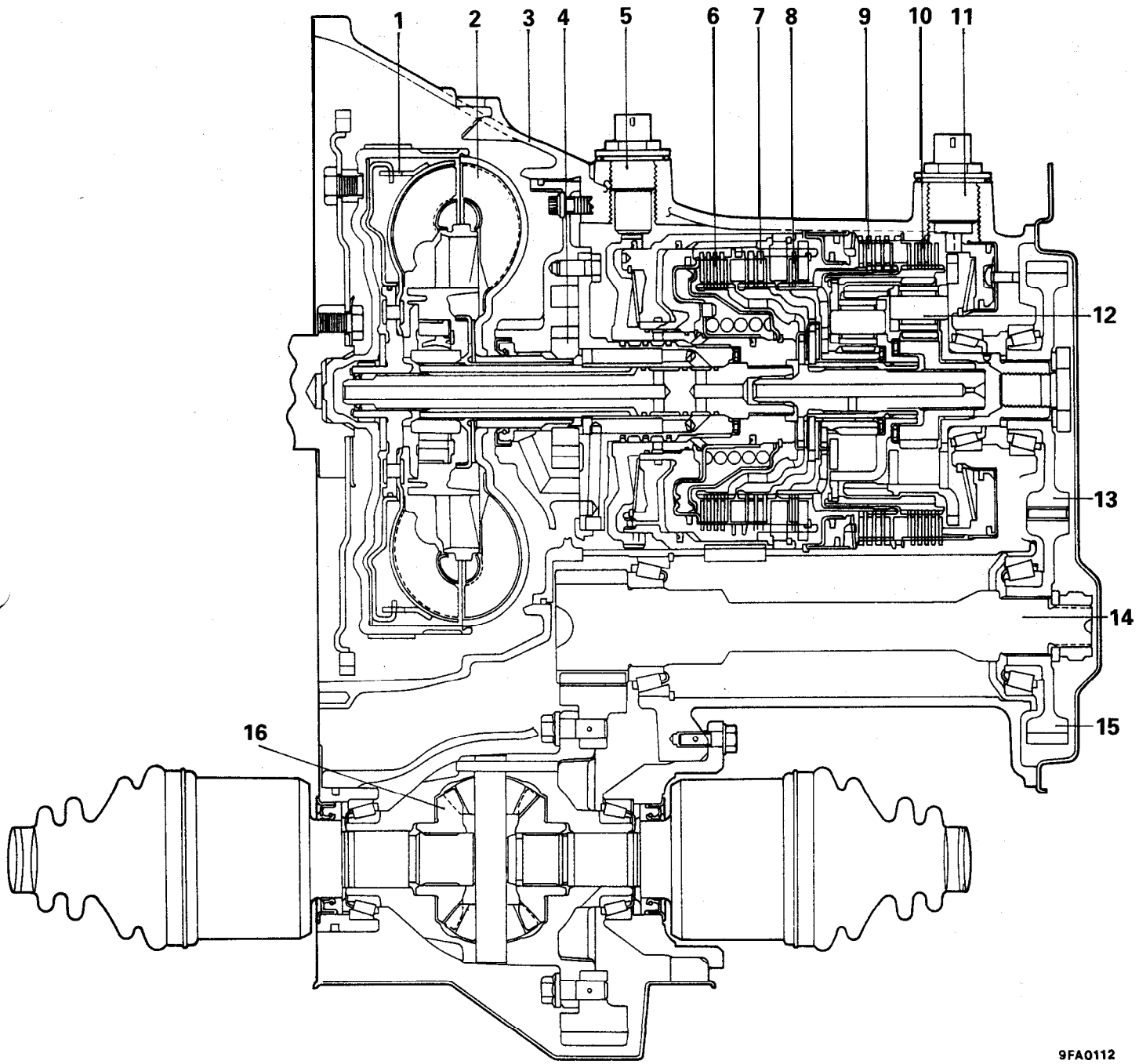
Drive system		FWD		AWD
Model		F4AC1-1-QZAF	F4A33-1-UPQ	W4A33-2-NPZT
Engine		420A-DOHC-MPI	4G63-DOHC-I/C,T/C	
Torque converter	Type	3-element, single stage, 2-phase type		
	Damper clutch	Provided (3rd to 4th)	Provided (2nd to 4th)	
	Stall torque ratio	2.65	1.70	
Transmission type		4 speeds forward, 1 reverse speed		
Gear ratio (Total gear ratio)	1st	2.842 (11.112)	2.551 (11.168)	2.551 (11.285)
	2nd	1.573 (6.150)	1.448 (6.514)	1.448 (6.583)
	3rd	1.000 (3.910)	1.000 (4.376)	1.000 (4.422)
	4th	0.689 (2.694)	0.685 (2.998)	0.685 (3.030)
	Reverse	2.214 (8.657)	2.176 (9.525)	2.176 (9.626)
Reduction ratio	Primary	1.042 (49/47)	1.228 (43/35)	1.228 (43/35)
	Front differential	3.750 (50/46)	3.562 (57/16)	3.600 (72/20)
	Transfer	–		1.090 (24/22)
	Rear differential	–		3.307 (43/13)
Clutch		Multiple disc type, 3 sets	Multiple disc type, 3 sets One way type, 1 set	
Brake		Multiple disc type, 2 sets	Multiple disc type, 1 set Band type, 1 set	
Manual control system		Lever type (P-R-N-D-2-L)		
Overdrive switch		Provided		
Fuzzy logic shift		Not provided	Provided	
Shift pattern		Single mode	Single mode (fuzzy mode)	
Speed change control		Electronic control		
Fluid pressure control during speed change		Electronic control		
Fluid pressure feedback control during speed change		Provided		
Damper clutch control		Provided		

Drive system	FWD	AWD
Self-diagnosis function	Provided	
Fail-safe function	Provided	
Data list function	Provided	
Actuator forced drive function	Provided	
ATF capacity dm^3(qts.)	8.6 (9.1)	6.7 (7.1)
Speedometer gear ratio	–	29/36

SECTIONAL VIEW

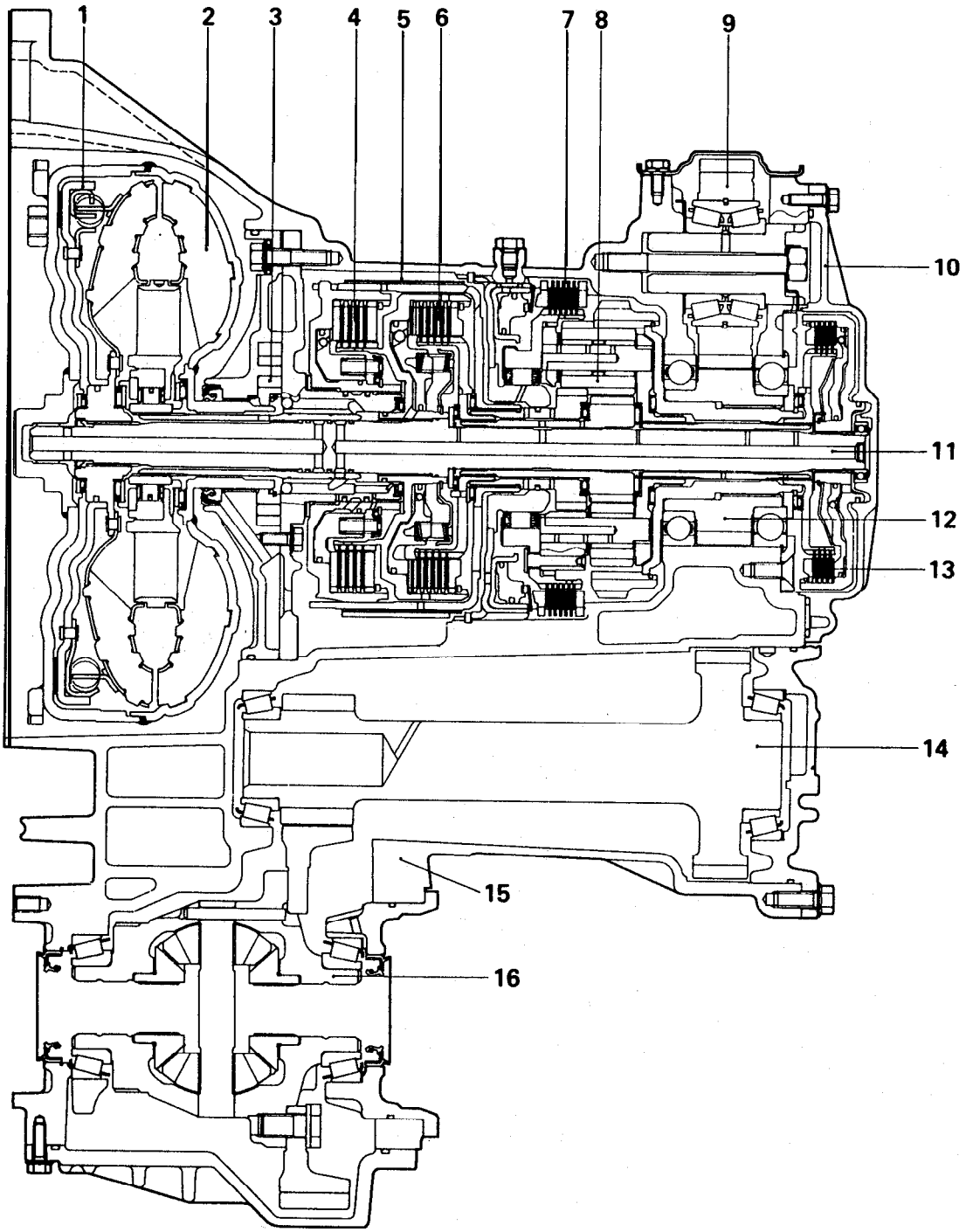
N72ZD02AA

F4AC1 <FWD – 4A/T>



1. Damper clutch
2. Torque converter
3. Case
4. Oil pump
5. Input speed sensor
6. Underdrive clutch
7. Overdrive clutch
8. Reverse clutch
9. 2-4 clutch
10. Low/Reverse clutch
11. Output speed sensor
12. Planetary gear set
13. Output shaft gear
14. Transfer shaft
15. Transfer shaft gear
16. Defferential
17. Input shaft

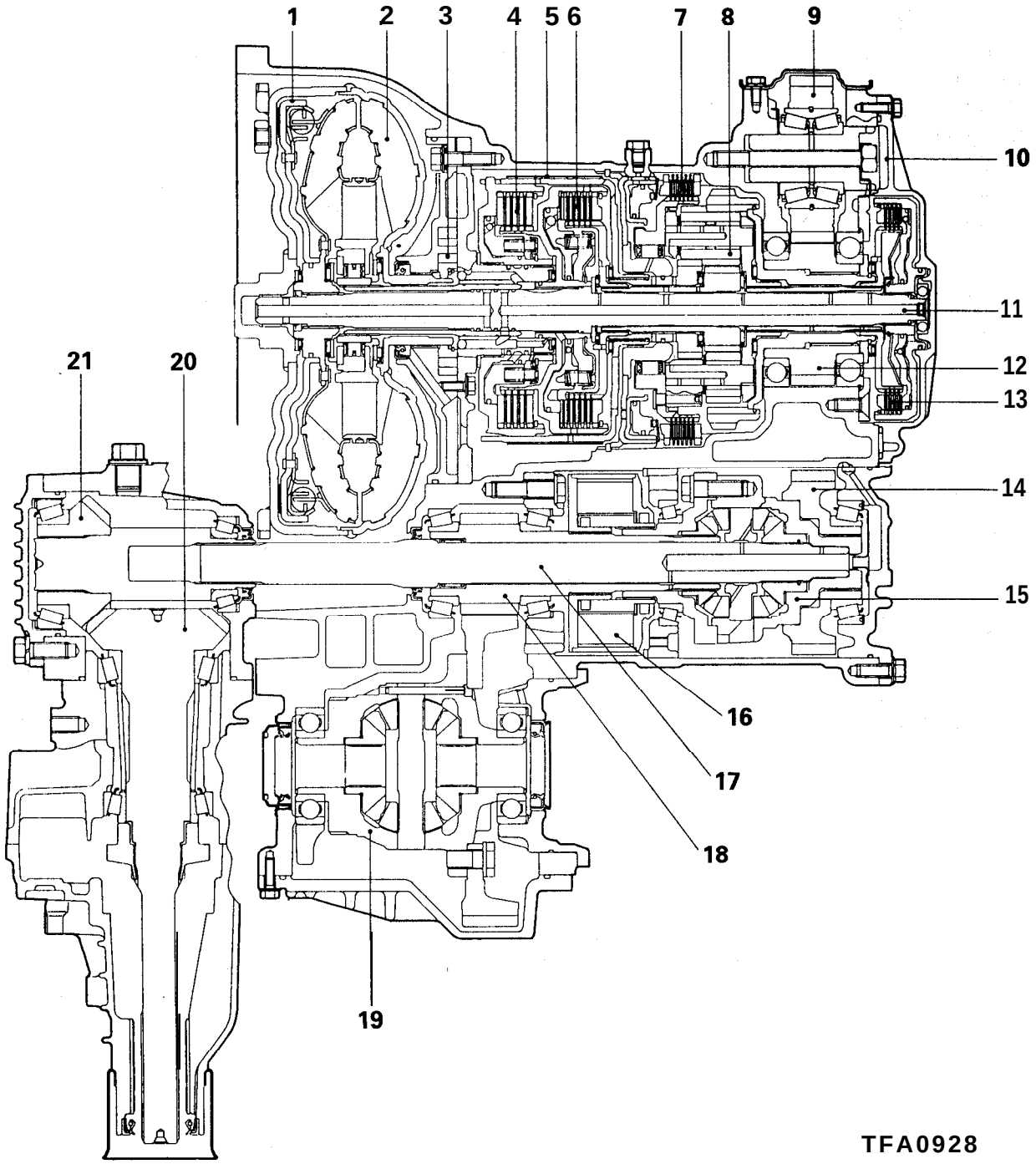
F4A33 <FWD – 4A/T>



TFA0540

1. Damper clutch
2. Torque converter
3. Oil pump
4. Front clutch
5. Kick-down brake
6. Rear clutch
7. Low/Reverse brake
8. Planetary gear set
9. Transfer idler gear
10. Rear cover
11. Input shaft
12. Transfer drive gear
13. End clutch
14. Transfer shaft
15. Transaxle case
16. Differential

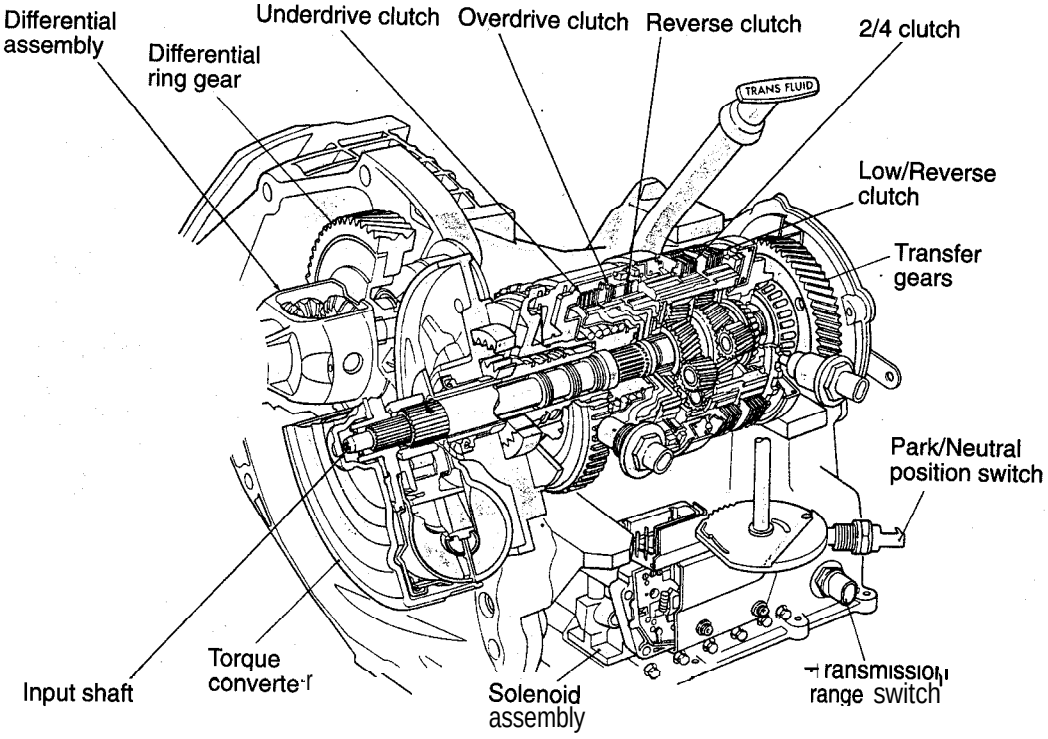
W4A33 <AWD – 4A/T>



1. Damper clutch
2. Torque converter
3. Oil pump
4. Front clutch
5. Kick-down brake
6. Rear clutch
7. Low/Reverse brake
8. Planetary gear set
9. Transfer idler gear
10. Rear cover
11. Input shaft
12. Transfer drive gear
13. End clutch
14. Transfer driven gear
15. Center differential
16. Viscous coupling
17. Center shaft
18. Front output shaft
19. Front differential
20. Driven bevel gear
21. Drive bevel gear

CONSTRUCTION AND FUNCTION <F4AC1> N72ZD03AA

Transaxle



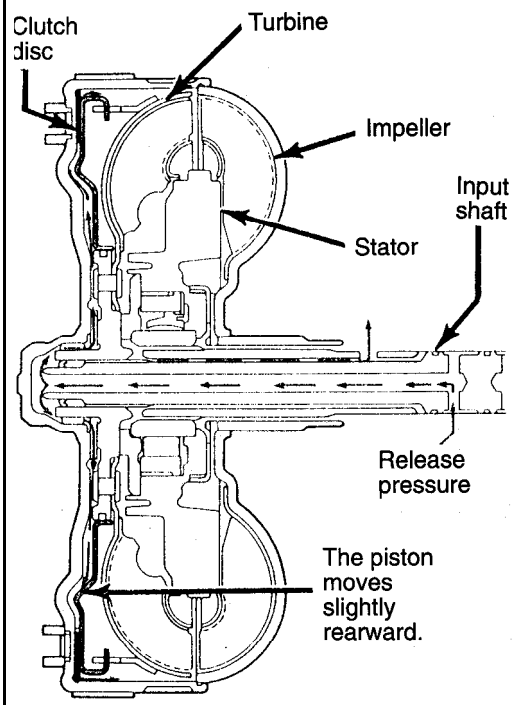
9321-415

- The transaxle consists of the torque converter, oil pump, gear train and valve body.
- The torque converter incorporates the damper clutch and is of the 3-element, single stage, 2-phase type.
- The gear train consists of three sets of multiple disc type input clutch, two sets of multiple disc type holding clutch and one set of Simpson type planetary gear set.

OPERATING ELEMENTS IN SELECT LEVER POSITIONS

Select lever position		P	R	N	D				2		L
Speed			R	–	1st	2nd	3rd	4th (With OD switch turned ON)	1st	2nd	1st
Input clutch	Underdrive clutch				●	●	●		●	●	●
	Overdrive clutch						●	●			
	Reverse clutch		●								
Holding clutch	2-4 clutch					●		●		●	
	Low/Reverse clutch	●*		●*					●		●

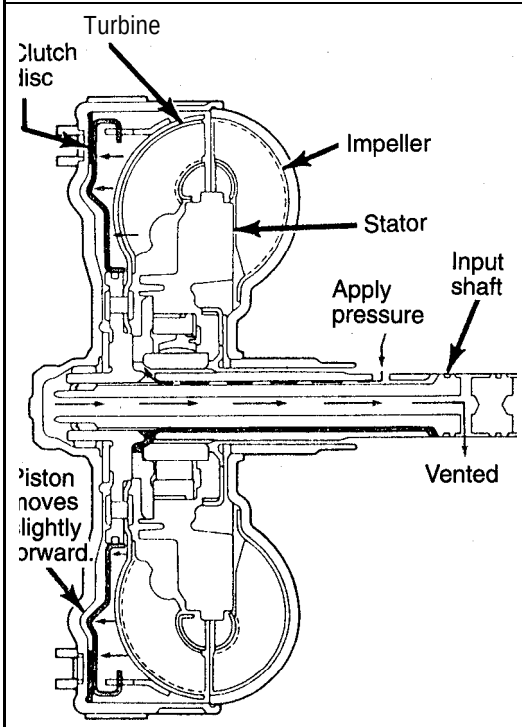
NOTE
*: Low/Reverse clutch is operated at P and N to provide smooth shift to D or R.



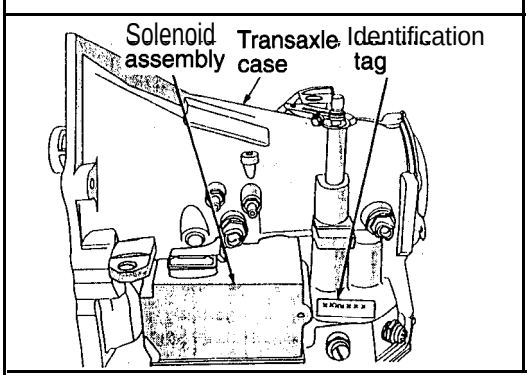
TORQUE CONVERTER

Torque converter clutch operation is controlled by the TCM through the solenoid assembly and valve body as mentioned. The clutch lining material is not bonded to either the piston or the torque converter cover in the F4AC1 transaxle, it is free floating.

When the clutch is not engaged, pressure is directed through the center of the input shaft to the front side of the piston. This pressure pushes the piston rearward and allows oil to flow around the outer edge of the piston. The oil exits the torque converter between the input shaft and the reaction shaft.



When the torque converter clutch engages, the pressure that was directed to the front side of the piston through the input shaft is shut off and the circuit is vented. The pressure on the back side of the piston pushes the piston forward and connects the turbine to the converter housing. The piston has no outer seal. The friction disc provides the seal between the piston and the housing. As mentioned the friction disc is free-floating and is not bonded to either the piston or the housing. When the torque converter clutch is engaged, fuel economy is improved, engine noise is reduced, and the transaxle and fluid operating temperature is lowered.

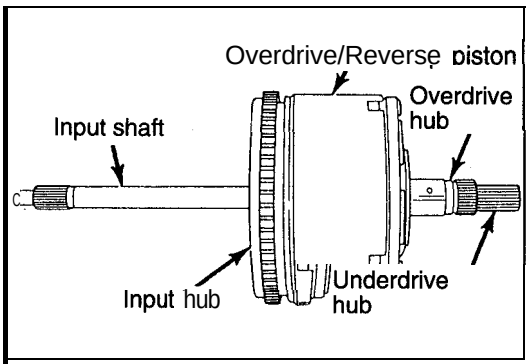


CASE

The F4AC1 transaxle uses an aluminum cast case with a stamped steel oil pan. The transfer gears on the end of the transaxle and differential assembly towards the back of the transaxle are under stamped steel covers. This transaxle is a single sump design. That is it uses only one fluid for both the transmission and differential areas. The transaxle case is vented through the top of the manual shaft.

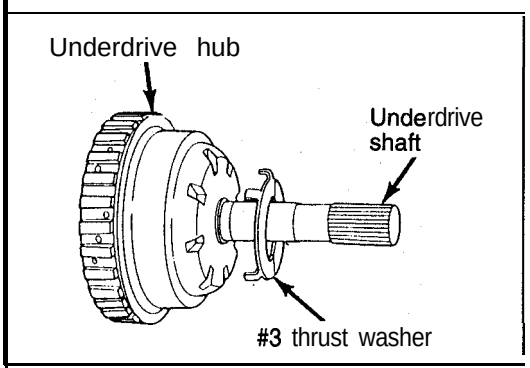
CLUTCH

All five clutches in the F4AC1 transaxle are applied hydraulically. Four of the clutches are released with belleville springs, and one is released with a coil spring. Three of the clutches supply input power to the planetary geartrain and are called input clutches. The other two clutches hold components of the planetary geartrain and are called holding clutches. With the exception of direct gear, one input clutch and one holding clutch must be applied to obtain a gear range. In direct gear, two input clutches are applied and basically connect the input and output shafts together. This causes the entire gearset to rotate as one with no relative motion between planetary gearset components.



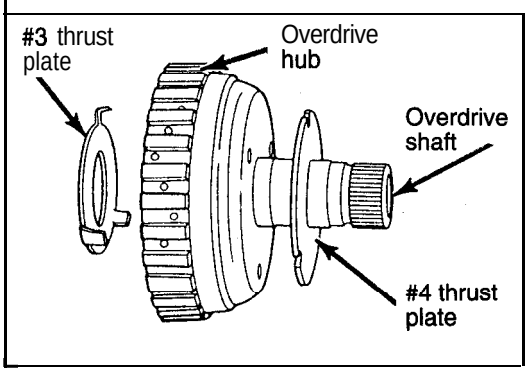
Input Clutch Assemblies

The input clutch assembly is located directly behind the oil pump housing, and rides on the reaction shaft support journal. The assembly consists of an input shaft, input hub, clutch retainer, clutch pistons, an overdrive hub, an underdrive hub and three input clutches. The clutches are the underdrive clutch, overdrive clutch and reverse clutch. When the torque converter turbine (which is splined to the input shaft) turns, the input shaft, hub, and clutch retainer also turn.



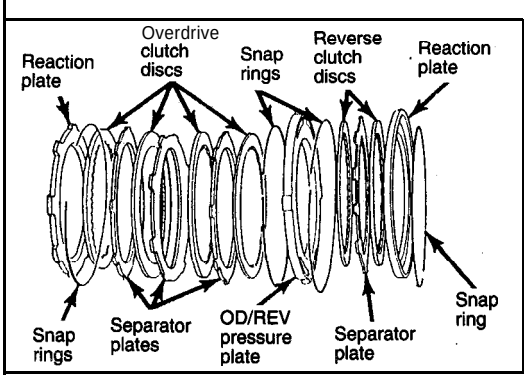
Underdrive Clutch Hub

The underdrive clutch is splined to the underdrive hub assembly. The underdrive hub and shaft assembly is splined to the rear sun gear. When the underdrive clutch is applied the rear sun gear is driven (rotated).



Overdrive Hub

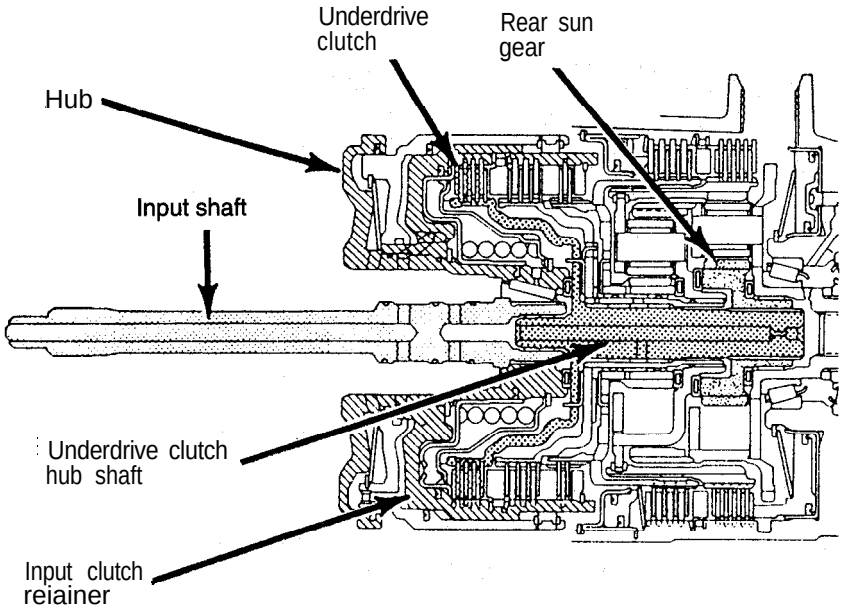
The overdrive clutch is splined to the overdrive hub assembly and the overdrive hub is splined to the front carrier assembly. The reverse clutch is splined to the front sun gear assembly and rotates it when applied.



Input Clutches

Each of the three clutches, in the input clutch assembly, have the job of supplying input power to a particular component in the planetary gearset when they are hydraulically applied. They are connected to the planetary gearset through the overdrive hub and shaft assembly, the underdrive hub and shaft assembly, and the front sun gear assembly. When any of these clutches are applied, they turn or drive a component in the planetary gearset.

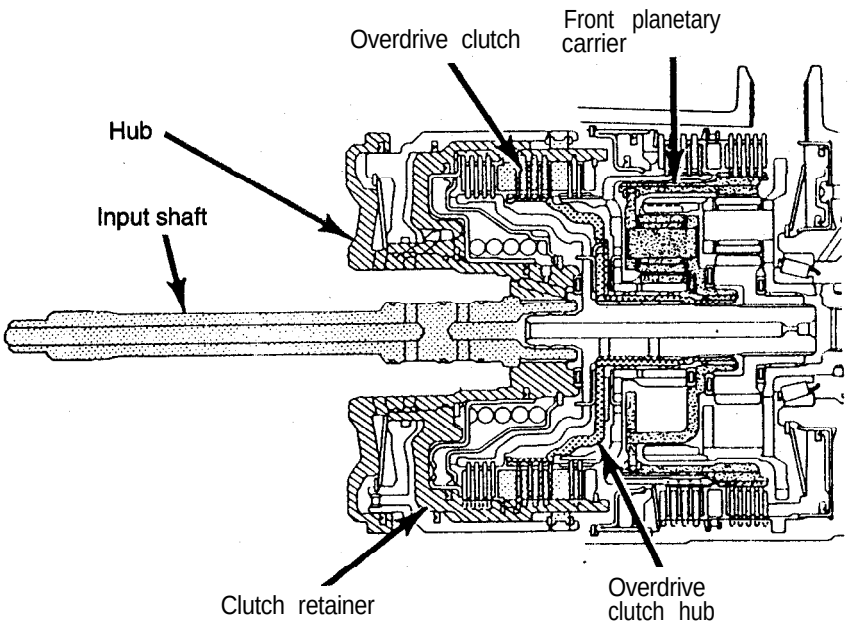
Underdrive Clutch



The underdrive clutch is located in the front of the input clutch retainer. Line pressure is supplied to the clutch from the valve body, through passages in the case, oil pump and reaction shaft support. The pressure then passes through a drilled passage in the input clutch hub and to the front side of the underdrive piston. The piston moves toward the rear of the transaxle, compressing the clutch and connecting it to the underdrive hub. The underdrive hub is splined to the rear sun gear and turns it when the clutch is engaged.

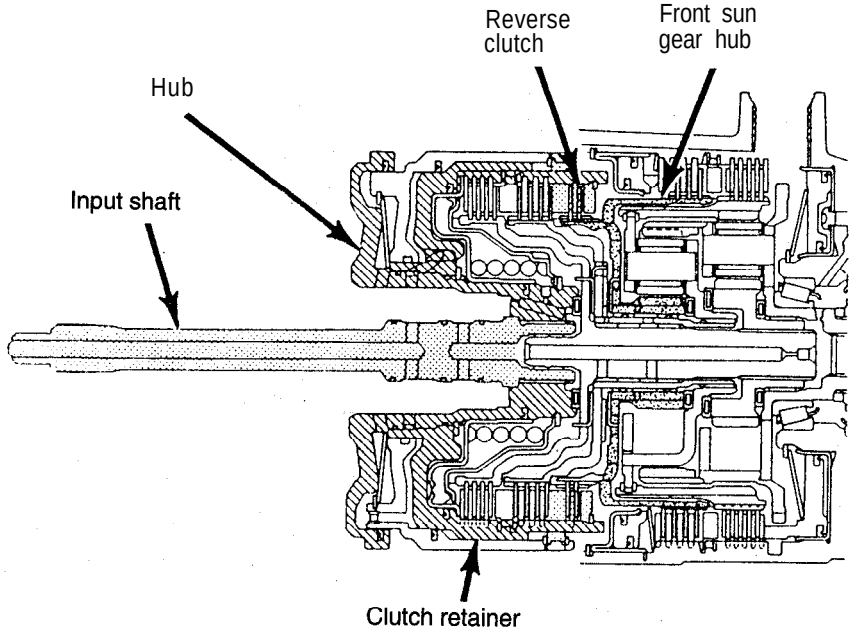
When line pressure is released, the clutch piston returns with tension from the coil spring between the piston and spring retainer. The piston has a vent in it, and the spring retainer has a seal on it. Both the vent and retainer seal are used to keep oil on the back side of the piston. They counteract the centrifugal pressure that develops when the clutch is spinning. Centrifugal pressure can cause the piston to move slightly and the clutch to drag when the clutch is not actually being applied.

Overdrive Clutch



The overdrive clutch is the center clutch in the input clutch assembly. The clutch pack is held on the retainer, and the piston that applies the clutch is located around the outside of the retainer. A pressure plate in the rear of the clutch pack is used to compress the overdrive clutch when needed. Line pressure from the valve body is directed through passages in the case, oil pump housing and reaction shaft support. It is then directed through the input hub and input clutch retainer to the back side of the OD/REV clutch piston. The pressure pushes the piston forward and applies the overdrive clutch. The clutch pack is compressed against the same reaction plate that the underdrive clutch uses. When applied, the overdrive clutch engages and turns the overdrive hub, which is splined to the front planetary carrier. When line pressure to the clutch is released, the belleville spring on the front side of the OD/REV piston returns the piston to its released position.

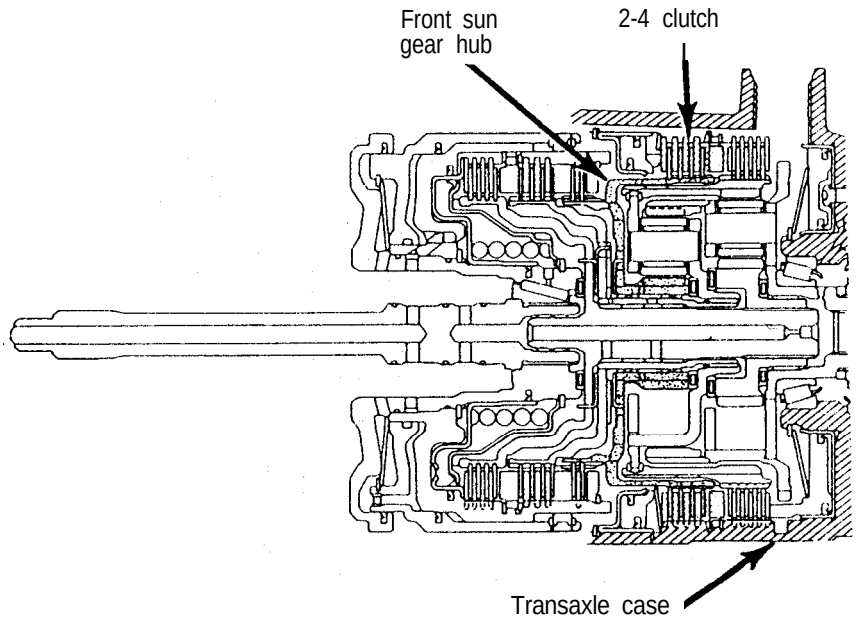
Reverse Clutch

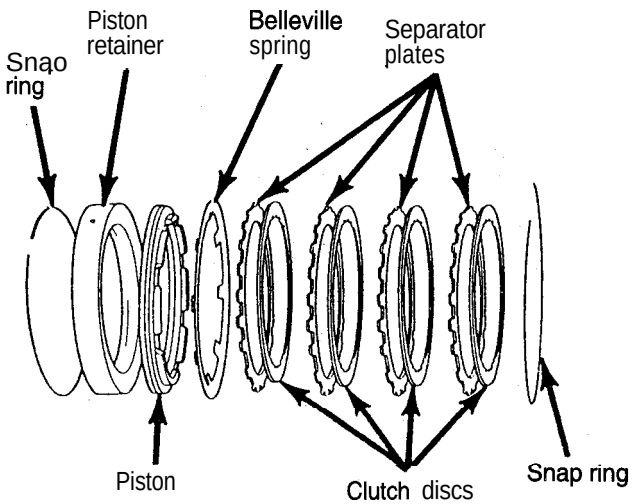


The reverse clutch is located in the back of the input clutch assembly. The reverse clutch is operated by the same piston, pressure plate and belleville spring that operates the overdrive clutch. Line pressure that applies the reverse clutch comes from the valve body, directed through passages in the case, oil pump and reaction shaft support. The line pressure then goes through the input hub to the front side of the OD/REV piston. The pressure moves the piston to the back and compresses the reverse clutch pack. When the clutch is applied, it turns the front sun gear and hub assembly. When line pressure to the reverse clutch is removed, the belleville spring will pull the piston forward to its released position. The OD/REV clutch piston belleville spring is positioned so it will counter the piston to prevent either the overdrive or reverse clutches from dragging when they are not applied.

Holding Clutches

2-4 Clutch

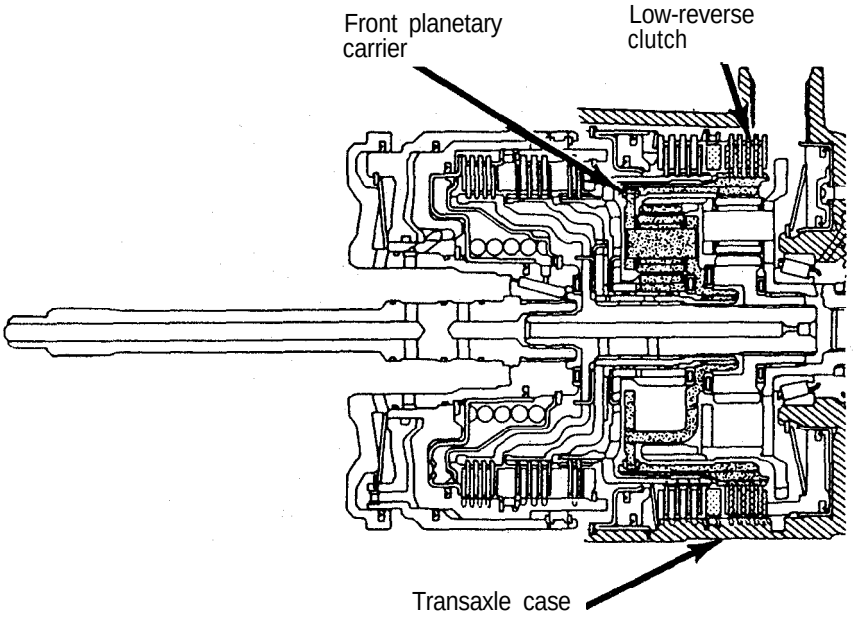


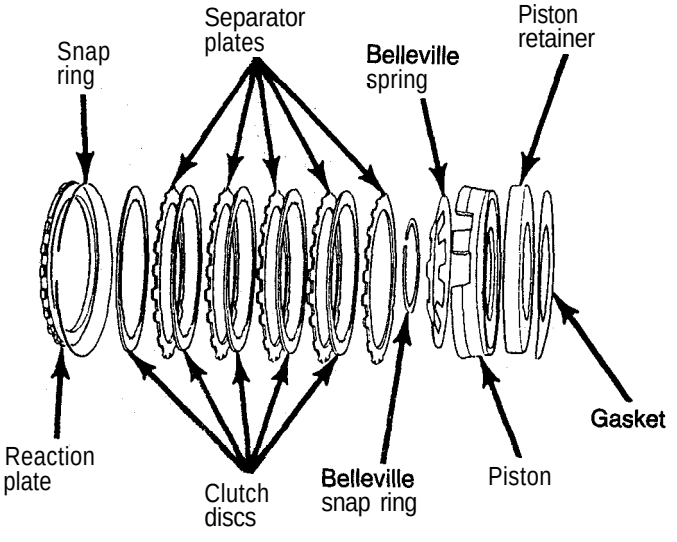


The 2-4 clutch is one of two clutches located in the rear portion of the transaxle case. This clutch sits behind the input clutch assembly. The 2-4 clutch/piston retainer is in the front and held in place by a snap ring. The 2-4 piston is located inside the 2-4 clutch/piston retainer. A belleville spring is used to return the piston after releasing the clutch. The clutch pack comes next in the case. The reaction plate is secured to the case using two snap rings. The reaction plate for the 2-4 clutch is shared with the Low Reverse clutch. When the 2-4 clutch is applied hydraulically, it locks or secures the front sun gear/hub assembly to the case so it does not turn.

To apply the 2-4 clutch, line pressure is sent from the valve body straight into the piston retainer. The valve body has a rubber seal located on the top of it that seals the valve body to the piston retainer. When line pressure is removed and vented, the belleville spring returns the piston to release the clutch.

Low/Reverse Clutch



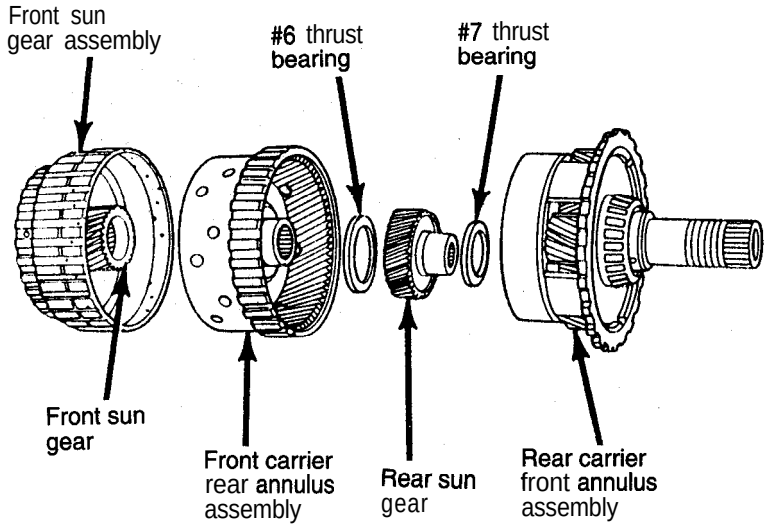


The second clutch, located in the rear of the transaxle case, is the Low Reverse (L/R) clutch. The L/R clutch is located in the very back of the case and, as previously mentioned, shares the reaction plate with the 2-4 clutch. Behind the reaction plate is the clutch pack, belleville spring, L/R piston, and piston retainer. The piston retainer is secured to the case with three screws and sealed with a gasket.

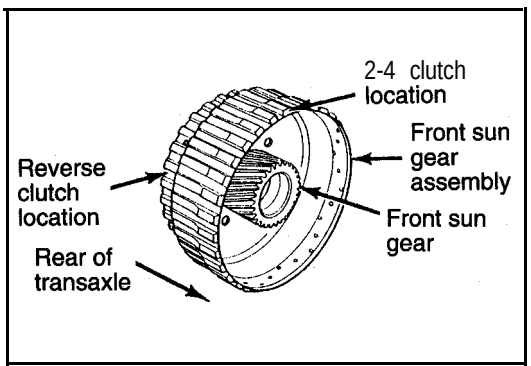
The clutch is applied with line pressure from the valve body that is directed through the transaxle case to the piston retainer. This pushes the piston forward and applies the clutch. When the clutch is applied, it will lock or secure the front planetary carrier to the transaxle case so it can not rotate. When line pressure is released, the belleville spring pushes the piston back to release the clutch.

POWER TRAIN

Planetary Geartrain Assembly

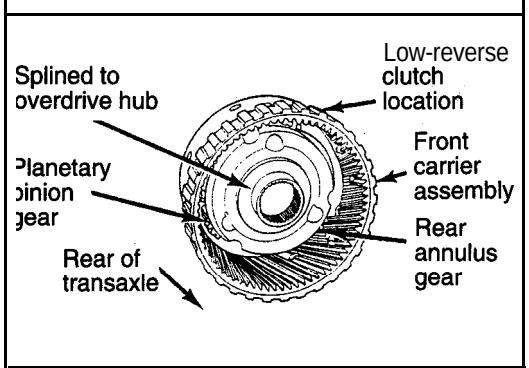


The entire planetary gear-train is located behind the input clutch assembly and is inside the 2-4 and L/R clutch assemblies. The planetary geartrain consists of two sun gears, two planetary carriers, two annulus (ring) gears, and one output shaft.



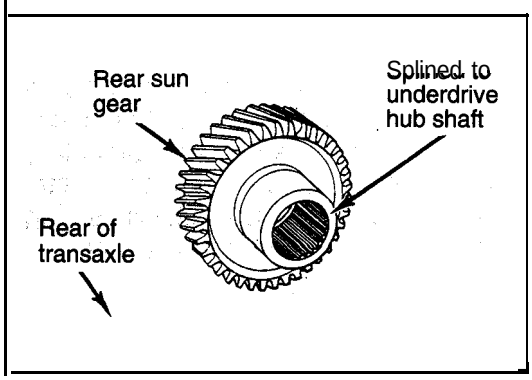
Front Sun Gear Assembly

The front sun gear assembly rides in the center of the front carrier and is welded to the center of two hubs that are arranged back to back. Each of the hubs are splined to a clutch. The front most hub is splined to the reverse clutch and when applied turns the front sun gear. The rearward hub is splined to the 2-4 clutch and when applied prevents the front sun gear from turning.



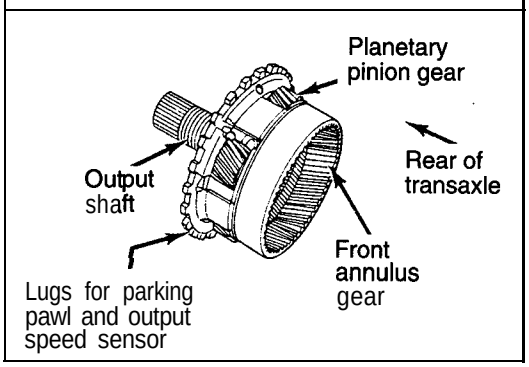
Front Carrier Assembly

The front planetary carrier and rear annulus (ring) gear are splined together as one unit. When the overdrive clutch is applied, it drives the front carrier assembly by the overdrive hub. When the low/reverse clutch is applied, it holds or prevents the front carrier assembly from rotating.



Rear Sun Gear

The rear sun gear is located in the center of the rear carrier assembly. There are two thrust bearings located on either side of the sun gear. When the underdrive clutch is applied, it drives the rear sun gear through the underdrive hub and shaft.



Rear Carrier Assembly

The rear planetary carrier, front annulus (ring) gear and output shaft are all one assembly. The rear carrier assembly is responsible for providing all output power for the transaxle assembly. In other words, all output from the transaxle must go through the rear carrier. The lugs around the outside of the assembly have two purposes; to engage the parking pawl when the driver selects "park", and to generate an output speed signal used by the TCM.

There are no clutches splined or connected to this unit in any way. The rear carrier assembly is supported to the case by two tapered roller bearings which must be set up with a specific preload setting.

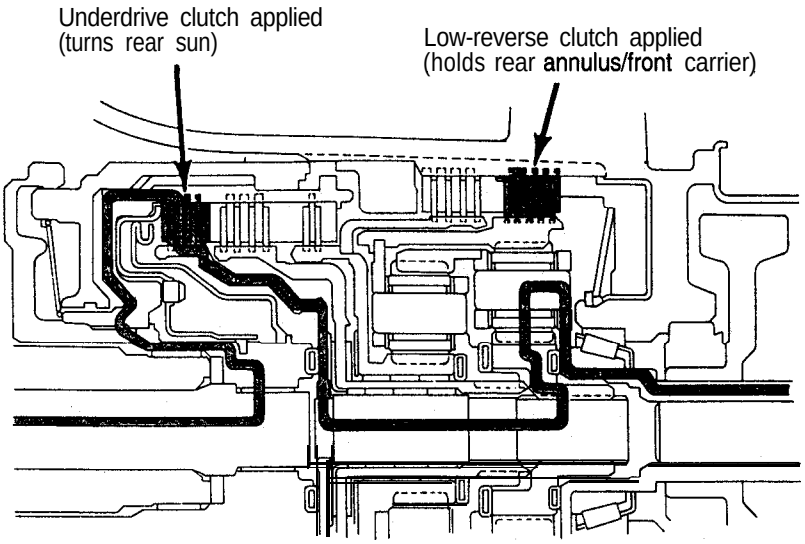
Planetary Geartrain Powerflow

The planetary gear-train in this transaxle provides four forward gear ratios and one reverse gear ratio. To obtain these different gear ratios, two planetary carrier and pinion assemblies, two sun gears and two annulus (ring) gears are used. Two shafts are used as input to the planetary gearset, the underdrive hub and shaft assembly, and the overdrive hub with its shaft. The underdrive shaft protrudes through, the center of the overdrive shaft and is the longer of the two.

To achieve any output through the components of this planetary gearset, the following rules apply; At least one component must be driven or turned, one component must be held stationary (kept from rotating), two components must be driven at the same speed and in the same direction, and all output from this gearset must go through the rear carrier assembly.

The planetary gear-train is driven by three input clutches. One of the input clutches must be applied before the vehicle can move. A variety of gear ratios are accomplished by using different input clutches to turn different components of the planetary gear set. Two clutches in the rear of the case must be used to hold specific planetary components. When going through the following power flows, keep in mind that the gear-train must somehow complete its power-flow by turning the rear carrier assembly. If the output shaft/rear carrier assembly does not turn, the vehicle will not move.

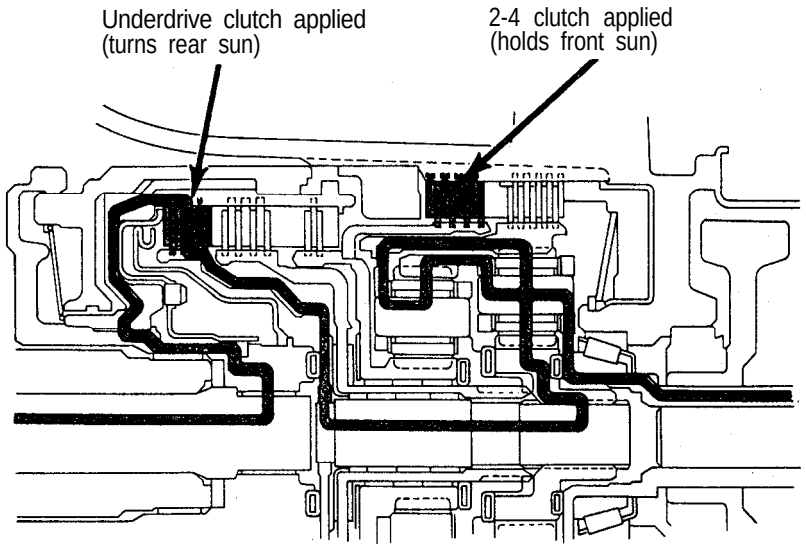
First Gear



In first gear range, torque input is through the underdrive clutch to the underdrive hub assembly. The underdrive hub is splined to the rear sun gear. When the underdrive clutch is applied, it rotates the underdrive hub and rear sun gear. The L/R clutch is applied to hold the front carrier/rear annulus (ring gear) assembly.

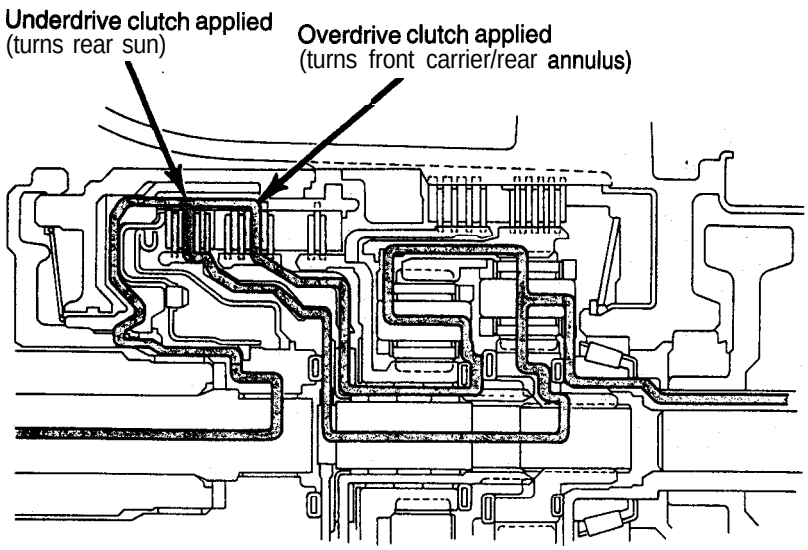
The rear sun gear drives the rear planetary pinion gears. The rear planetary pinion gears are forced to "walk around" the inside of the stationary rear annulus gear. 'The pinions are pinned to the rear carrier and cause the rear carrier assembly to rotate as they "walk around" the annulus gear. This provides the torque output for first gear. The other planetary gearset components are freewheeling. The first gear ratio is 2.84:1.

Second Gear



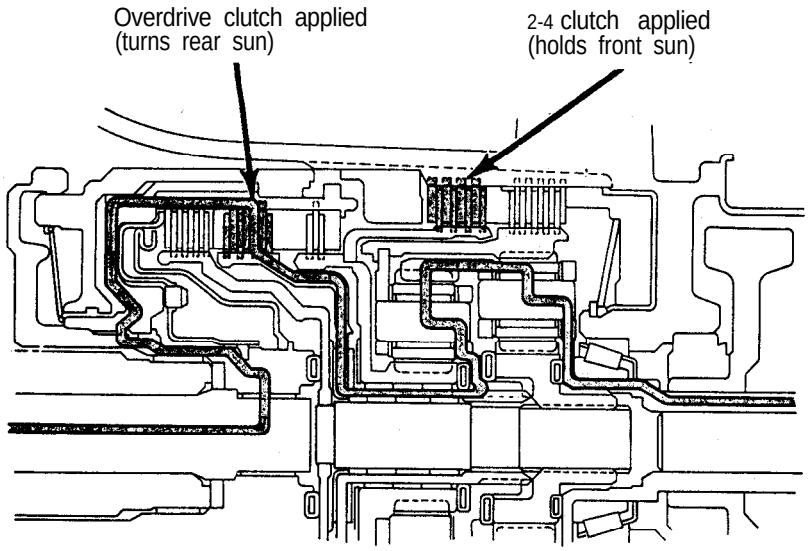
Second gear is achieved by having both planetary gear sets contribute to torque multiplication. As in first gear, torque input is through the underdrive clutch to the rear sun gear. The 2-4 clutch is applied to hold the front sun gear stationary. The rotating rear sun gear turns the rear planetary pinions. The rear pinions rotate the rear annulus/front carrier assembly. The pinions of the front carrier will "walk around" the stationary front sun gear. This transmits torque to the front annulus/rear carrier assembly which provides output torque and a gear ratio of 1.57:1.

Third Gear



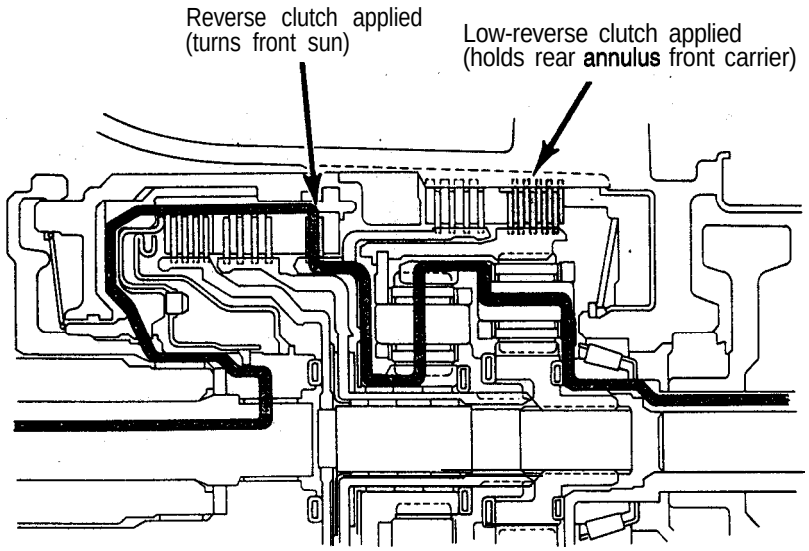
In third gear, two input clutches are applied to provide torque input; the underdrive and overdrive clutches. The underdrive clutch rotates the rear sun gear, while the overdrive clutch rotates the front carrier/ rear annulus assembly. The result is two components (rear sun gear and rear annulus gear) rotating at the same speed and in the same direction. This effectively "locks" the entire planetary gearset together and is rotated as one unit. The gear ratio in third is 1:1.

Fourth Gear

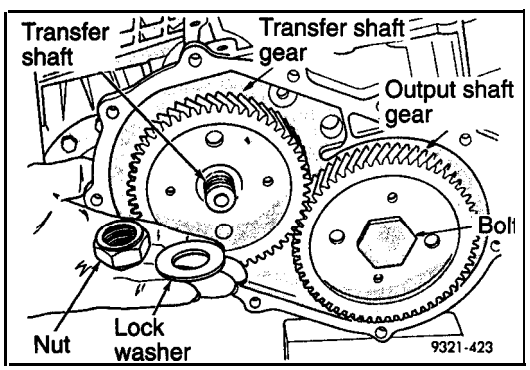


In fourth gear input torque is through the overdrive clutch which drives the front carrier. The 2-4 clutch is applied to hold the front sun gear. As the overdrive clutch rotates the front carrier, it causes the pinions of the front carrier to "walk around" the stationary front sun gear. This causes the front carrier pinions to turn the front annulus/rear carrier assembly which provides output torque. In fourth gear, transaxle output speed is more than engine input speed. This situation is called overdrive. Fourth gear (overdrive) ratio is 0.69:1.

Reverse Gear



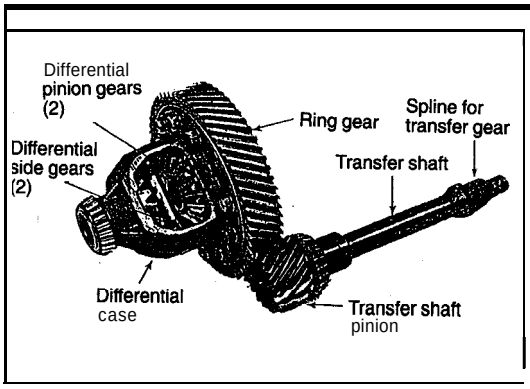
In reverse, input power is through the reverse clutch. When applied, the reverse clutch drives the front sun gear through the overdrive hub and shaft. The L/R clutch is applied to hold the front carrier/rear annulus assembly stationary. The front sun gear rotates the front carrier assembly pinions. The front carrier is being held by the L/R clutch so the pinions are forced to rotate the ɔnt annulus/rear carrier assembly in the reverse direction. Output torque is provided, in reverse, with a gear ratio of 2.21:1.



Transfer System

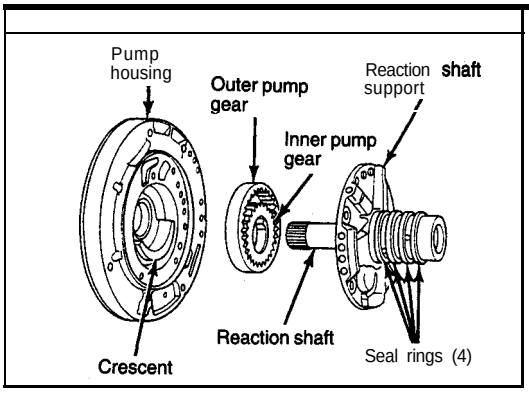
The F4AC1 transaxle uses a transfer gear system to transfer power from the output shaft of the rear carrier to the transfer shaft. The gear that is splined and bolted to the output shaft of the rear carrier is called the output shaft transfer gear. It supplies power to the transfer shaft transfer gear which is splined and retained by a large nut to the transfer shaft. The bolt and nut that retain the transfer gears to each shaft must be tightened to the proper torque specification. Proper torque is essential for two reasons; to keep the gears on the shafts and to maintain the bearing settings that provide for long life of the system.

Both gears have helical cut teeth designed for quiter operation. The overall gear ratio of the transaxle is in part determined by the transfer gear ratio.



Final Drive Gears and Differential

The final drive gears include the transfer shaft which has a pinion gear on one end and the differential ring gear which is driven by the transfer shaft pinion gear. The ring gear is bolted to the differential case and when rotated drives the case. The case drives the differential **gearset** and in turn, the front axle shafts. The axle shafts then drive the front wheels. The differential gears are typical in design and include; a shaft, two pinion gears, and two side gears. The final drive gears and the differential case each are supported by tapered roller bearings. The transfer shaft and its tapered roller bearings are set-up with a specific amount of **endplay.** The differential ring gear and case assembly bearings are set-up with a specific amount of preload. Follow the service manual procedures for setting up these bearings to ensure long life of the bearings and the components they support.



Hydraulic Control System

OIL PUMP

The oil pump is located in the pump housing inside the bell housing of the transaxle case. The F4AC1 uses a crescent type gear pump. The inner gear is driven by the torque converter hub. Torque is supplied to the hub by the engine crankshaft through the flex plate and torque converter housing.

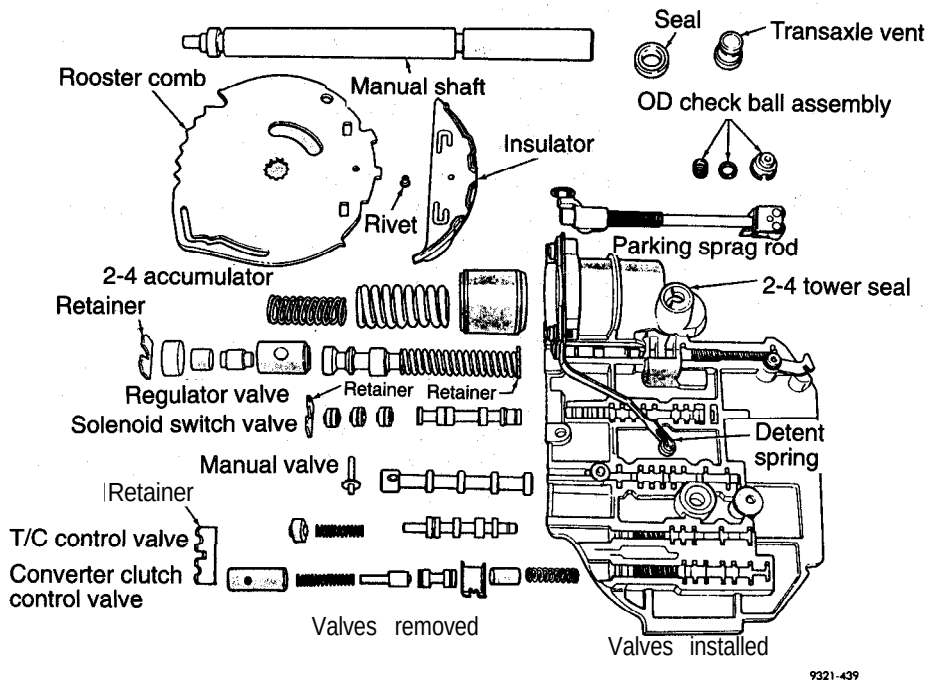
As the gears rotate, the clearance between the gear teeth increases in the crescent area and creates a suction at the inlet side of the pump. Fluid is pulled through the pump inlet from the oil pan. As the clearance between the gear teeth in the crescent area decreases, it forces fluid into the pump outlet. The pressurized oil from the outlet operates the torque converter, clutches, and the lubrication system. The pump is held in the housing by the reaction shaft support. The reaction shaft is splined to and holds the inner race of the torque converter stator's overrunning clutch.

VALVE BODY AND SOLENOID ASSEMBLY

The valve body and solenoid assembly work together to control five transaxle clutches and the torque converter clutch. It also directs pressurized fluid for lubrication. The oil pump is the source of pressurized fluid for the valve body and solenoid assembly. The pump is a positive displacement, gear and crescent type pump. It is driven by the engine through the torque converter hub.

Fluid for the pump is drawn through the transaxle filter, through the valve body housing, and into the pump. The pump pressurizes the fluid and sends it back through the valve body to the regulator valve. The valve body uses only five valves along with four solenoids in the solenoid assembly. They perform all functions needed to operate the transaxle for each of its gear ranges. A brief description on the operation of each valve and solenoid follows.

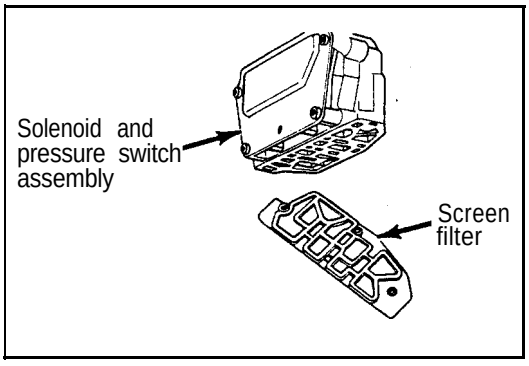
Valve Body Assembly



The F4AC1 has a relatively simple, cast aluminum valve body that uses only five valves. No governor pressure or throttle pressure is used to operate this valve body. These two pressures have been replaced by electronic signals from the output speed sensor and throttle position sensor. Shift valves have also been eliminated and replaced by the solenoid/valves in the solenoid assembly.

The valve body has two major functions. To control line pressure and torque converter clutch pressure and to direct fluid to the clutches, torque converter, lubrication system, and the solenoid/valves by means of the manual and switch valves.

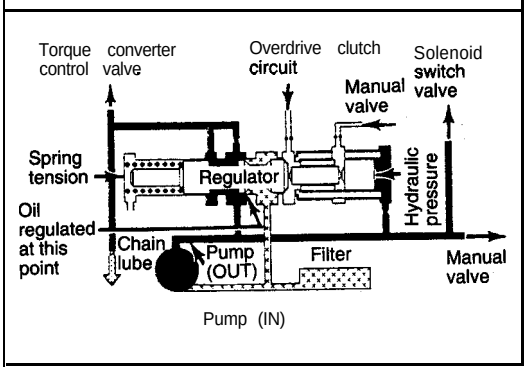
One side of the rooster comb (secured to top of valve body) operates two switches, the park neutral and transmission range switches. The solenoid and pressure switch assembly is indirectly connected to the valve body through an extension of the case in the oil pan area.



Solenoid and Pressure Switch Assembly

The solenoid and pressure switch assembly is controlled by the TCM through the transmission control relay. The assembly consists of four solenoid/valve assemblies that control hydraulic pressure to four of the five clutches in the transaxle and the torque converter clutch. A unique feature of the solenoid/valves are that they directly control the application of a clutch. In other electronically controlled transaxles/transmissions, the clutches are indirectly controlled by the solenoids through the normal hydraulic valving. The solenoid assembly also contains three pressure switches that feed information to the TCM. The "UR" pressure switch, the "2-4" pressure switch and the "OD" pressure switch. The eight-way electrical connector to the solenoid is sealed and bolted in place with the bolt tightened to proper specification.

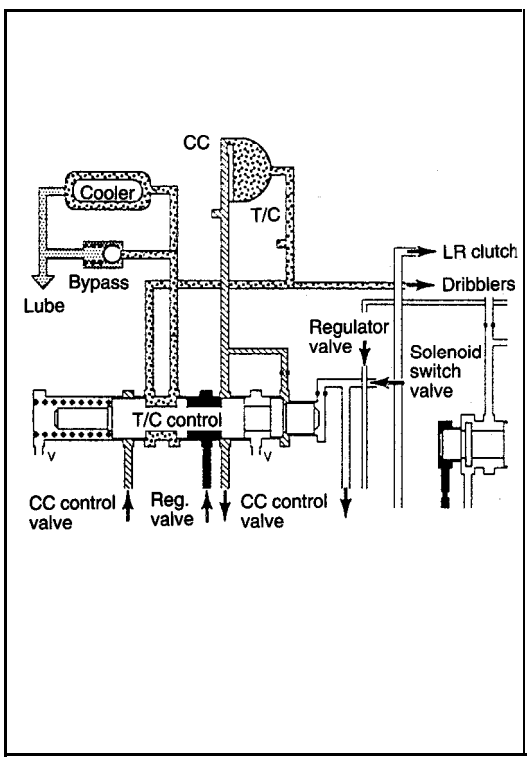
The assembly is located outside the transaxle case, under a sound shield and protective cover, towards the front of the vehicle. The filter screen between the solenoid assembly and valve body protects the assembly from contamination and is a replaceable item. However, if the valve body and solenoid pack have been heavily contaminated, the solenoid pack should be closely inspected to determine the need for its replacement. The solenoid pack is not a serviceable unit.



Regulator Valve

The regulator valve has one function, to regulate or control hydraulic pressure in the transaxle. The pump supplies unregulated pressure to the regulator valve. The regulator valve controls or limits pump pressure. Regulated pressure is referred to as "line pressure". The regulator valve has a spring on one end that pushes the valve to the right. This closes a dump (vent) to lower pressure. Closing the dump will cause oil pressure to increase. Oil pressure on the opposite end of the valve pushes the valve to the left, opening the dump and lowering oil pressure. The result is spring tension working against oil pressure to keep or maintain the oil at specific pressures. Regulated pressure will vary depending on the gear range the transaxle is operating in.

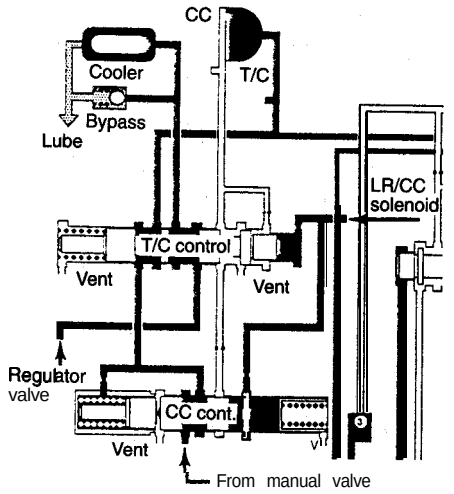
A system of sleeves and ports allows the regulator valve to work at one of three different predetermined pressure levels. The oil that is dumped by the regulator valve is directed back to the intake side of the oil pump.



Torque Converter Control Valve

The main responsibility of the torque converter (T/C) control valve is to control hydraulic pressure applied to the front ("off") side of the converter clutch (CC). Line pressure from the regulator valve is fed to the T/C control valve where it passes through the valve. The T/C control valve reduces or regulates the pressure slightly. The T/C control valve pressure is then directed to the converter clutch (CC) control valve and to the front side of the converter clutch piston.

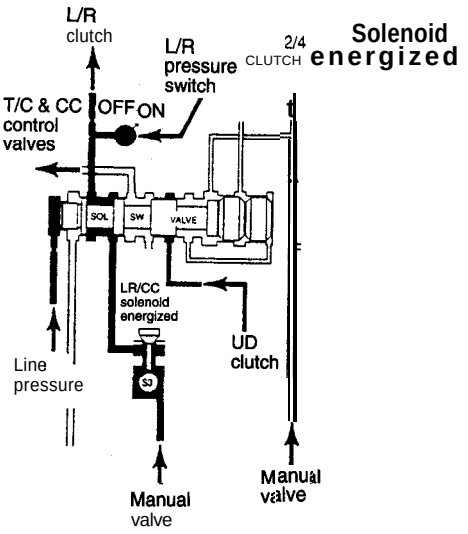
The pressure that is being fed to the front of the piston pushes the piston back. This disengages the converter clutch. The oil then passes around the outside of the piston, flowing out of the torque converter and back to the T/C control valve. From the T/C control valve the oil flows to the transaxle oil cooler and cooler bypass valve. It returns to the transaxle as lube oil pressure.

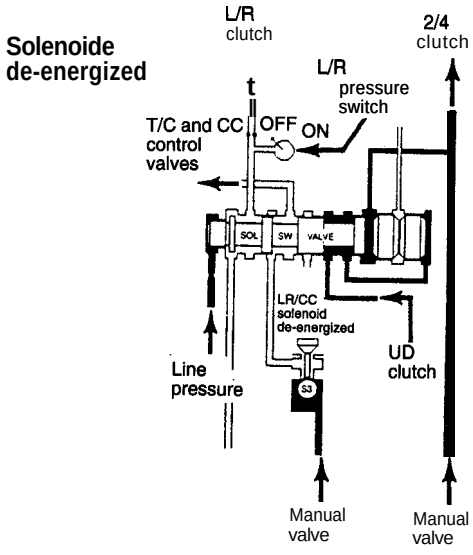


Converter Clutch Control Valve

The **CC** control valve has the job of controlling the back or "on" side of the torque converter clutch. When the TCM energizes the **LR/CC** solenoid to engage the converter clutch piston, the CC control valve and T/C control valves move to the left. The oil on the front or "off" side of the converter clutch piston is vented to the sump.

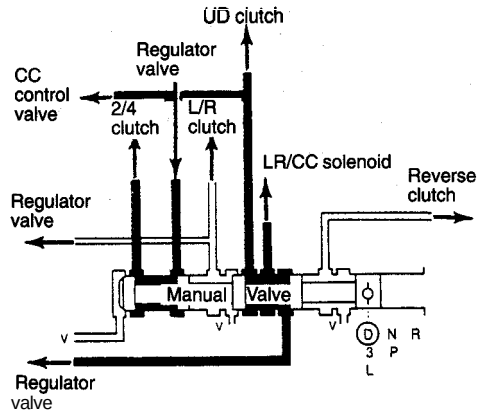
Line pressure enters the CC control valve through the manual valve and then passes through the CC control valve and the T/C control valve to the back ("on") side of the converter clutch piston. Line pressure forces the piston forward which engages the torque converter clutch. This action effectively connects the torque converter turbine with the impeller. Line pressure also flows from the regulator valve, through the T/C control valve, to the cooler and cooler bypass for improved fluid and transaxle cooling.





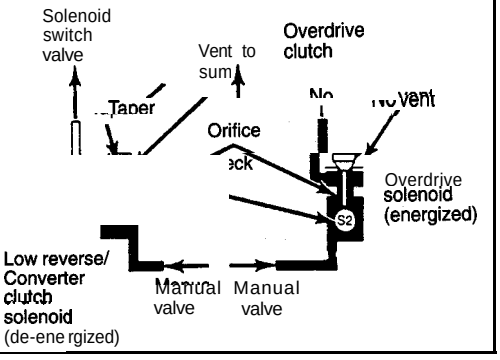
Solenoid Switch Valve

The switch valve controls line pressure direction from the **LR/CC** solenoid. When the valve is shifted to the right, it allows the low/reverse (L/R) clutch to be pressurized. When it is shifted to the left, it directs line pressure to the T/C and CC control valves to operate the T/C clutch. The valve is shifted to the right in all positions except second, third, or fourth gear. When the transaxle upshifts to second gear, the valve moves to the left which allows converter clutch engagement when needed. The valve must return to the right before a downshift to first gear can occur.



Manual Valve

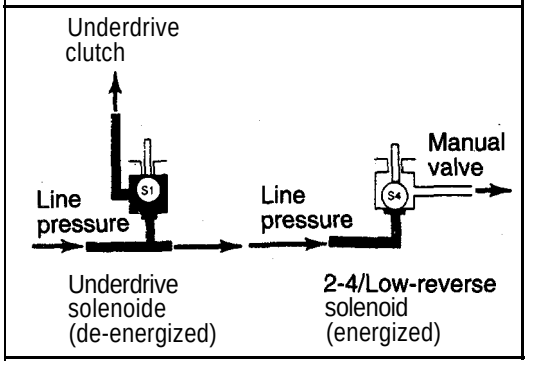
The manual valve is operated by mechanical shift linkage only. Its job is to send line pressure to the appropriate hydraulic circuits and solenoids. The valve has three operating ranges or positions. The valve is shifted to the left position when Overdrive (OD), Drive (3) or Low (L) is selected. The valve is shifted to the middle position in both Park (P) and Neutral (N). The valve is moved to the right position when Reverse (R) is selected.



Low Reverse/Converter Clutch and Overdrive Solenoids

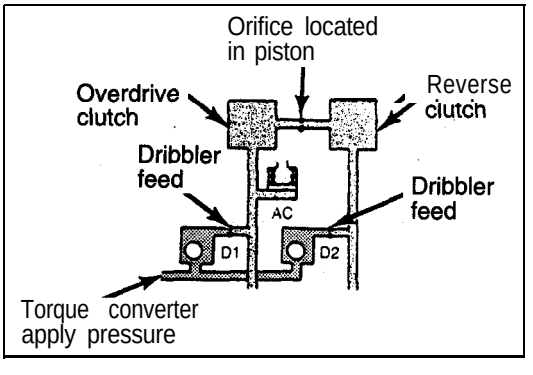
When these two solenoids are not energized by the TCM, their check balls are seated on orifices and do not allow hydraulic pressure to pass through their particular circuits. The top of these solenoids are tapered to allow fluid to vent to the sump when de-energized. They are referred to as normally vented valves. When the solenoids are energized by the TCM, the check balls are unseated, allowing hydraulic pressure to flow past the check ball and into the circuit. At the same time, the tapered part of the solenoid closes the vent port to the sump. This action causes full line pressure to be applied to the desired clutch.

The TCM can cycle (turn “on” and “off”) the solenoids at a high frequency (many times per second). This action modulates the element pressure between zero and line pressure. The modulation is used when the solenoids are initially eneragized for more precise control of the clutches. Under certain driving conditions, the TCM may modulate the LWCC solenoid to obtain a specific amount of T/C clutch slippage. This feature is referred to as Electronically Modulated Converter Clutch (EMCC). It allows partial converter clutch engagement, which gives increased fuel economy and smoothes out engine pulses.



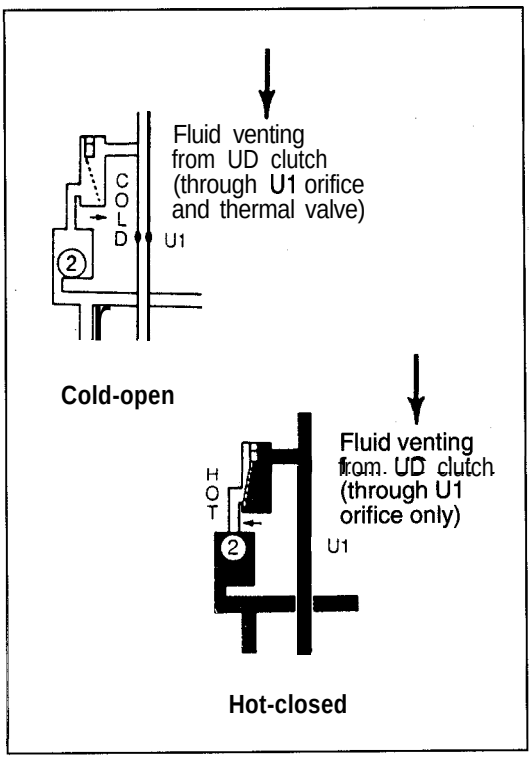
2-4/Low Reverse and Underdrive Solenoids

When these two solenoids are not energized by the TCM, their check balls prevent venting of a clutch. In this position the check balls allow line pressure to reach the desired clutch. These solenoids allow oil pressure to the clutch when de-energized and are referred to as normally applied valves. When the solenoids are energized, the plunger forces the check ball down and prevents line pressure from reaching the clutch. At the same time, pressure is vented from the clutch.
Similar to the normally vented valves, these normally applied valves are also cycled to modulate clutch pressure to any value between line pressure and zero.



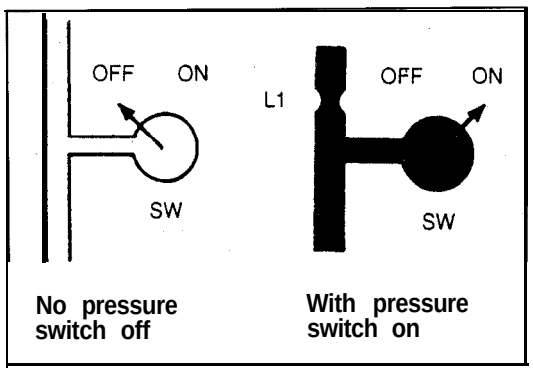
Dribbler Circuits

Two dribbler circuits feed low flow rate oil (residual pressure) from the torque converter to the overdrive and reverse clutches at all times. The low flow rate oil provided by the dribbler circuits keeps both clutches full of oil. These clutches share a common piston. If there is a difference in the amount of oil on either side of the piston, the piston would tend to move toward the clutch with less oil and cause that clutch to drag. If oil is only on one side of the piston, and the retainer is spinning at high speed, the spinning action will force oil to the outer diameter of the retainer and cause the piston to move. The oil pressure build-up caused by spinning is called centrifugal pressure.
Another feature added to avoid this situation is a small orifice in the overdrive/reverse piston that helps equalize pressure on both sides of the piston. The dribbler circuits only involve low flow rates, which do not have any significant effect when the clutches receive full line pressure.



Thermal Valve

The thermal valve is a bi-metallic shutter valve that helps control the venting rate of oil pressure in the underdrive clutch passage during release of the clutch. When the oil temperature is approximately 20 degrees Fahrenheit or less, the valve will be fully open to assist in venting oil past the U1 orifice. At temperatures above 20 degrees, the valve starts to close and becomes fully closed at approximately 140 degrees, The thermal valve is located in the transfer plate of the valve body.



Pressure Switches

The pressure switches in the solenoid assembly supply information to the TCM. When pressure is applied to a hydraulic circuit where there is a pressure switch, the switch is forced to the "on" or closed position. The switches do not tell the TCM how much pressure there is in a circuit, but rather that pressure does exist. Basically, the switches confirm to the TCM that the intended solenoid action did occur. They can also be used to determine a hydraulic problem.

VALVE AND SOLENOID HYDRAULIC CONTROL IN SELECTED GEAR RANGES

Park/Neutral

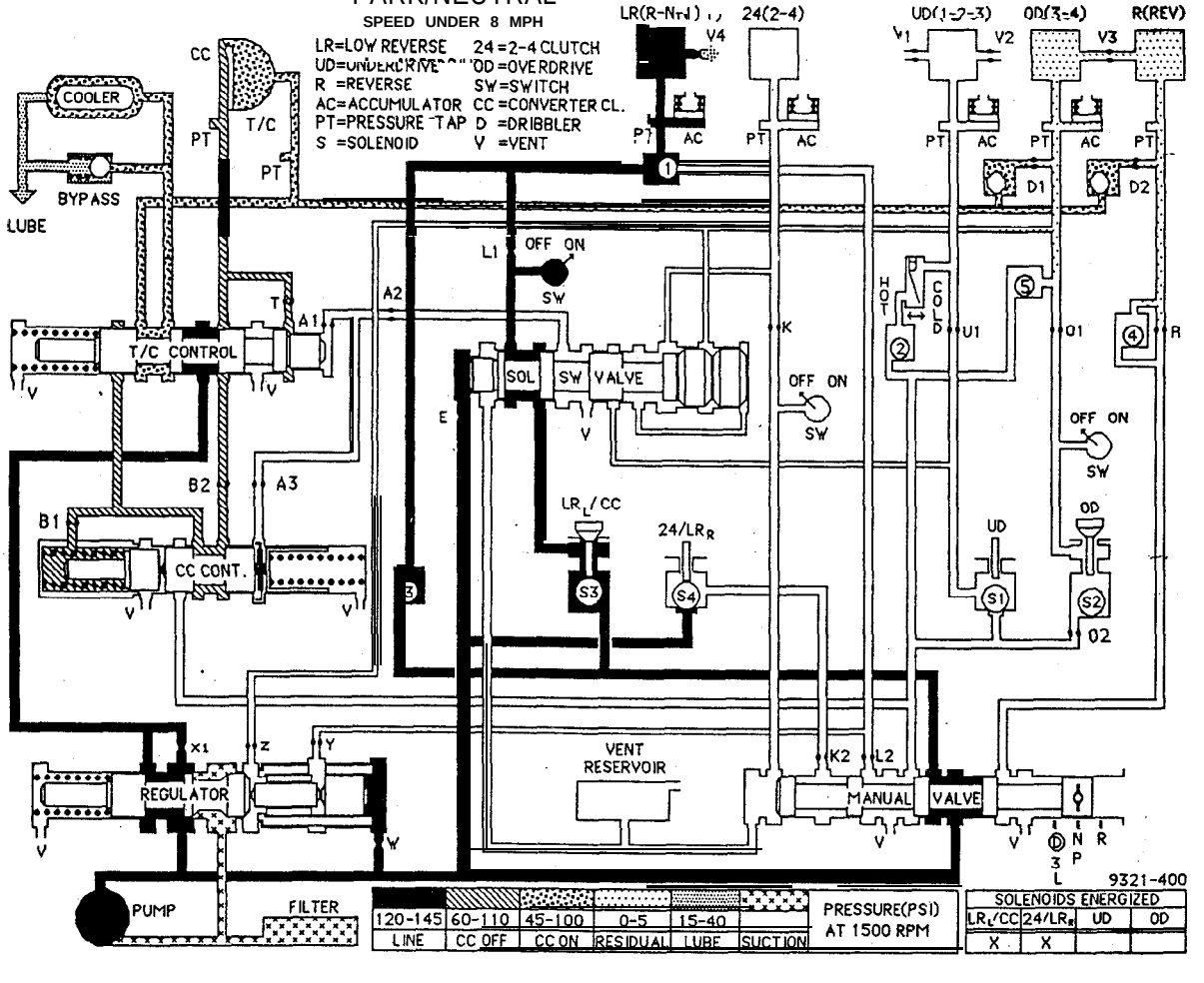
In either of these gear selections, the transaxle has lube pressure. To provide smoother engagement, the low/reverse clutch is pressurized, anticipating a shift to a forward or reverse gear. The LR/CC solenoid is energized which permits line pressure to the low/reverse clutch. The 2-4/LR solenoid is energized to close off the circuit to the manual valve.

Hydraulically, this internal transaxle condition is identical for both the Park and Neutral positions. The only mechanical difference is that the parking pawl is engaged in the Park position.

PARK/NEUTRAL

Speed under 8 mph

LR = Low reverse
UD = Underdrive
R = Reverse
AC = Accumulator
PT = Pressure tap
S = Solenoid
24 = 2-4 clutch
OD = Overdrive
SW = Switch
CC = Converter CL
D = Dribbler
V = Vent



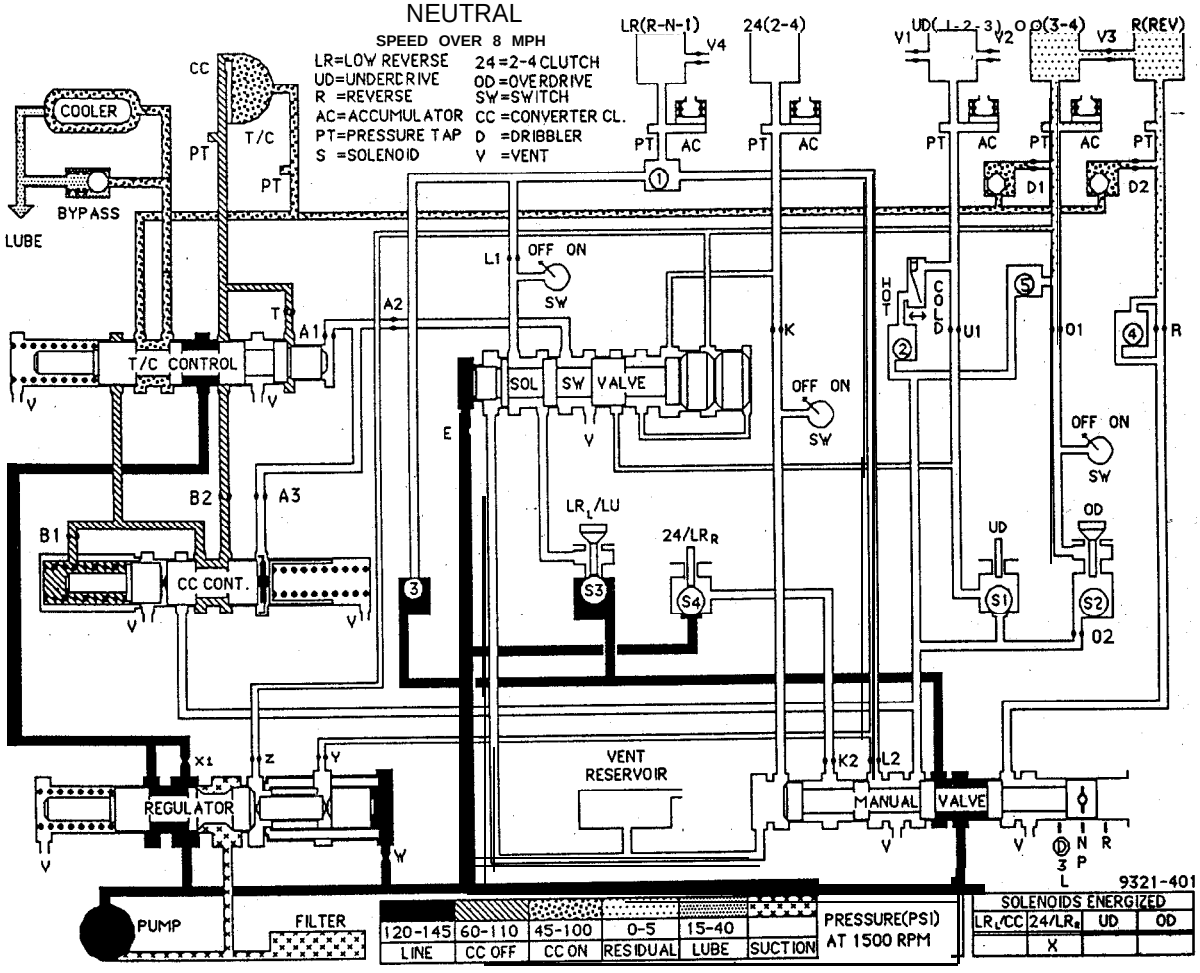
Rolling Neutral Above Eight MPH

When the transaxle is in neutral, and vehicle speed is above eight mph, all friction elements are disengaged to minimize or reduce drag and to avoid excessive element speed. The TCM de-energizes the LR/CC solenoid to vent the LR circuit. This configuration is ready to engage any forward gear, depending on vehicle speed and throttle position.

NEUTRAL

Speed over 8 mph

LR = Low reverse
UD = Underdrive
R = Reverse
AC = Accumulator
PT = Pressure tap
S = Solenoid
24 = 2-4 clutch
OD = Overdrive
SW = Switch
CC = Converter CL
D = Dribbler
V = Vent

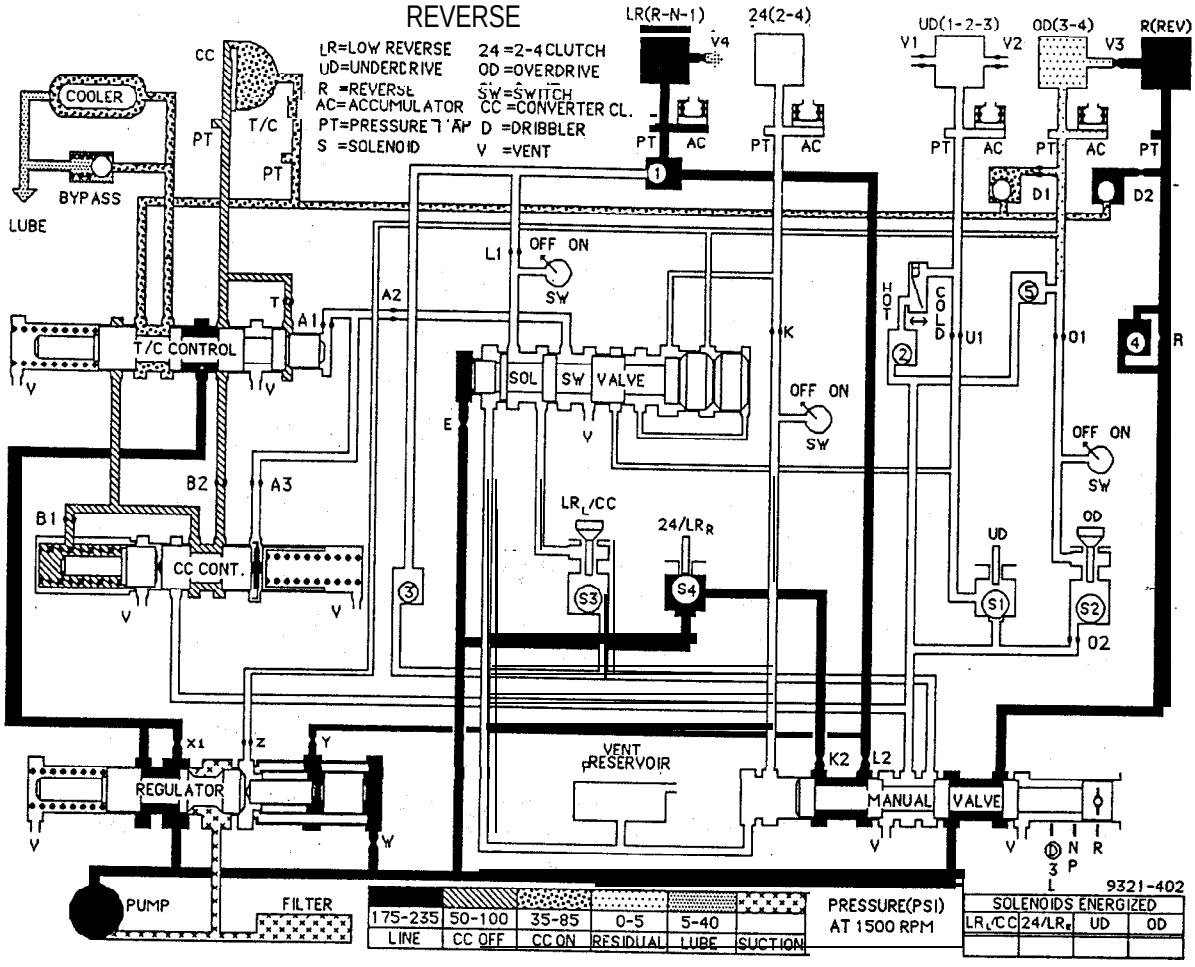


Reverse

With the manual valve moved to the reverse position, line pressure is allowed through the manual valve directly to the reverse clutch and also through the 2-4/LR solenoid to the low/reverse clutch. The regulator valve is designed to increase line pressure in the reverse gear range above the pressure that is normal for other ranges. This is done to increase clutch capacity. Line pressure is directed between a small valve and larger valve at the right end of the regulator valve. This neutralizes the effects of the larger valve on the regulator valve. With only the smaller valve working against the regulator valve, the regulator valve spring further closes down the vent, causing line pressure to increase. There are no solenoids energized in the reverse gear range. However, the 2-4/LR solenoid is modulated during initial engagement to smoothe the torque transition and prevent harsh engagement into reverse.

REVERSE

LR = Low reverse
UD = Underdrive
R = Reverse
AC = Accumulator
PT = Pressure tap
S = Solenoid
24 = 2-4 clutch
OD = Overdrive
SW = Switch
CC = Converter CL
D = Dribbler
V = Vent



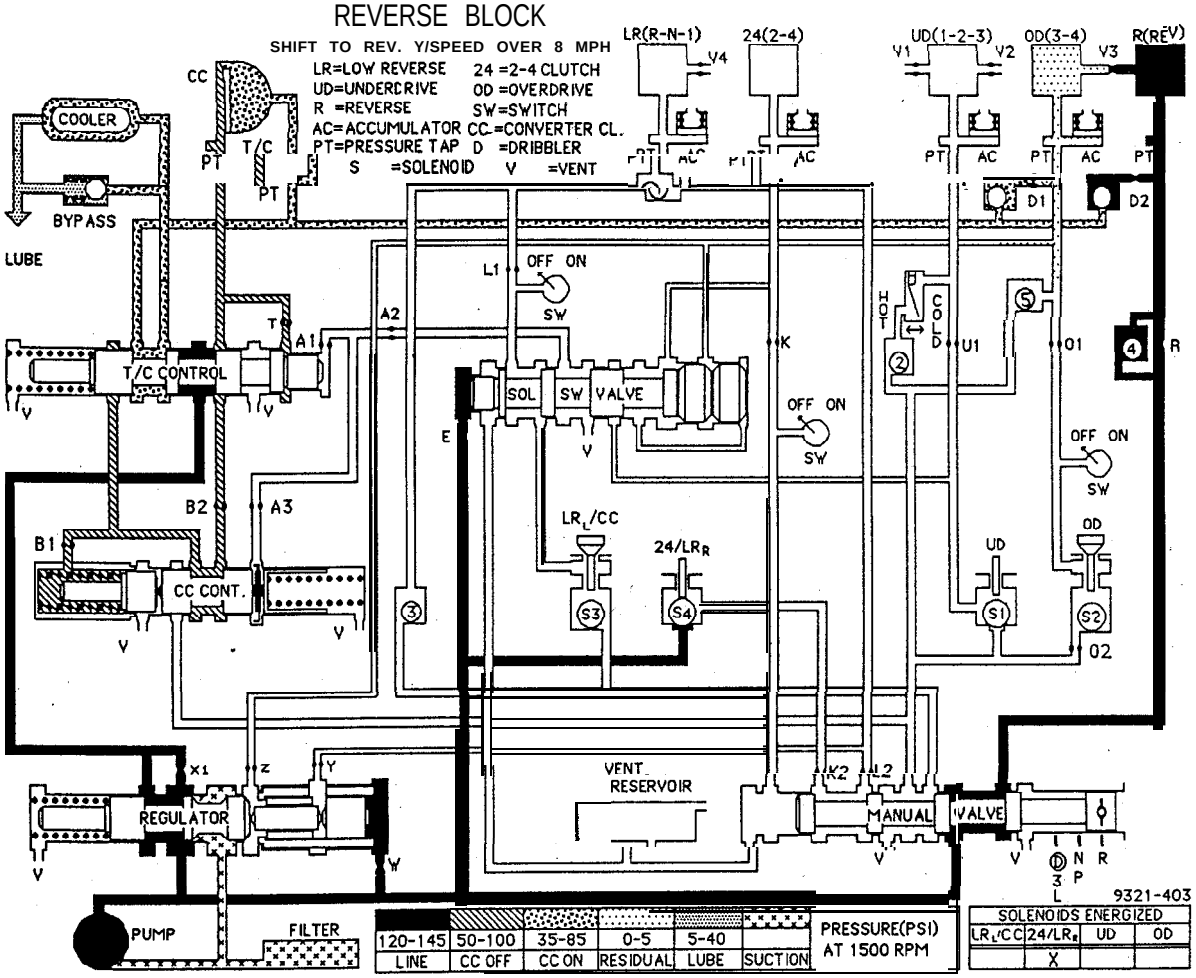
Reverse Block Above Eight MPH

Reverse gear will not engage if the TCM senses vehicle speed above eight mph. This is to prevent damage that could occur if a driver accidentally puts the gear selector in "R" while rolling in any forward gear range. If the output speed sensor detects that the output shaft is spinning at a speed equal to or greater than eight mph, the TCM activates reverse block to protect the transaxle. The function is inoperable in "limp-in" mode. To accomplish or initiate reverse block, the TCM energizes the 2-4/LR solenoid. The solenoid prevents line pressure from applying the low/reverse clutch. Without a holding element, the planetary gearset in this range will provide no output. It must have both an input and a holding element to provide output. In this condition, the transaxle is effectively in Neutral.

REVERSE BLOCK

Shift to Rev. w/speed over 8 mph

LR = Low reverse	24 = 2-4 clutch
UD = Underdrive	OD = Overdrive
R = Reverse	SW = Switch
AC = Accumulator	CC = Converter CL
PT = Pressure tap	D = Dribbler
S = Solenoid	V = Vent

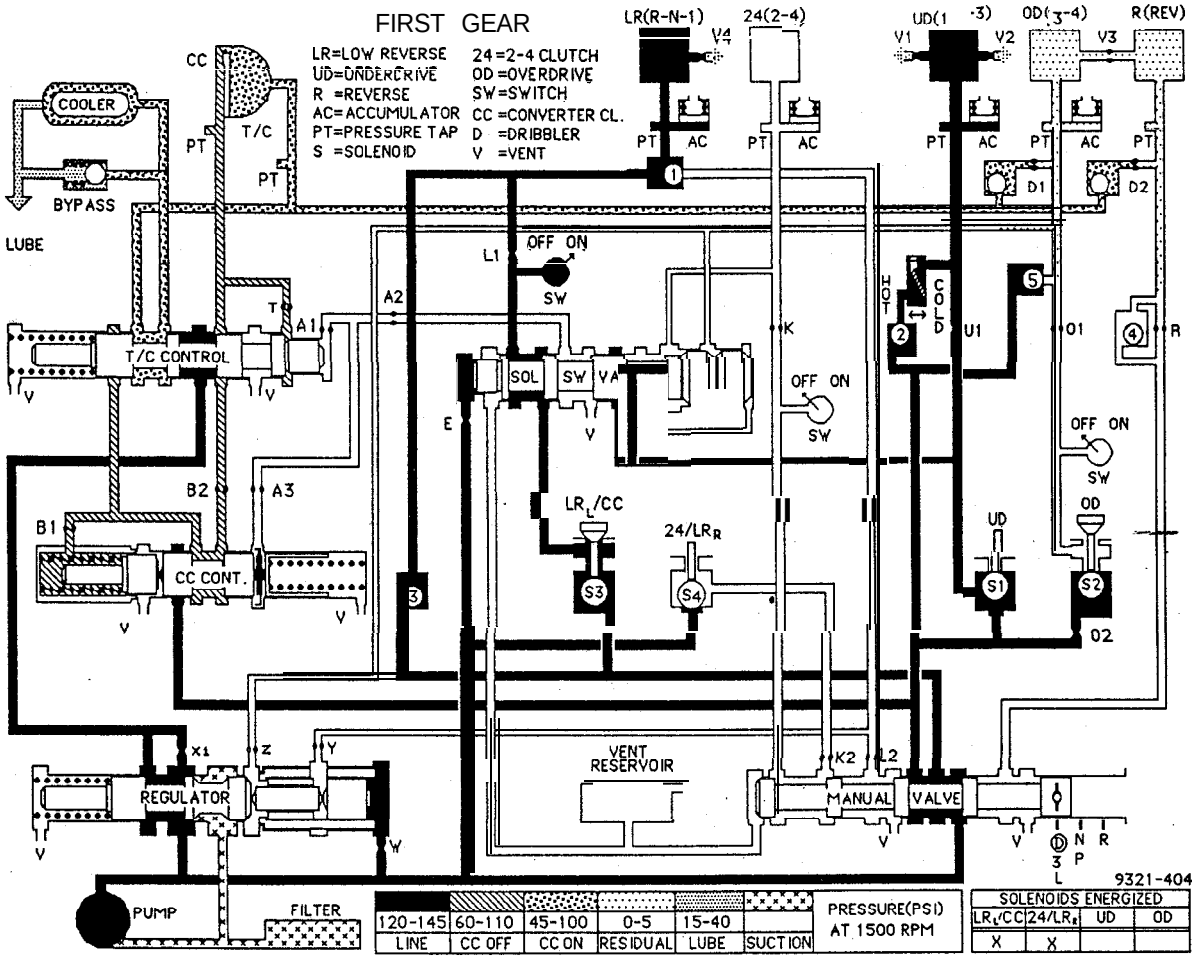


First Gear

When any of the forward gear selections are made, line pressure is directed to all four solenoids. In first gear the TCM will energize the LR/CC and 2-4/LR solenoids. This action applies the low/reverse and underdrive clutches. The forward gear position selected by the driver has no effect on manual valve position. Its location will be the same for all forward positions. The selection difference is detected by the TCM through the transmission range and park/neutral position switches. The switches provide the TCM with the information needed to determine which shift pattern and schedule to use for the selected gear range.

FIRST GEAR

LR = Low reverse
UD = Underdrive
R = Reverse
AC = Accumulator
PT = Pressure tap
S = Solenoid
24 = 2-4 clutch
OD = Overdrive
SW = Switch
CC = Converter CL
D = Dribbler
V = Vent

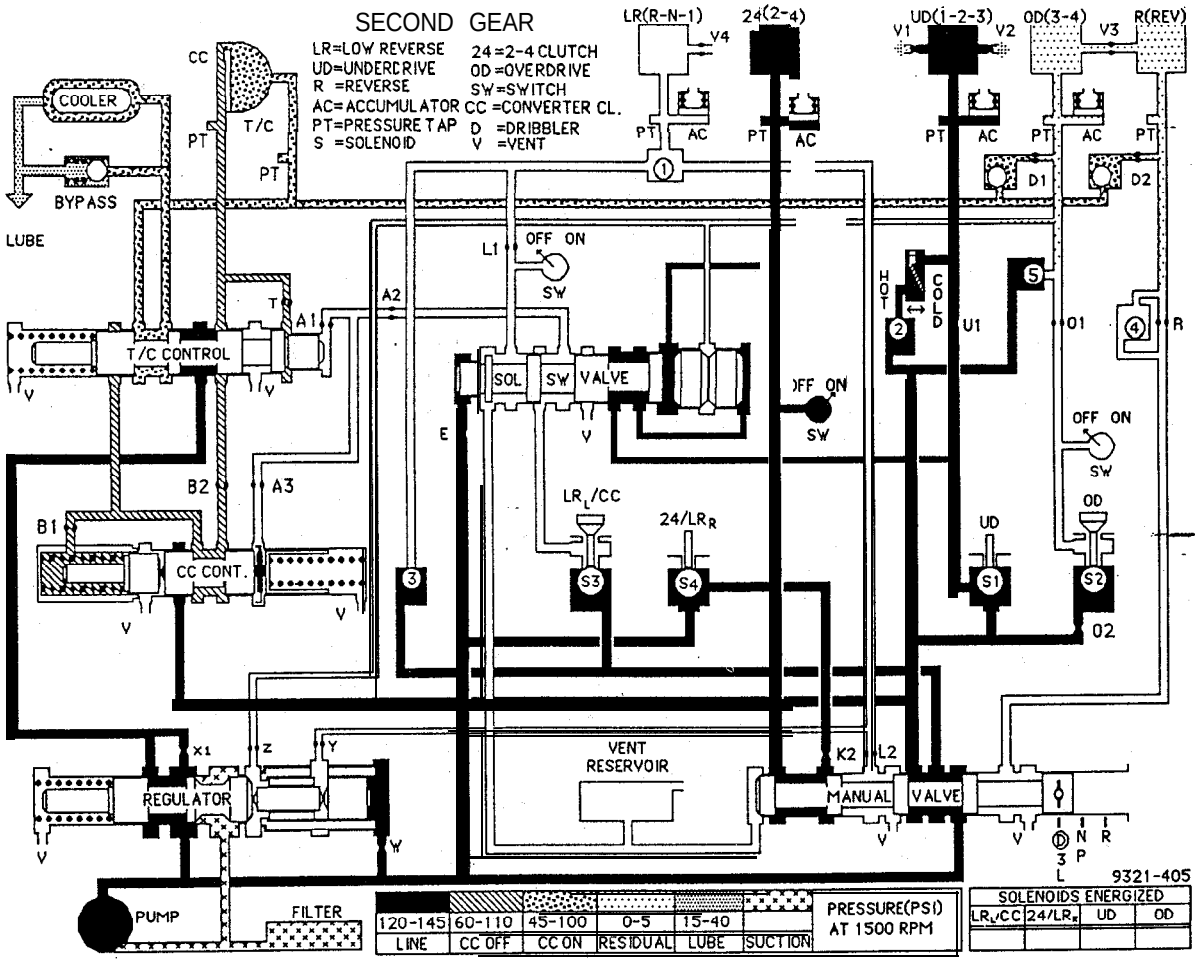


Second Gear

There are no solenoids energized in second gear. With the solenoids de-energized, line pressure is directed to the 2-4 and underdrive clutches. Line pressure from the 2-4 clutch circuit is also directed to the solenoid switch valve, which moves the valve to the left. When the solenoid switch valve is moved to this position, it opens a circuit that can be applied by the TCM and LWCC solenoid for torque converter clutch engagement. When the TCM recognizes a problem or is unable to function properly, the transaxle goes into a default or limp-in mode. In this mode of operation, the solenoids and valve body shift to a position that only provides second gear range, regardless of any forward gear that is selected by the driver.

SECOND GEAR

LR = Low reverse
UD = Underdrive
R = Reverse
AC = Accumulator
PT = Pressure tap
S = Solenoid
24 = 2-4 clutch
OD = Overdrive
SW = Switch
CC = Converter CL
D = Dribbler
V = Vent



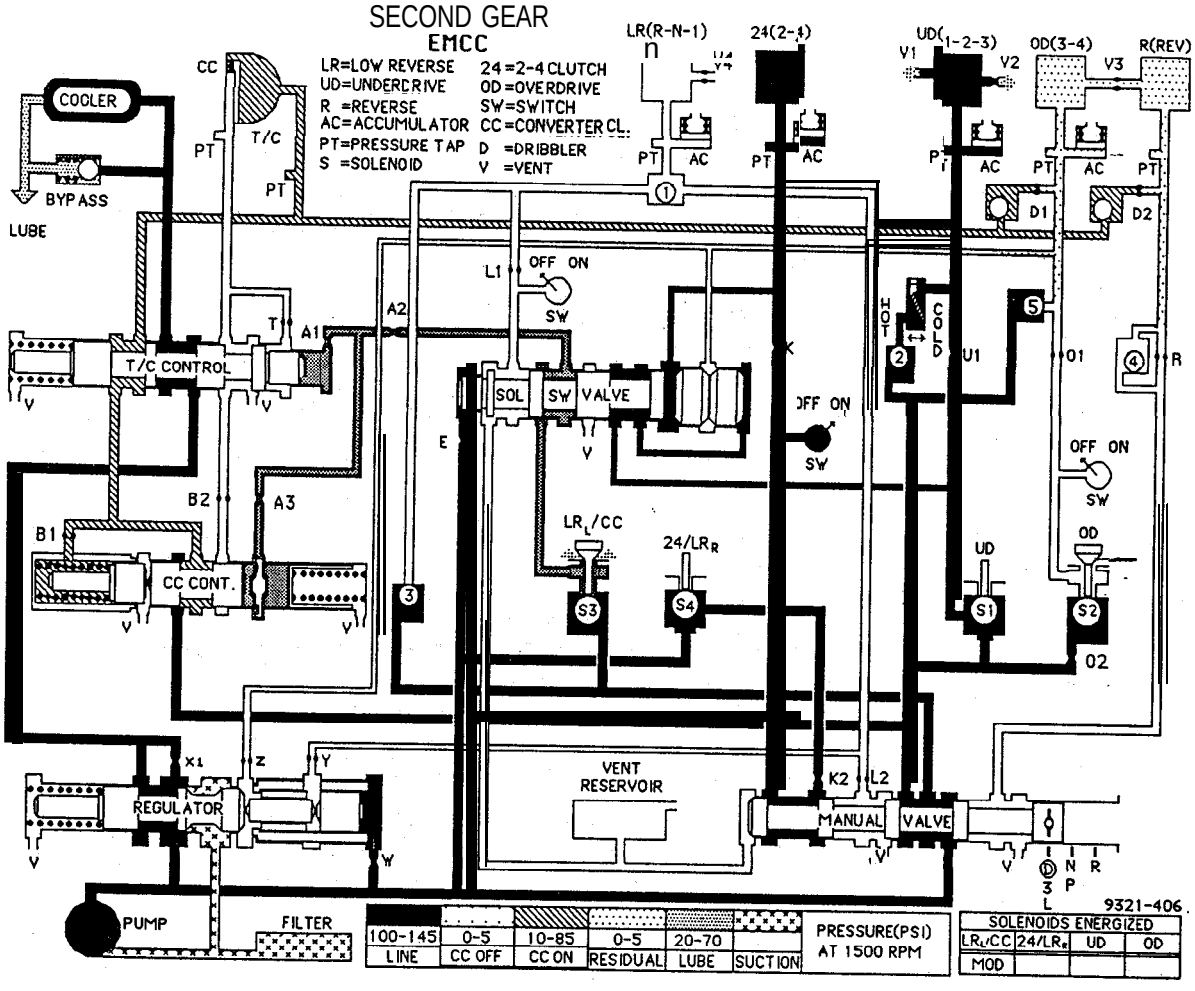
Second Gear EMCC

When conditions allow for it, the TCM pulses or modulates the LWCC solenoid. This is called Electronically Modulated Converter Clutch (EMCC), as mentioned earlier. By pulsing or modulating the solenoid, the TCM can lower the line pressure that passes through the solenoid before reaching the converter clutch and torque converter control valves. When the modulated pressure reaches the two valves, it fully moves the T/C control valve to the left, but only partially moves the CC control valve. When the T/C control valve moves, it vents the fluid from the front side of the torque converter piston. At the same time, the CC control valve provides modulated pressure to the back side of the torque converter piston. This condition does not cause the torque converter piston to fully engage but instead regulates the amount of slippage (partial engagement).

SECOND GEAR

EMCC

LR = Low reverse	24 = 2-4 clutch
UD = Underdrive	OD = Overdrive
R = Reverse	SW = Switch
AC = Accumulator	CC = Converter CL
PT = Pressure tap	D = Dribbler
S = Solenoid	V = Vent

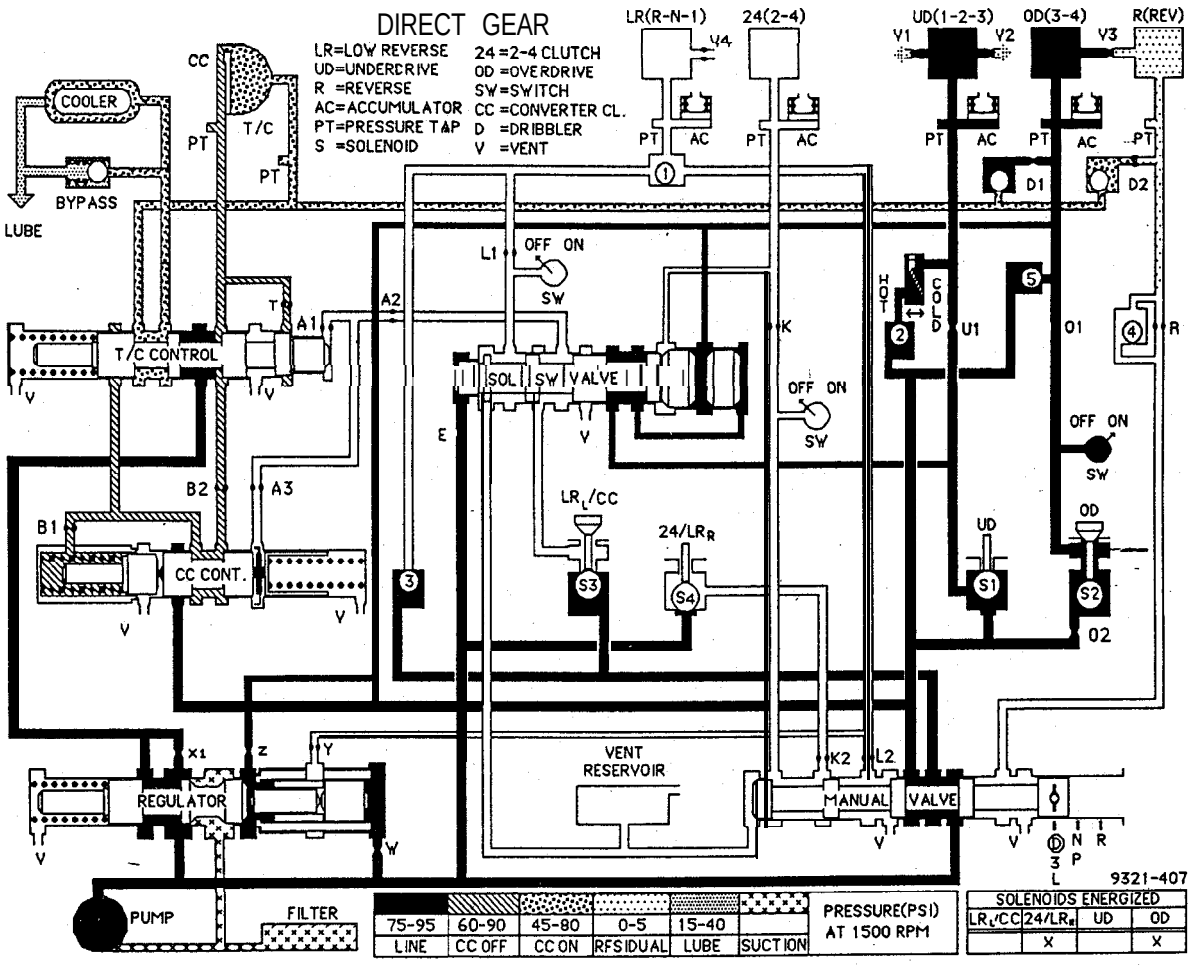


Direct Gear (Third)

To shift into direct gear, the TCM energizes the 2-4/LR and overdrive solenoids. This feeds line pressure to the underdrive and overdrive clutches. Line pressure from the overdrive clutch circuit is directed to an area between two large plugs at the end of the solenoid switch valve. This keeps the solenoid switch valve shifted to the left. The redirected line pressure from the overdrive clutch circuit allows for torque converter clutch engagement. It also takes the place of second gear line pressure, that was holding the valve to the left but has now been vented. The line pressure has also been reduced by using line pressure from the same overdrive clutch circuit that keeps the solenoid switch valve moved to the left. Line pressure is directed to an area between the regulator valve and the smaller of the two valves on the end. This aids in moving the regulator valve to the left, dumping additional oil, which results in lower line pressure.

DIRECT GEAR

LR = Low reverse
UD = Underdrive
R = Reverse
AC = Accumulator
PT = Pressure tap
S = Solenoid.
24 = 2-4 clutch
OD = Overdrive
SW = Switch
CC = Converter CL
D = Dribbler
V = Vent

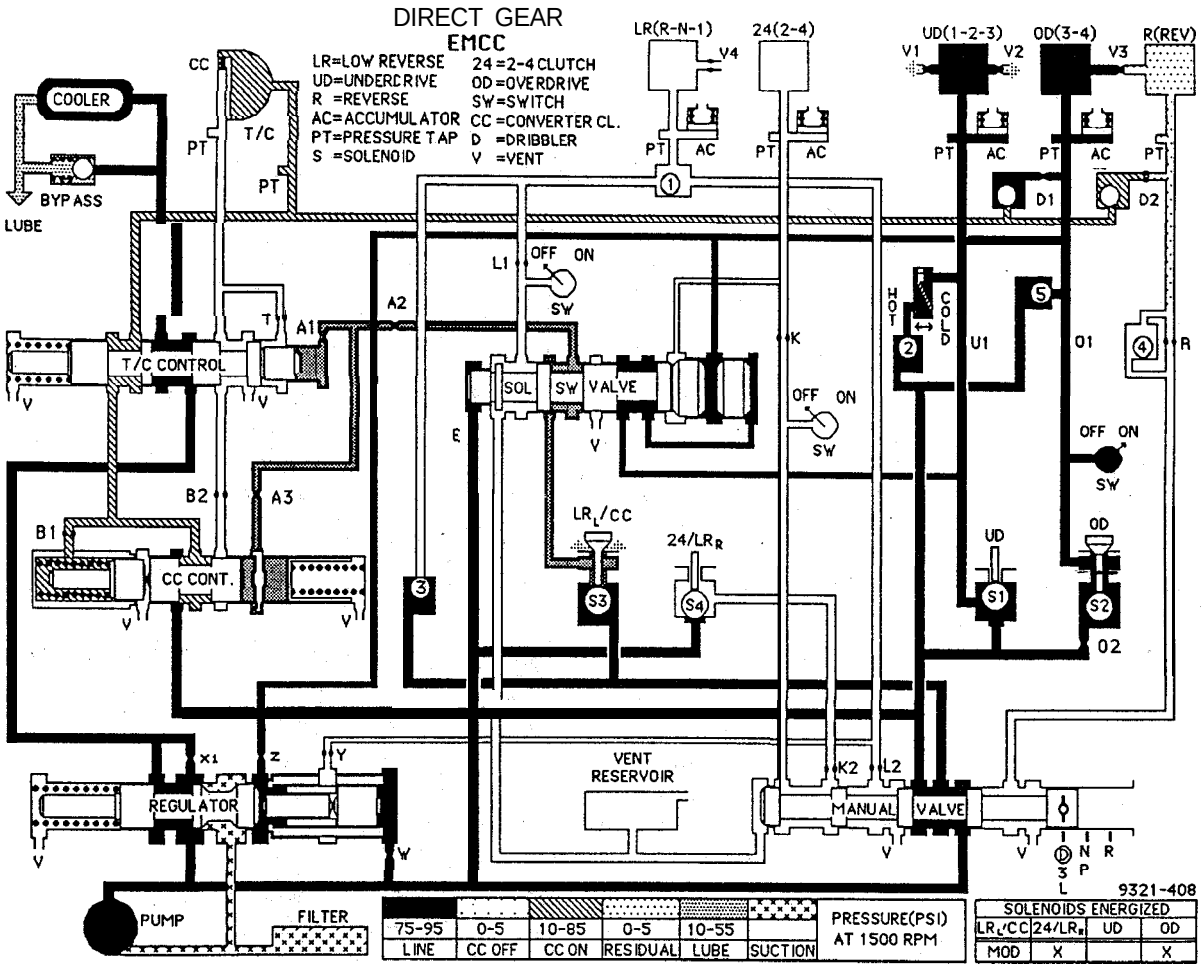


Direct Gear EMCC

Direct gear EMCC is accomplished the same way as second gear EMCC. Whenever the TCM activates EMCC, it provides full line pressure from the regulator valve through the T/C control valve to the transaxle cooler to help improve transaxle cooling. For a review of EMCC operation, refer to Second Gear EMCC.

DIRECT GEAR
EMCC

LR = Low reverse
UD = Underdrive
R = Reverse
AC = Accumulator
PT = Pressure tap
S = Solenoid
24 = 2-4 clutch
OD = Overdrive
SW = Switch
CC = Converter CL
D = Dribbler
V = Vent

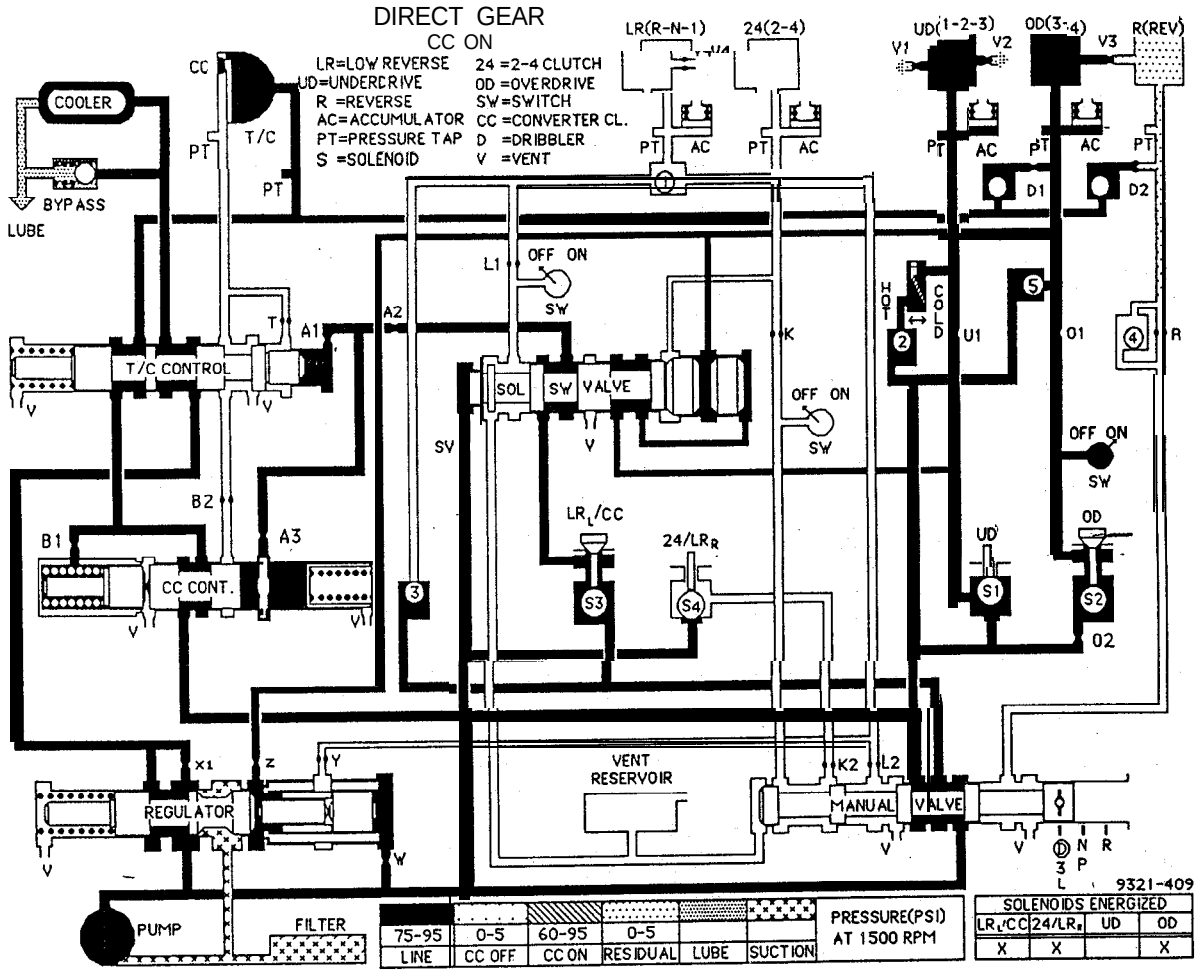


Direct Gear CC On

In direct gear, when the torque converter clutch is fully engaged it is called CC On. The solenoid and valve configuration for this position is the same as direct gear EMCC except the LR/CC solenoid is fully energized instead of pulsed or modulated. When the LR/CC solenoid is energized, it sends full line pressure to the ends of the T/C and **CC** control valves. Both the valves shift to the left. This allows the T/C control valve to fully vent the pressure on the front side of the torque converter piston, causing full engagement.

DIRECT GEAR
CC ON

LR = Low reverse
UD = Underdrive
R = Reverse
AC = Accumulator
PT = Pressure tap
S = Solenoid
24 = 2-4 clutch
OD = Overdrive
SW = Switch
CC = Converter CL
D = Dribbler
U = Vent

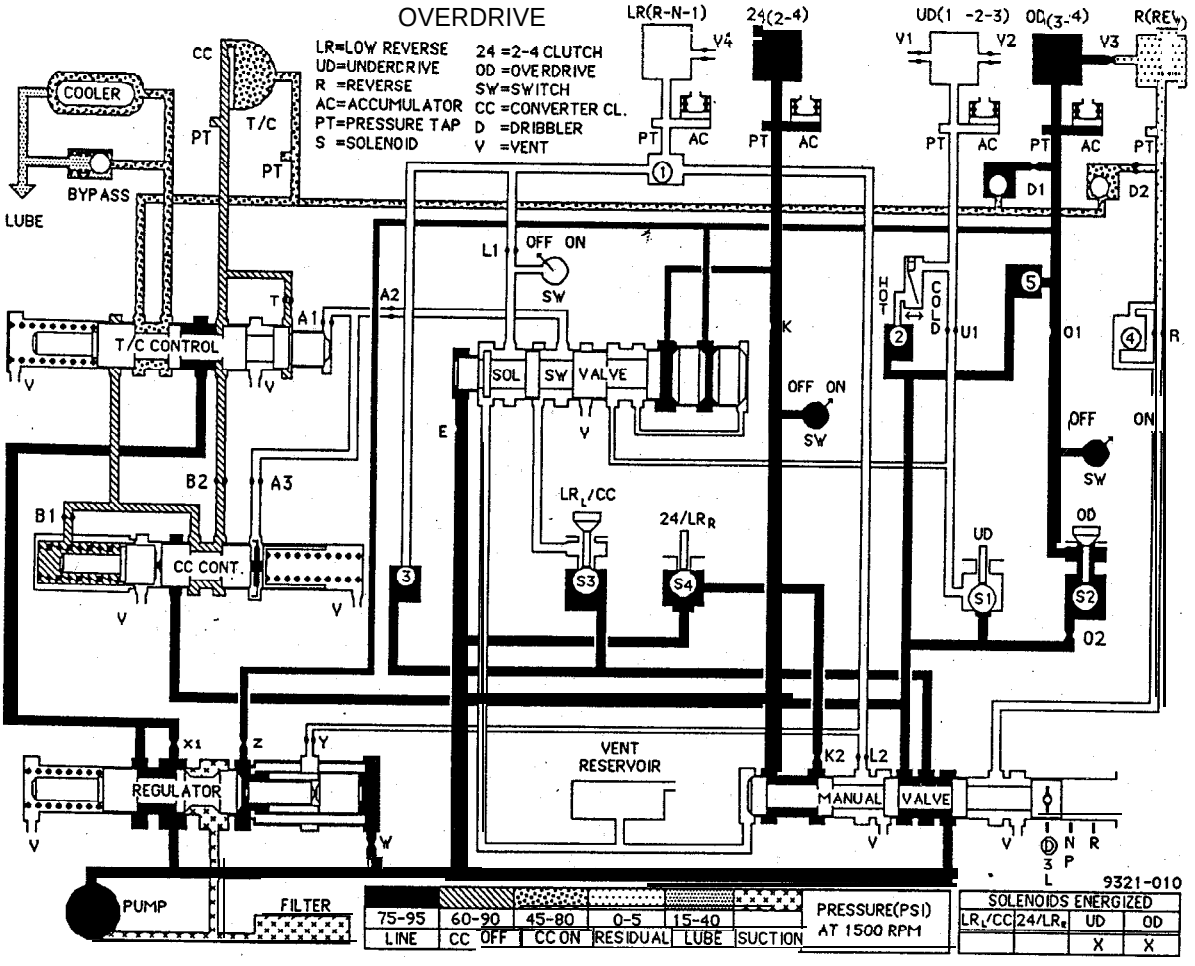


Overdrive Gear (Fourth)

The TCM energizes the underdrive solenoid which shuts off line pressure to the underdrive clutch. The TCM also de-energizes the 2-4 solenoid and allows the 2-4 clutch to engage. This shifts the transaxle into overdrive by allowing only the 2-4 and overdrive clutches to be applied.

OVERDRIVE

LR = Low reverse
UD = Underdrive
R = Reverse
AC = Accumulator
PT = Pressure tap
S = Solenoid
24 = 2-4 clutch
OD = Overdrive
SW = Switch
CC = Converter CL
D = Dribbler
V = Vent



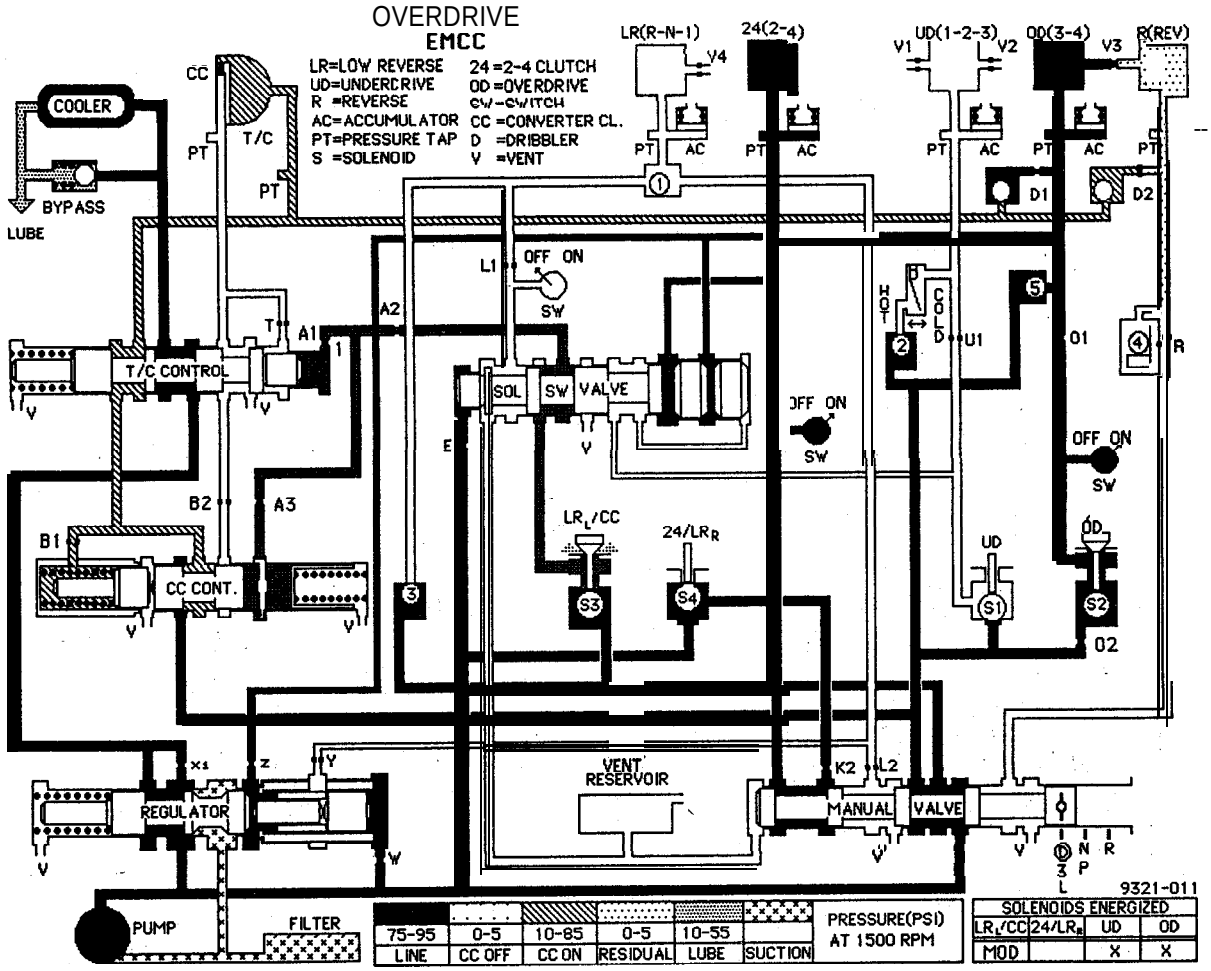
Overdrive Gear EMCC

The EMCC function is the same in Overdrive as it was in the second and direct gear positions. For a review of EMCC operation, refer to second Gear EMCC.

OVERDRIVE

EMCC

LR = Low reverse	24 = 2-4 clutch
UD = Underdrive	OD = Overdrive
R = Reverse	SW = Switch
AC = Accumulator	CC = Converter CL
PT = Pressure tap	D = Dribbler
S = Solenoid	V = Vent



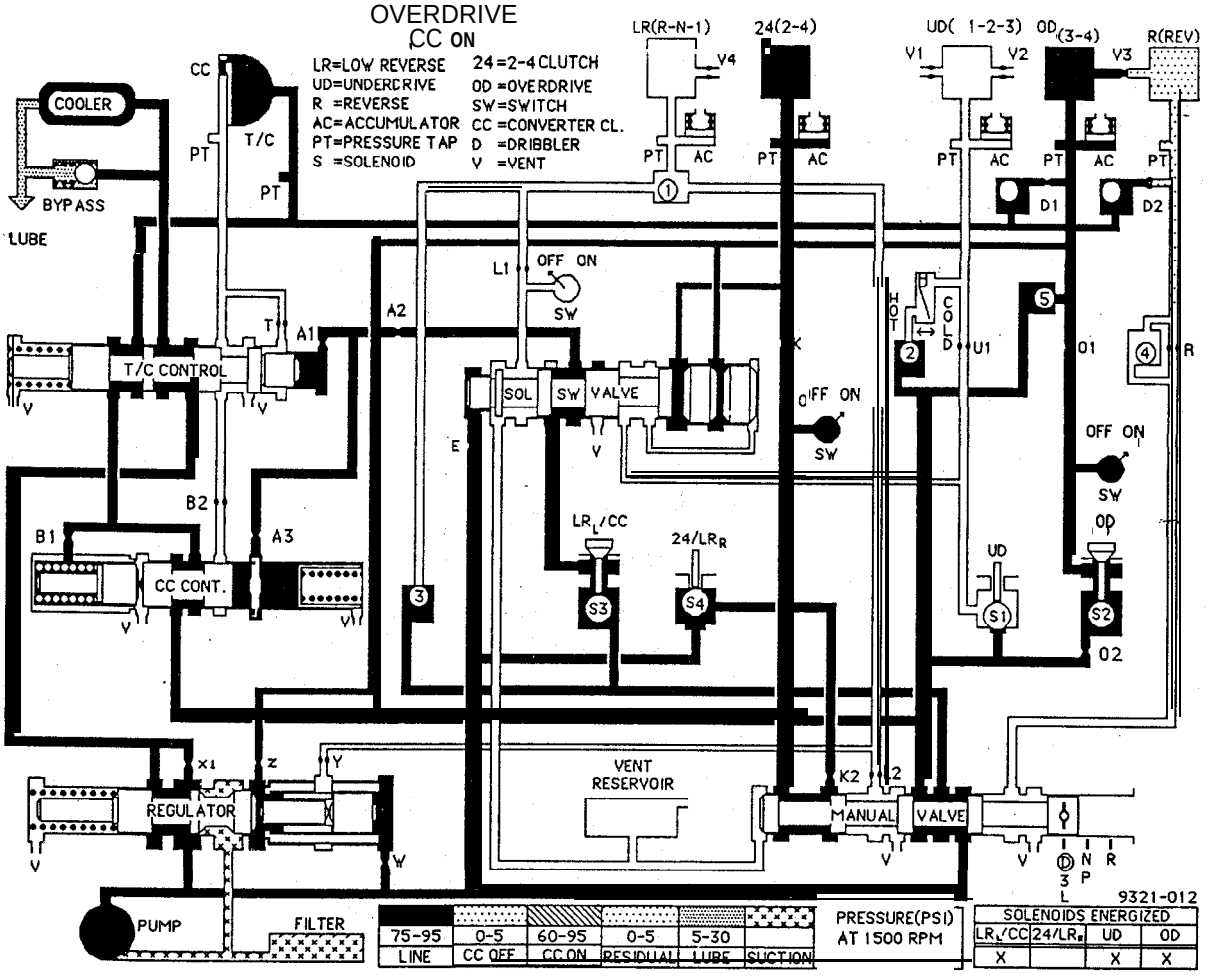
Overdrive Gear CC On

In this position the torque converter clutch is fully engaged (CC On). The LWCC solenoid is fully energized as it was in the direct gear CC on position.

For a review of the transaxle operation in the CC on position, refer to Direct Gear CC On.

OVERDRIVE
CC ON

LR = Low reverse
UD = Underdrive
R = Reverse
AC = Accumulator
PT = Pressure tap
S = Solenoid
24 = 2-4 clutch
OD = Overdrive
SW = Switch
CC = Converter CL
D = Dribbler
V = Vent



Electronic Control System

INTRODUCTION TO THE ELECTRONIC CONTROL SYSTEM

The advantage of using the electronic control system is more precise control over transaxle function. An added advantage of the system is that it can help the technician find a problem in a malfunctioning transaxle. The system can do this through what is called On-Board Diagnostics. The Transmission Control Module (TCM) continuously monitors its critical functions during normal operation. It records malfunctions in the form of diagnostic trouble codes and the number of engine starts since the last code stored in memory. The technician can use this information in the event of a malfunction or complaint. Up to seven, two digit numeric diagnostic trouble codes may be stored in memory at one time.

When a failure is identified by the TCM, the system may go into a limp-in mode by turning off the solenoids. TCM logic is included to ensure that the limp-in event results in an orderly shut-down of transaxle function when possible. The shut-down sequence will vary depending on which gear the transaxle is in and what the vehicle speed is at the time the failure is identified by the TCM. This "all-solenoids off" limp-in mode is designed to allow for shift lever manual control of PARK, REVERSE, NEUTRAL and SECOND GEAR operation. When any forward gear shift lever position is chosen, the transaxle will remain in second gear range.

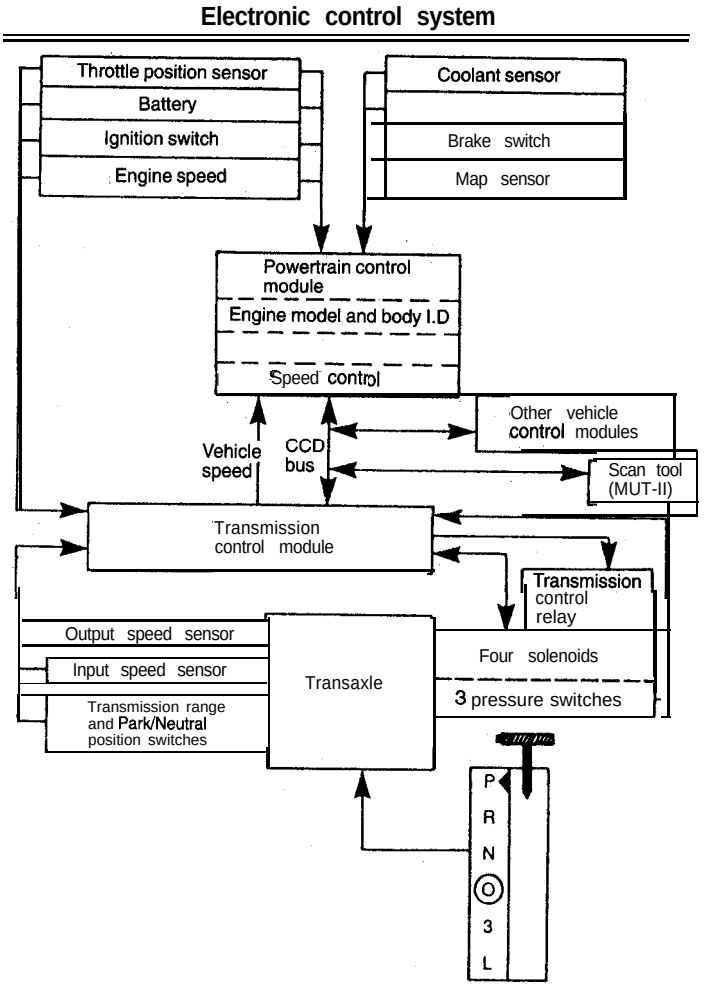
All failures do not result in limp-in, just those that could potentially cause internal transaxle damage. If the TCM itself fails, the transaxle will also go into the limp-in mode.

The transaxle control system consists of an electronic control module, called the TCM, and a system of input and output components, that function together to control the operation of the transaxle.

Electronic Control System

Each of the major system components are represented as a block of information. The lines between the blocks represent the flow of input and output information between the components.

Some of the input and output information is unique to the TCM. In other words, some of the input to the TCM is "Direct Input." Some information (input) to the TCM is shared with other components through the Chrysler Collision Detection (CCD) data bus. As the TCM receives input information, it continuously processes it through its logic circuits in order to perform all of the control functions that it has been designed to perform. The following is a list of inputs related to the transaxle control system, both direct and indirect.



TCM Direct Inputs

The direct inputs connected to the TCM are battery feed, ignition run signal, cranking signal, throttle position sensor signal, engine speed signal (distributor or DIS crank sensor signal), input speed sensor signal, output speed sensor signal, transmission range switch signal, park neutral position switch signal, low/reverse pressure switch signal, 2-4 pressure switch signal, and the overdrive pressure switch signal.

TCM Indirect Inputs over the CCD Bus

The indirect input signals the TCM senses from the powertrain control module (PCM) that are sent over the CCD data bus are, target idle speed, coolant temperature, battery temperature, brake switch ON/OFF signal, engine speed (verifies direct input engine speed signal), speed control ON/OFF switch signal, and the manifold absolute pressure sensor signal.

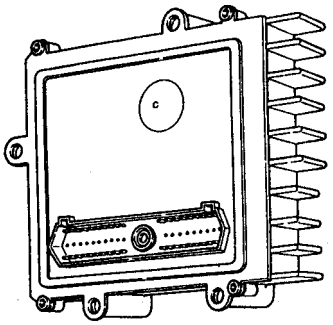
As stated earlier, the TCM receives input information, and it continuously processes this information through its logic circuits in order to perform all of the control functions that it has been designed to perform. However, some of these control functions are internal to the TCM, while other control functions are performed when the TCM provides some type of output signal to another control device. The following is a list of outputs related to the transaxle control system.

Direct Outputs from the TCM

The direct output signals or output devices the TCM has control over are, the transmission control relay, the four solenoids in the solenoid pack, and the vehicle speed signal.

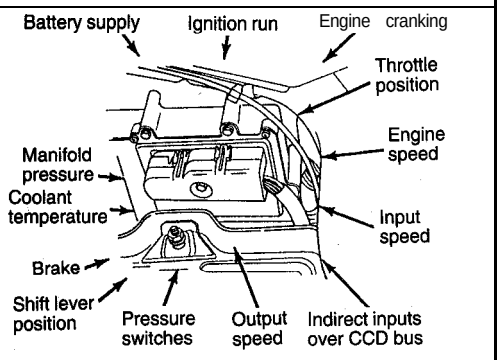
Indirect Outputs from the TCM over the CCD Bus

The only signal sent out from the TCM over the CCD data bus is communication with the scan tool (MUT-II) for diagnostics.



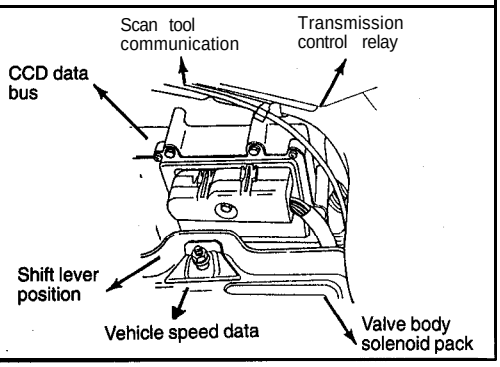
TRANSMISSION CONTROL MODULE (TCM)

The Transmission Control Module (TCM), is the brain of the transaxle. It receives information from several inputs for making decisions on how the transaxle should function. Some of the information is used only by the TCM, and some of the information is shared with other components through the CCD bus. The CCD bus is simply a communication link between the TCM and other electronic components on the vehicle.



TCM Inputs

The TCM uses various inputs to determine when to upshift or downshift and when to engage or disengage the torque converter clutch. The TCM also uses these inputs for continuous feed-back data for controlling shift quality. Without any input, the TCM has no way to determine the state of the transaxle and therefore cannot control its operation as designed. The illustration is a list of the input sensors and signals that the TCM uses to determine control over its outputs.



TCM Outputs

In order for the TCM to perform, it must have the necessary number of outputs (signals or devices) that cause the transaxle to function as desired. Some of these controlled functions (or outputs) are used by the TCM to cause upshifts or downshifts (clutch control). Other TCM outputs are information signals sent across the CCD bus to another control module. The illustration provides a list of the output signals or devices controlled by the TCM.

Transmission Control Module Operation

The main reason for having the transaxle controlled by the TCM is to have superior shift quality. The TCM actually "learns" the characteristics of a particular transaxle to optimize vehicle shift quality using its program logic.

(1) Adaptive Memory

The TCM automatically adapts for engine performance variations and clutch torque variations to provide consistent shift quality for the life of the transaxle. This learning capability is called adaptive memory. If for some reason the TCM loses its memory, through a loss of battery power or the disconnection of its 60-way connector, it takes approximately ten shifts for the TCM to re-learn shift characteristics.

(2) Quick Learn

A quick-learn procedure is available to pre-program the shift characteristics into the TCM. The quick-learn procedure simply speeds up the TCM learning process. The vehicle still must be driven and shifted several times in each gear range during the road test. This will fully utilize the TCM's adaptive memory capability. The quick-learn procedure is accessed through transaxle diagnosis and performed by the scan tool (MUT-II).

(3) Self Diagnostics

Another feature of the TCM is that it helps the technician find a problem within a malfunctioning transaxle or control system. It can do this through self-diagnostics. When something goes wrong with any of the major electronic circuits in the TCM and/or its input sensor and output device network, a two digit numeric diagnostic trouble code is put into memory.

(4) Diagnostic Trouble Codes

In addition to sensing electrical malfunctions, the TCM can also detect some hydraulic and mechanical malfunctions that also produce diagnostic trouble codes. Each code represents a different malfunction. In order to read the diagnostic trouble codes, the technician must hook-up a special diagnostic scan tool, called a scan tool (MUT-II). It will be hooked up to a diagnostic connector, located under the instrument panel.
To retrieve diagnostic trouble codes, it is necessary to follow the procedures outlined in the Powertrain Diagnostic Procedures manual for this transaxle. The TCM can retain up to seven diagnostic trouble codes in memory at one time.

(5) Default or Limp-In Mode

Another feature of the TCM is the ability to protect the transaxle from potentially hazardous operation, when certain problems arise. The TCM constantly monitors its systems. If it senses a problem, it puts a diagnostic trouble code in memory and shuts down the electronic controls. When this happens, it is referred to as default or limp-in. Not all diagnostic trouble codes put the transaxle into default or limp-in mode. Only the codes that indicate a problem that could potentially cause further transaxle internal damage or hazardous operation. If the TCM fails for some reason, the transaxle automatically goes into default.
When the transaxle goes into the default mode, it automatically shifts to second gear when in any forward gear selection and stays there. When the ignition key is turned “off” and then back “on” again, the TCM resets itself to operate normally until it senses the fault and again goes into second gear. No matter what forward gear is selected, the vehicle stays in second gear. Park, Neutral, Reverse, and Second gear are the only gears that the transaxle will operate in when in the limp-in mode. The idea behind limp-in mode is to prevent the customer from being stranded and to provide them the ability to drive in (or limp-in) for service.
As mentioned previously in the “Component Identification” section, the TCM has the job of controlling four solenoids in the solenoid assembly. To do this, the TCM uses its programming and information from several sensors. Some of the sensors are wired directly to the TCM and other sensor signals come from other electronic components across the CCD bus. The CCD bus is simply a communication link between the TCM and other electronic components on the vehicle. The communication link is made through two twisted wires.

TRANSMISSION CONTROL MODULE INPUTS AND SENSORS

The TCM must depend on receiving information in order to control shift quality. Let's take a look at what information it receives and how it uses that information.

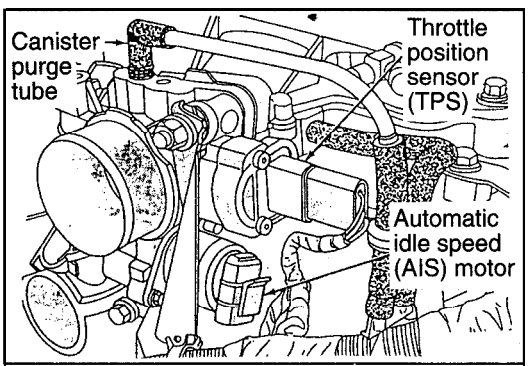
Direct Battery Voltage

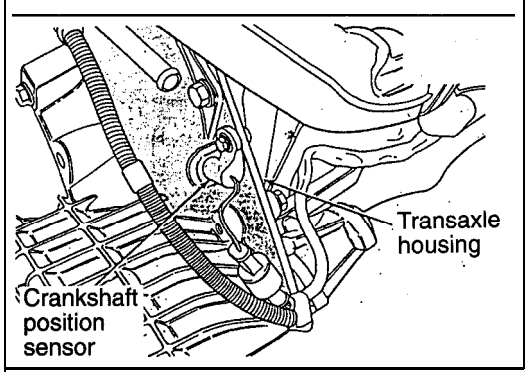
There is constant battery voltage supplied to the TCM, even when the ignition is turned off. This battery supply is responsible for keeping the TCM's memory alive. If the TCM loses battery voltage at any time, it will lose the adaptive memory and have to re-learn the characteristics of the transaxle for optimum shift quality.

Ignition Voltage

When the ignition switch is turned to the OFF (column unlock), the RUN (on), or the Start (crank) positions, the TCM is activated and looks at incoming voltage. If the voltage is above approximately 24 volts or below eight volts, the TCM automatically puts itself in default. Either voltage condition could damage the TCM.

When the TCM is activated, besides checking the incoming voltage level, it performs a self-test to determine if the transmission control relay and the solenoid assembly are performing as they should. If the self-test results are good, the TCM sends battery voltage to the transmission control relay. The relay closes its internal contacts which supply battery voltage to the TCM, the four solenoids and the three pressure switches in the solenoid assembly. Whenever the TCM goes into default, it de-energize the transmission control relay and prevents the solenoids from functioning. The solenoids will then be in de-energized positions, which cause the transaxle to shift into second gear.



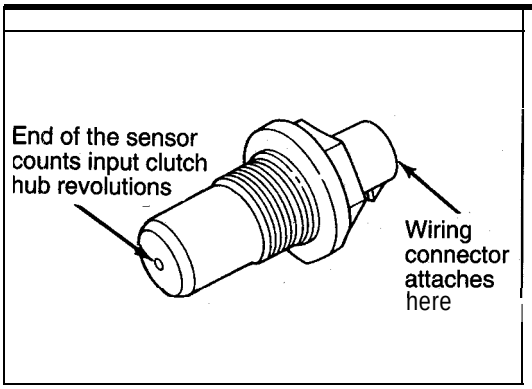


Throttle Position Sensor

The F4AC1 does not use throttle pressure to control shift points like previous transaxles did. Instead, an electronic signal from the Throttle Position Sensor is used by the TCM to help determine shift points and shift quality.

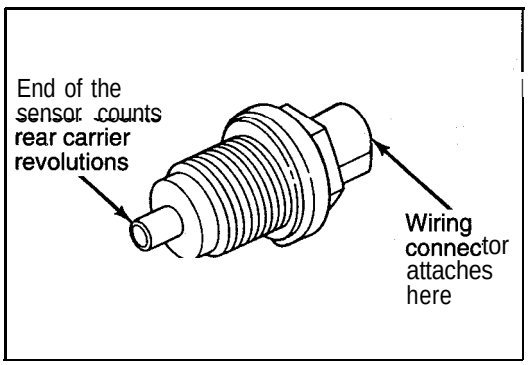
Engine Speed Signal

Engine speed is supplied to the TCM from the engine crankshaft position sensor or distributor, depending on the engine and ignition system used. This signal not only lets the TCM know the engine is running, but also lets the TCM calculate engine speed to control torque converter clutch engagement, determine torque capacity, etc.



Input Speed Sensor

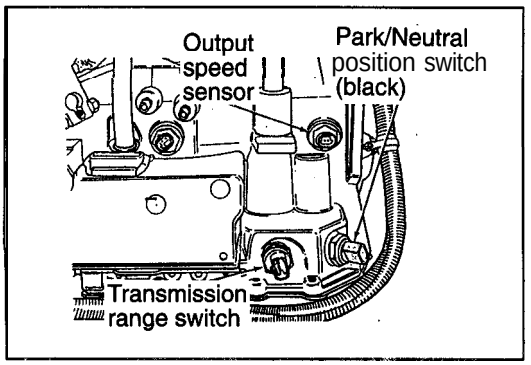
The input speed sensor gives information, to the TCM, on how fast the torque converter turbine is spinning. The sensor is located on the front side of the transaxle case, close to the bell housing. Even though the sensor is called the input speed sensor, the sensor is actually generating a signal from the torque converter turbine through the input clutch hub. The torque converter turbine and input clutch hub are splined together through the input shaft. The information supplied to the TCM from the input sensor is compared to the output shaft signal and the engine speed signal to determine planetary gearset operating ratio, torque converter clutch slippage, torque converter element speed ratio, torque capacity, etc. The rate of input speed change is calculated and used in controlling shifts.



Output Speed Sensor

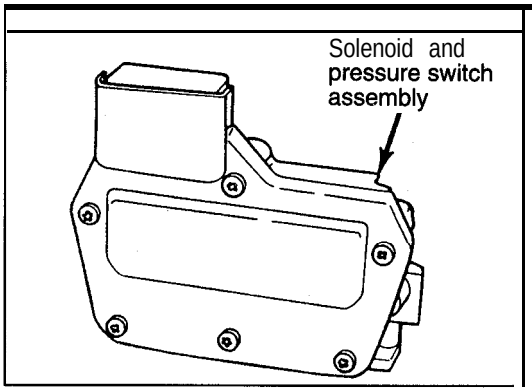
The output speed sensor is located on the same side of the transaxle case as the input speed sensor, but much closer to the end of the transaxle. The output speed sensor generates a signal from the rotation of the rear planetary carrier assembly. When the output speed sensor signal is received by the TCM, the signal is compared to the input speed signal to determmine gear ratio, detect clutch slippage, etc. It is also compared to the throttie signal to determine shift points.

The output speed sensor is also used as the input for calculating vehicle speed to the Powertrain Control Module (PCM). The F4AC1 transaxle does not have a vehicle speed sensor as in other applications. The output speed signal is a direct input to the TCM and is sent across the CCD bus for use by other control modules.



Transmission Range and Park Neutral Position Switches

The transmission range switch is mounted to the case in the valve body area. The input from the switch along with the park neutral position switch tells the TCM what gear range was selected by the driver. The TCM uses this input to determine what gear range and shift pattern to use. The park neutral position switch operates the starter relay and both the park neutral position and transmission range switches operate the back up lamp relay. The park neutral position switch does not allow starter engagement in any positions other than Park "P" or Neutral "N". Both switches must be closed to operate the back-up lamps.

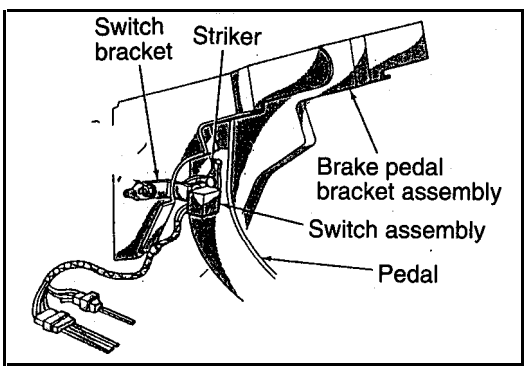


Pressure Switches

The low/reverse, overdrive, and 2-4 pressure switches are all located in the solenoid pack assembly. All three switches send the same type of information to the TCM. These switches tell the TCM if there is hydraulic pressure in their particular circuits. The pressure switches do not tell the TCM how much pressure is in the circuit. They just indicate that pressure exists or does not exist. This information verifies that the solenoids are operating correctly and what gear the transaxle is in. The switches open at approximately 11 psi and close at approximately 23 psi.

Engine Coolant Temperature Sensor

This engine coolant temperature sensor tells the TCM the temperature of the engine. When the engine is cold, the TCM may delay upshifts slightly to improve vehicle driveability. The TCM prevents the torque converter clutch from engaging until the engine warms up to normal operating temperature. If the engine temperature is too high in any forward position, the TCM engages the torque converter clutch in second, third, or fourth gears to help cool the engine and prevent the transaxle from overheating.



Brake Switch

The brake switch signal is used to make sure the torque converter clutch is disengaged when the brakes are applied. It is also used to cancel cruise control so that braking can occur.

Engine Speed

The TCM uses both direct engine speed input from the crankshaft position sensor or distributor and calculated engine speed input from the PCM over the CCD bus. The direct input is required to provide immediate information for use by the TCM control logic. The slower CCD engine speed data is used by the TCM fail-safe logic to confirm that the direct engine speed data is valid.

Speed Control Switch

The speed control on/off switch modifies the shift pattern when a speed control "on" signal is received by allowing a torque converter clutch engagement or disengagement, as well as kickdown shifts.

Manifold Absolute Pressure Sensor (MAP)

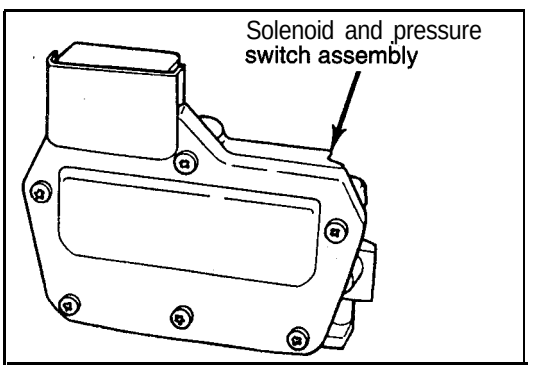
The MAP sensor provides engine load input and output torque load on the input shaft to the TCM. These signals are sent across the CCD bus to the TCM. The TCM uses this information to modify shifting and reduce 3-4 shift hunting on grades.

TRANSMISSION CONTROL MODULE OUTPUT SIGNALS AND DEVICES

The TCM takes the input information from the sensors, evaluates the input, then uses it to control the transmission control relay and the solenoid assembly. The following items are output components operated by the TCM.

Transmission Control Relay

The instant the ignition is turned on, the TCM performs a self-test to determine if its internal electronic circuits are all working properly. If the self-test results are good, the TCM sends battery voltage to the transmission control relay. The relay closes its internal contacts which then supply battery voltage to the TCM (confirms function of the relay), the four solenoids and the three pressure switches in the solenoid assembly. If the TCM "sees" a problem in the system, it turns off the power feed to the transmission control relay, causing the contacts to open. A diagnostic trouble code is then stored in memory. The transmission control relay is located in various places depending on the vehicle model. It can be located directly on the TCM or in the harness near the TCM.



Solenoid Assembly

When the transmission control relay contact points are closed, the solenoid assembly receives electrical power. The TCM can now operate the solenoids, as determined by its programming. The relay provides power to all four solenoids through a single wire. This means that all the solenoids have voltage supplied to them whenever the transmission control relay is closed. The solenoids, however, are not energized until the TCM grounds the solenoid return wire for the solenoid that is needed.

Power and Ground

The ground wire from each solenoid goes back to the TCM. The TCM energlizes each solenoid by connecting the solenoid return wire to ground. Four of the wires in the 8-way solenoid assembly connector are solenoid return wires. Three wires are for each pressure switch, and the last wire is the battery feed wire from the transmission control relay. The TCM controls both the power feed (through the transmission control relay) and the ground to each solenoid (through the return wires).

Vehicle Speed Signal

The vehicle speed signal is sent as a direct input from the TCM to the PCM. This system is called electronic pinion. The output speed sensor signal is sent to the TCM and used as the vehicle speed signal. The F4AC1 does not use a vehicle speed sensor as in past transaxles. The TCM converts the output speed sensor signal to an 8000 pulse-per-mile signal. The signal is then sent directly to the PCM.

Using the transaxle output speed sensor for the vehicle speed signal has resulted in reduced manufacturing process time, cost savings, increased reliability, and increased speedometer accuracy.

Scan Tool (MUT-II) Interface

The TCM and other components have the ability to interface ("talk" to each other) over the CCD bus. The scan tool (MUT-II) connects to a data link connector located in the passenger compartment. This allows communication with the TCM on the CCD bus. Refer to the F4ACI Transaxle Powertrain Diagnostic Procedures manual for the data link connect location.

TRANSMISSION CONTROL MODULE OPERATION

Introduction

What does it do and how does it know? You have probably asked yourself this question more than once as you pondered some transaxle problems. This is really a very complex question. Just stop and think about it for a minute. Think of all the electronic logic features that have to be programmed into this small control module so that it will always know just what clutch to apply and release, at just the right time, under all the different driving conditions that could possibly take place.

A description of the TCM's electronic functions can be simplified if we look at them, one main logic function at a time. We will use this "logic function" approach to describe in simple terms how the TCM makes some of these complex decisions. We will concentrate on the main logic functions and define the primary input and output requirements. By doing this we will be able to use simple block diagrams, charts and graphs to illustrate how some of the decisions are made. We will not cover electronically how the actual logic circuits inside the TCM work. The main logic functions, covered in this lesson, include the Start Routine, Transmission Range and Park Neutral Position Switch Logic, Shift Lever Position Logic, Speed Sensor Logic, Transaxle Temperature, Shift Schedule Logic, Torque Converter EMCC Logic, Shift Selection Logic, Shift Execution Logic, Solenoid Switch Valve Control Logic, Clutch Apply Status (Clutch Volume Tracking), Normal Shutdown Routine, Fail-Safe Routine.

TCM Routine and Logic Functions

Many of the control logic functions discussed in this section rely on output information from a prior logic function as their main input information. This should be kept in mind when you are doing your diagnosis. Most of these logic functions are recalculated and updated on a regular basis and in a specific sequence. This sequence and the time interval that it takes to complete these normal functions is referred to as a program loop. A program loop occurs once every 7 milliseconds (.007 seconds). Some special checks or logic functions may be performed more or less frequently.

Start Routine

The first function the TCM performs, when the ignition key is turned on, is the Start Routine. This routine allows the TCM to check critical inputs and memory circuits before it powers-up the system. If everything is ok up to and including the switched battery tests to the TCM and pressure switches, then the TCM will power-up the transmission control relay and finish the remaining checks as described below.

The Start Routine is performed when the ighition switch is turned to the OFF (column unlock) or RUN positions and again when the ignition switch is returned to the run position after engine cranking.

NOTE

The ignition switch has been redesigned to allow for power up of the TCM, BCM and electronic PRND2L display. This occurs with the key in the column un-lock position, just before the ignition run position.

Any invalid result sets the appropriate diagnostic trouble code, and the system immediately goes into limp-in. The TCM identifies the crank period by the crank signal input provided at pin 8. When the crank signal is present, the TCM is stopped and is re-initialized after cranking to eliminate the possibility of low cranking voltages or spikes confusing the Central Processing Unit (CPU). The CPU is a small microprocessor inside the TCM that contains thousands of transistors and diodes on a chip of silicone small enough to fit on the tip of your finger.

Random Access Memory (RAM)

One of the start routine checks is to verify that the data storage bits in each RAM location are functioning properly. RAM is a form of memory that can be written to and changed, as well as read from. Code 17 is reported with a failure of RAM.

Read Only Memory (ROM)

A ROM check also occurs during the start routine. The check is to verffy that all of the data stored in the ROM is valid. ROM is a permanent memory in the TCM and is used to store the programs needed to run the system. Code 16 is reported with a failure of ROM.

Transmission Control Relay and Driver Circuit Continuity Checks

Prior to power-up, the relay contacts should not be passing current (relay open). Code 14 is reported with a failure of the transmission control relay contacts (stuck closed).

All three pressure switch inputs should be in a power-off condition. Code 20 is reported with a failure of any pressure switch (switch closed, indicating pressure when none exists).

With the above checks all valid, the TCM then closes the relay and verifies that the relay contacts are passing current. Code 15 is reported if this fails (relay contacts never close).

With the transmission control relay contacts closed, the TCM then confirms the driver circuit continuity for each solenoid. Codes 41 through 44 are reported with a failure of any one solenoid.

After completion of the Start Routine, all of the necessary control logic variables are reset prior to activating the main control program. Some of the variables that require resetting are clutch volume tracking values set to zero, initial speed values are calculated, various counters and timers are cleared, and shift logic selection is set to neutral.

For the first few seconds of main program execution following start up, the pressure switch checks are not performed. This allows time for the transaxle oil pump to develop pressure and purge the air from the various hydraulic circuits.

Park/Neutral Position and Transmission Range Switch Logic

This logic function reads the switch positions of the transmission range and park neutral position switches on the manual lever (rooster comb) to determine the driver-selected operating mode.

The primary input for shift lever position to the TCM comes from the transmission range and park neutral position switches. The logic in the TCM for these switches reads the four bit code determined by the switch positions. When closed, each switch provides ground for the particular circuit it is in (TI, T3, T41, T42). The status of these switches is based on shift lever, manual valve and rooster comb positions which determines the logic output code.

The output signal may be any of the following, depending on the logic output code. P= Park, R = Reverse, N = Neutral, D = Drive, 2 = Second, and L = Low. There are also some transition codes that occur between switch positions that are recognized by the TCM. They are T1, T2, and T3. An I code also exists as an invalid code.

These logic output codes are then used by the Shift Lever Position (SLP) logic in the TCM.

NOTE

The scan tool (MUT-II) does not recognize the difference between transition and invalid codes. A "?" on the display screen, of the scan tool (MUT-II), is used to represent these codes when they are present. They can occur between shift lever positions. F4AC1 Transaxle Electronics

SLP	T42	T41	T01	T03
P	CL	CL	OP	OP
R	OP	OP	CL	CL
N	OP	CL	CL	OP
D	OP	OP	OP	CL
2	OP	OP	CL	OP
L	CL	OP	OP	OP
T1	OP	CL	OP	OP
T2	OP	OP	OP	OP

Shift Lever Position (SLP) Logic

The primary function of SLP logic is to provide safe, continuous, but limited operation of the transaxle with the presence of an invalid or transition input code. The SLP logic function screens the input codes from the switches and provides an SLP output signal to control actual gear selection.

Inputs include the codes indicated by the transmission range and park neutral position switches, current shift lever position, pressure switch indications, and speed ratio data from the input and output speed sensors.

Shift Lever Position output becomes the "PRND2L" input to most of the other functions.

The R, P, N, T1 and "D" PRND2L codes are always accepted by the SLP logic as being valid and are always converted directly to R, N or "D" SLP codes. This is done because these codes can only occur when the corresponding Reverse, Neutral or Drive manual valve porting is established. This improves the response time necessary for garage shifts (Reverse – Neutral – "D").

SLP output with 2, L, T2 and T1 codes is based on the current SLP position as well as current pressure switch and speed ratio data. The pressure switch and speed ratio data are monitored to identify which hydraulic mode of operation exists (reverse, neutral or drive) so that the appropriate selection is made for Shift Lever Position.

NOTE

To help clarify the SLP table, keep in mind that SLP logic only uses N because transmission control module logic is identical in Park and Neutral (same hydraulic porting).

NOTE

An incorrect input (for example, a defective switch) of one of these positions could, with sufficient time, result in either a pressure switch or speed check fault, when in fact the real cause is a transmission range or park neutral position switch error. This type of fault can occur, for example, when the manual valve porting is in reverse but the code is indicating "D". In this case, the low/reverse pressure switch data and input speed data will not agree with the expected results for Shift Lever Position = "D".

NOTE

It is extremely important that accurate shift lever position data be available to the TCM. The accuracy of any diagnostic trouble code found in memory is doubtful unless the Shift Lever Test, performed on the scan tool (MUT-II), passes without fail.

On some vehicles it may be possible to cause pressure switch or speed check diagnostic trouble codes by holding the shift lever mid-way between "D" and Neutral.

Speed Sensor Logic

Speed and acceleration calculations provide critical input information to the logic functions within the TCM. Speed sensor logic determines gear selection, shift timing and shift quality. This information is used as input to the shift schedule, shift logic selection and shift logic execution functions, programmed into the TCM.

There are four important input values that must be calculated; engine speed, input speed, input acceleration, and output speed.

The TCM receives a direct engine speed signal from the crankshaft position sensor or distributor depending on the vehicle and engine used. Engine speed is calculated and updated with each sensor pulse. The TCM also receives an engine speed signal from the PCM over the CCD bus. Immediate direct input of engine speed is needed for proper transaxle operation. It cannot be provided by the engine speed signal from the PCM over the bus. However, both "engine run" signals allow the TCM to distinguish between a failure of the crankshaft position sensor or distributor pulse input through the circuits versus an actual engine stall or key on engine off condition.

Input speed data from the input speed sensor is calculated by the TCM. The data is based on the number of teeth and time between each tooth since the last main program loop. Input acceleration is calculated from the change in torque converter input speed over time.

Output shaft speed data from the output speed sensor is calculated based on the number of teeth and the time between each tooth since the last main program loop.

Speed information is also used to verify that steady state in-gear operation is normal. Output shaft speed times current gear ratio is continually checked against input speed in order to identify the occurrence of an input or output speed sensor failure or a clutch that is slipping.

Transaxle Temperature

The transaxle temperature operating range is based on a predicted fluid temperature which is calculated from a combination of inputs. The predicted fluid temperature is continually updated and retained in memory for 20 minutes after the ignition switch is turned off. When the vehicle is started after an extended off time, the predicted fluid temperature is reinitialized at a value equal to the battery temperature signal received from the PCM over the CCD bus. The temperature input signal must then be calculated and then increased primarily based on transaxle run time in gear. Time calculation excludes operation in park and neutral.

A detailed explanation of how transaxle temperature range affects transaxle operating characteristics is covered in the shift schedule and EMCC sections. The primary temperature inputs to the TCM are battery temperature, engine coolant temperature and in-gear run time since start-up.

Transaxle Temperature Output Modes

Output modes used by the TCM are extreme cold, supercold, cold, warm or hot. The extreme cold range is set when the initial predicted fluid temperature is less than – 15 degrees F. It will clear two minutes after a cold start. The supercold range is set when the predicted fluid temperature is less than 0 degrees F. It will clear when the predicted fluid temperature exceeds 10 degrees F. The supercold range allows for near normal transaxle operation under sub-zero conditions. The cold, warm, and hot ranges provide different operating features as warm-up occurs. The transaxle temperature range is “cold” at less than 36 degrees F, “warm” above 40 degrees F and “hot” above 80 degrees F.

Shift Schedule Logic

Shift schedule logic, programmed into the TCM, selects the appropriate shift schedules for the current operating conditions. This is to determine the “desired” gear range the transaxle must be operated in. The desired gear range is a primary input to the shift logic selection function. The TCM then activates the appropriate shift logic schedule to achieve the desired gear. The actual shift points within each shift schedule have been pre-determined for best transaxle operation and are stored in the TCM's ROM memory.

The primary inputs to the TCM are the transmission range and park neutral position switches (shift lever position), throttle position, and output speed. Some other secondary inputs include, but are not limited to, calculated transaxle temperature and current shift logic.

Shift schedule output codes simply provide the TCM with the desired operating gear range signal. Shift schedule logic output is updated every 7 milliseconds and is a primary input to the Shift Logic Selection function programmed into the TCM.

Inhibits and Shift Action Summary

For neutral (N) and reverse (R) there are no logic inhibits placed on SLP changes into or out of either neutral or reverse. These gear ranges are shift lever controlled modes of operation. Neutral and reverse must be immediately provided for. Also, a reverse block function is used at speeds over approximately 10 – 15 mph by continuously venting the Low/Reverse (L/R) clutch. The L/R clutch is also vented at speeds over 8 mph in neutral.

For drive (D), Second (2) or low (L), when speed ratio or pressure switch errors occur during transaxle use, the TCM will maintain the current gear range to prevent potentially hazardous gear selection.

A separate set of shift schedules exist for each engine/transaxle application. The TCM knows which set of shift schedules to use by looking at the PCM identiftcation over the CCD bus. The engine and body identifications are retained in the TCM's memory to ensure that the correct schedule is used if the CCD bus fails.

There are four different shift schedules within each engine set. They are selected primarily by the Shift Lever Position input code and the transaxle operating temperature range that is calculated. Separate shift schedules exist for the following; Shift Lever Position = D, Shift Lever Position = D (supercold temperature range), and Shift Lever Position = L. A typical set of shift schedules have been plotted out in graph form. These have been modified for clarity. The shift schedules primarily use throttle angle and output shaft speed as the determining factors. The main difference between these schedules are as follows:

SLP = "D" Cold, Warm or Hot

The "D" schedule provides first, second, third and fourth gears. This shift schedule is selected when SLP = "D" and the transaxle calculated temperature range is cold, warm or hot. It should be noted that the "D" schedule will delay the 3-4 upshift, and will cause earlier 4-3 downshifts when the transaxle temperature range is cold. Throttle input is also limited to prevent high engine speeds with a cold engine.

SLP = "D" (Supercold and Extreme Temperature Range)

The supercold "D" schedule is a revised D schedule. It is selected whenever the initial calculated transaxle temperature is less than 0 degrees F. This revised schedule prevents closely spaced shifts and part throttle kickdowns. This results in delayed (higher speed) upshifts, earlier closed throttle downshifts, and in most cases the inability to obtain either 4-2 or 3-1 kickdowns. The primary reason is to allow more time for clutch pressures to achieve their normal in-gear condition after a shift. This should happen before the next shift occurs to avoid clutch overlap (two clutches applied at the same time).

If the calculated transaxle temperature at start-up is in the extreme cold range of – 15 degrees F. or less, all the solenoids will be held off. Also, the pressure switch and speed sensor checks will be disabled. This action provides the same mode of operation as with limp-in or default (second gear operation only, in any forward gear range selection). This is done to prevent clutch damage and inadvertent shutdowns by delaying all TCM operation until supercold conditions can be met.

SLP = L

The L schedule also has 1-2 and 2-3 shifts but they are much more delayed. The determining factor for this schedule is that engine speed is monitored and shifts occur at peak engine RPM. Even though the driver has selected the low position, the shift schedule is designed to upshift the transaxle at upper level engine RPM to protect the engine from over-speed. Downshifts also occur at higher vehicle speeds. This is done to provide the highest gear ratio for maximum engine braking when descending steep grades.

Adaptive Coast Down Scheduling

Adaptive scheduling may result in delayed 4-3 or 3-2 downshifts under certain conditions in order to maintain good shift quality.

Speed Control

When the transmission temperature range is either warm or hot, the 4-3 shift pattern is modified to kickdown earlier if a cruise control "on" signal is received over the CCD bus from the PCM. If the bus should fail, this logic will not be initiated with speed control "on", and the vehicle may lose more speed and not kick down on grades.

Manifold Absolute Pressure (MAP)

This signal is used to calculate changes in engine output torque to the input shaft of the transaxle. This information is used by the TCM to improve shift quality and reduce 3-4 shift hunting on steeper road grades. A loss of this signal will cancel grade hunting detection logic.

Throttle Failure

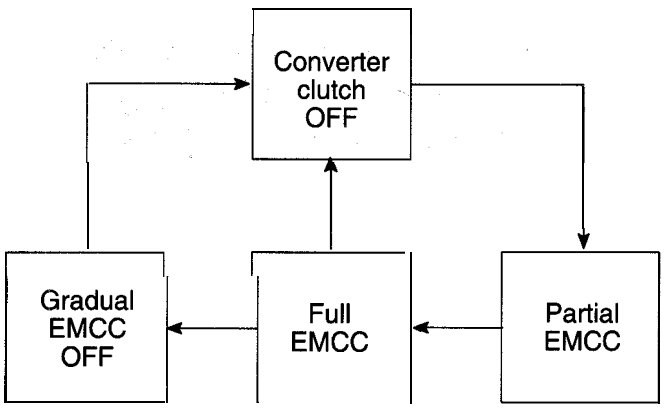
A throttle default value of 25 degrees throttle opening is substituted to provide reasonable driveability. Third gear is substituted for fourth to provide a tolerable performance level. Throttle induced kickdowns will become unavailable, but selection of drive and low shift lever operation remains normal.

CCD Bus Failure

The initial predicted fluid temperature is based on the battery temperature after an extended time off. It is important to understand that if this data becomes invalid (out of normal range or the CCD bus fails), the TCM will substitute -3 degrees F. for ambient temperature. This is done because the control logic for the colder temperature range is designed to tolerate an actual warmer transaxle. Some of the effects of this are as follows; Defaults are possible if the actual transaxle temperature is within the extreme cold range. The 3-4 shift will occur at a higher speed for approximately the first minute of operation in-gear (see supercold "OD" shift schedule). A reduction in upshift shift quality is possible for approximately 4 minutes if the actual transaxle temperature is in the warm to hot range.

Loss of Prime Protection

Special logic is included in the fail safe routines to identify a loss of oil pump prime. A no pressure condition is usually due to a low fluid level and typically occurs following hard braking or cornering. This will cause the oil filter to be exposed to air. The result will be a loss of oil pump prime and possibly a no drive condition. The special logic prevents the inappropriate setting of diagnostic trouble code.



Torque Converter EMCC Logic

The use of partial Electronically Modulated Converter Clutch (EMCC) is available at speeds as low as 17 mph, giving the advantage of improved fuel economy while buffering the rest of the power-train from engine firing pulses. Full EMCC is utilized under certain conditions to improve gas mileage. Both full EMCC or partial EMCC may also be scheduled to help reduce heat build-up of the transaxle or its fluid under certain driving conditions.

Torque converter full EMCC and partial EMCC availability depends on many different input conditions. These include shift lever position (D, 2, L), current gear range (second, third, or fourth), engine coolant temperature, input speed, and throttle angle.

The outputs controlling the torque converter are; No EMCC, Partial EMCC, Full EMCC and Gradual to No EMCC. The boxes in the chart represent the four EMCC logic states.

Types of EMCC Logic

No EMCC Logic -This is when the torque converter clutch is off.

Partial EMCC Logic – This logic will modulate the LR/CC solenoid (duty-cycle) to obtain partial torque converter clutch application. Partial EMCC operation is maintained until full EMCC logic is called for and actuated.

Full EMCC Logic – This increases the LR/CC solenoid duty-cycle to full "on", after partial EMCC control brings the engine speed to within the desired slip range of transaxle input speed relative to engine rpm (crankshaft speed).

Gradual to No EMCC from Full or Partial Logic – This logic is designed to soften the change from Full or Partial EMCC to No EMCC, at mid-throttle, by gradually decreasing the LR/CC solenoid duty-cycle.

EMCC Fail-safe

A malfunction of the EMCC system is detected from a lengthy partial EMCC operation near the maximum allowable duty-cycle, except at heavy throttle. If a diagnostic trouble code is reported, the TCM will not operate the torque converter clutch. It will remain unapplied until the next restart. Diagnostic trouble code 38 will be stored in memory.

EMCC Break-in Procedure

With the vehicles odometer reading from 0 to 500 miles, there will be no torque converter EMCC. From 500 to 1500 miles, the TCM will gradually decrease EMCC from a 200 rpm slip to a 60 rpm slip. When vehicle mileage is above the EMCC break-in period and a malfunction occurs with the torque converter, the new replacement torque converter must go through the same EMCC break-in procedure. The TCM must be re-programmed to allow for (restart) the break-in period. To do this, use the scan tool (MUT-II).

EMCC Inhibits

The TCM is provided with EMCC inhibits to prevent EMCC from occurring under specific conditions. The following are times when EMCC will not occur.

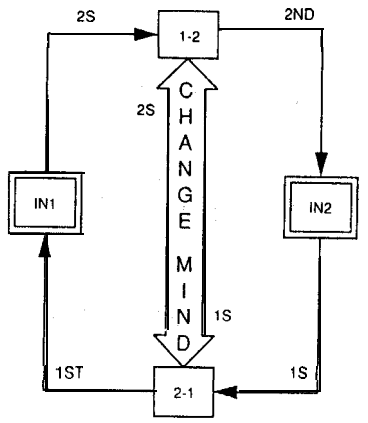
Transaxle Temperature – When the transaxle temperature range is cold or supercold, EMCC is inhibited (kept from occurring). In the event of a CCD Bus failure, -3 degrees F. is substituted for the initial temperature. This initial value is incremented up to normal engine operating temperature based on engine running time. This will result in delayed EMCC operation under start-up conditions.

Brake Signal (on) – This will cancel and prevent EMCC as long as a brake signal is "on". If a bus failure occurs, the "brake on" signal is not received, and EMCC is still possible.

Throttle Position Sensor – Any throttle value less than 2 or 3 degrees (closed throttle) will cancel EMCC. If a throttle position sensor failure is identified by the TCM, EMCC will not occur.

Solenoid Switch Valve – If a solenoid switch valve (SSV) malfunction is detected, EMCC will not occur. A SSV diagnostic trouble code will only be stored if the transaxle operating temperature range is hot, and the malfunction occurs at least three times. The fault counter is reset during the start routine.

EMCC Fault – Any reported EMCC diagnostic trouble code will prevent any type of EMCC from occurring.



= In-gear logic

= Shift logic

1 S, 2S = Shift schedule output

1 ST, 2ND = Speed ratio shift complete signal

Shift Logic Selection

The purpose of the Shift Logic Selection program is to activate the appropriate "shift logic" so that the "in-gear logic" condition matches the gear called for by the shift schedule (driver selected gear, throttle position).

Imagine that the TCM must always be in one of the logic boxes at any given time. The double line boxes represent the "in-gear logic" the TCM uses to maintain a certain gear range. The single line boxes represent the "shift logic" required by the TCM to execute a desired gear change from one gear to another. The paths (lines with arrows) between the blocks are labeled with one or more of the shift schedule output signals (Is, 2s). These desired gear signals (shift schedule output signals) become the primary input which will cause the correct path to be taken, from one in-gear box (such as inl) to a shift logic box (such as I-2).

The output is a change to "shift logic" in order to obtain an in-gear conditon that matches the output of the shift schedule routine. The TCM knows whether the desired shift has been completed when a correct speed ratio check of the input and output speed sensors is present. The speed ratio check is used to verify that the desired gear has been achieved. For example, when the correct speed ratio signal for second gear has been verilied by the TCM by checking the speed ratio between the input and output speed sensors, it will switch to the appropriate in-gear logic (in2).

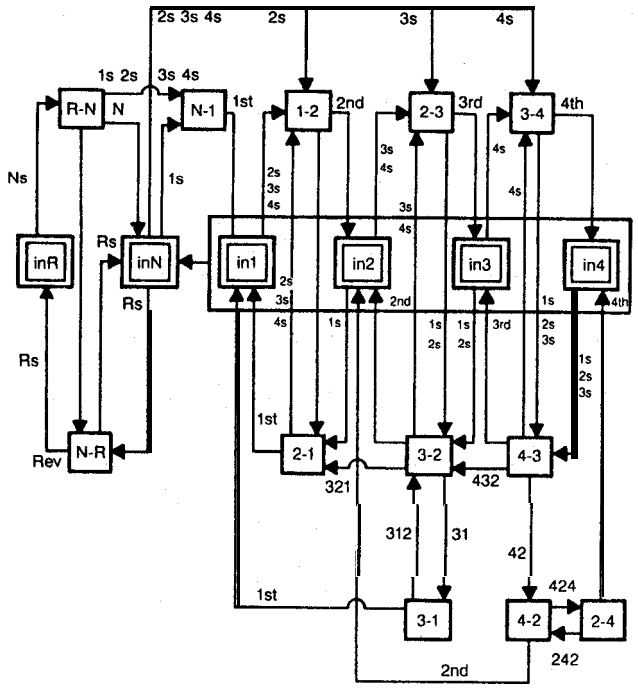
Changes to "In Gear" or "Shift" Logic

If the transaxle is in first gear logic (inl) and the shift schedule output changes to call for second gear (2s), then "1-2" logic will be activated. This generally remains in effect until the completion of the shift is determined by the speed ratio check. When the speed ratio check confirms that the degired gear (second) has been obtained, "in2" logic is activated. There are other possible exits or changes that may be made to the normal shift schedule logic from the "1-2" shift logic example, such as a change-mind condition.

A "change-mind" shift condition may occur when a shift that has begun directly from within another shift, instead of from an in-gear condition. A "change mind" condition occurs if a change in the throttle position signal causes the normal shift schedule routine to select a different desired gear signal, such as is, during a 1-2 shift change. These shifts are accommodated by direct paths between upshift and downshift logic within the logic selection routine. "Change mind" shifts are needed to provide the proper response to changes in driver demand. Changes in the manual lever (selector lever) position may also cause a "change-mind" shift depending on when the lever position changes. A more detailed shift logic chart is illustrated.

Shift Logic Chart

Another exit or change to the normal shift schedule logic is the fail shift timer may expire. The TCM will only allow a certain amount of time to elapse for the shift logic to complete a shift. If a speed ratio check does not confirm the completion of an attempted shift within this time limit, the shift logic is aborted, and the desired in gear logic is activated.



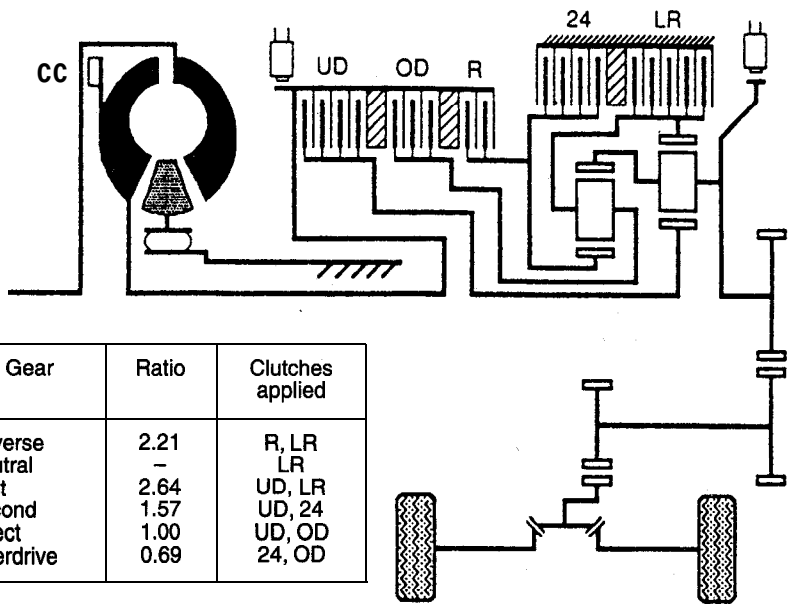
= In-gear logic
= Shift logic

1 S, 2S, 3S, 4S, RS = Shift schedule output
lst, 2nd 3rd, 4th, Rev. = Speed ratio shift complete signal

i d

Shift Execution Logic

As with most automatic transmissions, including the F4AC1 gearset, two clutches must be applied to provide an operating gear range. One of the applied clutches must be an input clutch driven by the torque converter, such as the Reverse, the Underdrive, or the Overdrive clutches. The other applied clutch is usually a reaction or holding device, such as the 2-4 or L/R clutches. For all gear ratios this is the rule, except Direct Drive (3) where output is achieved by applying two input clutches. All shifts leave one clutch continuously engaged and involve changing another clutch from the releasing clutch to a different applying clutch.



Gear	Ratio	Clutches applied
Reverse	2.21	R, LR
Neutral	–	LR
First	2.64	UD, LR
Second	1.57	UD, 24
Direct	1.00	UD, OD
Overdrive	0.69	24, OD

Solenoid Driver Logic

Electronic solenoid valves connect the clutches to either a hydraulic source or a vent. Solenoid coils, when energized, exert force on a push rod which in turn opens or closes a ball valve and/or vent. To increase efficiency, the current through the solenoid coil is pulse-width modulated. The microcomputer within the TCM is responsible for providing this modulation (pulsing) signal as well as an initial pull-in current pulse each time a solenoid is energized.

Pulsing the Solenoids

The Full ON pulse time is normally around 8 milliseconds and provides rapid pull-in response time. Pull-in response time is dependent upon battery voltage. The pull-in response time will increase with reduced battery voltage to maintain pull in power.

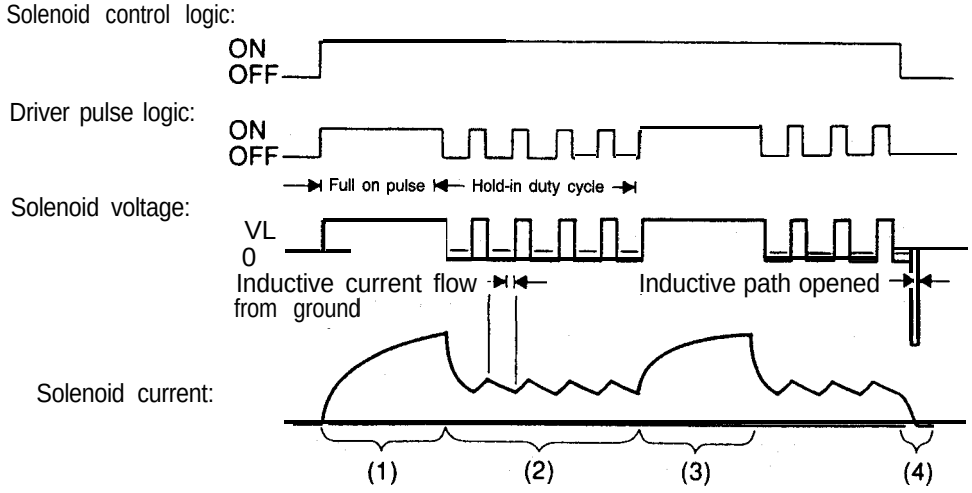
To protect against inadvertent drop-out of an energized solenoid, each ON solenoid is issued a refresher pulse every 50 milliseconds. The refresher pulse is used to prevent hydraulic pressure from overcoming the solenoids strength. The frequency is increased during shifts and as certain faults start to occur.

The hold-in duty cycle is also dependent on battery voltage as well as the in-gear condition. The percentage of solenoid on-time is normally 38%. In third or fourth gear, the typical percentage is 30%. This is because less power is required to overcome the reduced hydraulic line pressure in third and fourth gear ranges.

Current efficiency is maximized by the use of the inductive energy of the solenoid during the OFF portion of the cycle.

The turn OFF command opens the circuit to provide for rapid drop-out response time. The circuit is monitored to permit checking the continuity of the solenoid and its power return line.

SOLENOID DRIVER LOGIC



(1) provides rapid ON pull-in response time
(2) reduces power level
(3) refresh pulse – a periodic reissue of the FULL ON pulse to any energized solenloid
(4) provides for rapid OFF drop-out response time; inductive OFF voltage spike monitored to confirm circuit continuity

Solenoid		Clutch
OD	ON	ON
LR/CC	ON	ON
UD	OFF	ON
24/LR	OFF	ON

Solenoid and Element Logic

Since both normally-ON and normally-OFF solenoids are used, the following logic is recognized by the TCM.

The LWCC solenoid controls the LR clutch in first gear, Neutral, and Park and controls the Converter clutch (CC) in second, third, and fourth gears. The solenoid switch valve position determines which clutch (LR or CC) the solenoid will control.

The 2-4/LR solenoid controls the 2-4 clutch in Overdrive, Drive and Low. The 2-4/LR solenoid controls the LR clutch in Reverse. In this case, the manual valve position determines which clutch is being controlled.

Gear	Solenoids				Manual valve
	s2	s3	S1	s4	
	OD	LR/CC	UD	24/LR	
Park/Neutral (Under 8 MPH)		LR		◯	
Neutral (Over 8 MPH)				◯	
Reverse				LR	R
Reverse (Over 8 MPH)				◯	R
First		LR	UD	◯	
Second			UD	24	
Second EMCC		CC	UD	24	
Third	OD		UD	◯	
Third EMCC	OD	CC	UD	◯	
Fourth	OD		◯	24	
Fourth EMCC	OD	CC	◯	24	

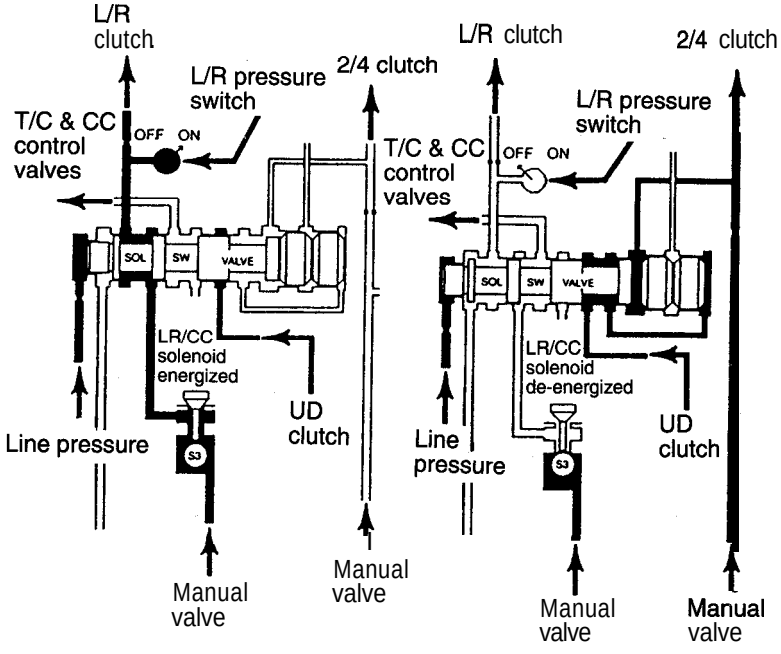
Solenoid energized = ◯

Clutch applied = OD, LR, CC, UD, 2-4, R

Solenoid Switch Valve Control Logic

This valve protects against the inadvertent application of LR clutch in second, third, or fourth gear ranges. When shifting to first gear, the Solenoid Switch Valve (SSV) must be in the downshifted position or action must be taken to shift the SSV into the downshifted position. As long as any of three pressures (2-4, OD, or UD) are greater than X% of line pressure (X = 60% for UD and OD, 70% for 2-4), the SSV will remain upshifted. To confirm that the SSV has downshifted, both the LR solenoid and LR pressure switch must be high (voltage value seen by TCM). To downshift the valve for 3-1 or 2-1 shifts, shift logic will briefly vent the UD clutch (shift logic must vent the other two clutches also) and test for valve motion by eneraizing the LR/CC solenoid and verifying that the LR pressure switch turns on.

A SSV diagnostic trouble code will only be stored if the transaxle operating temperature range is hot, and the malfunction occurs at least three times. The fault counter is reset during the start routine. Under certain conditions, such as very cold fluid temperatures, it is possible that the SSV valve may not move as quickly as it normally would at operating temperature. This slow response may occasionally result in a second gear launch or a change mind shift to second gear from a 2-l or 3-1 shift. No diagnostic trouble code will be set if the transaxle operating temperature range is cold.



Clutch Apply Status

To execute the shift logic, the TCM must maintain a continuous record of each clutch element apply status. This is done by tracking the instantaneous fluid volumes in each clutch circuit. Instantaneous fluid volumes are tracked using predetermined flow rates and learned "clutch fill volumes". This is particularly useful for closely-spaced shifts or change-mind shifts.

Learned clutch fill volumes represent the volume of fluid that is required to stroke a clutch piston to the point where zero clutch pack clearance is obtained. The clutch fill volume learn value is the **fill volume** without stroking the accumulator or picking up any torque load on the clutch. This learned fill volume is updated for each clutch element as it wears and clutch pack clearance increases.

The Clutch Volume Index (CVI) display of the scan tool (MUT-II) can be used to view learned clutch fill volumes for each clutch. The normal range for clutch fill volumes are LR = 35 to 85, OD = 75 to 150, 2-4 = 20 to 77, and UD = 24 to 70.

If the battery feed is disconnected from the TCM, the learned clutch fill volumes will be lost, and initial values will be substituted until correct values can be re-learned. Shifting may be somewhat harsh. The initial values are; LR = 64, OD = 89, 2-4 = 48, and UD = 45.

A transmission which has experienced a sudden clutch failure may not be capable of learning the correct values. A road test of a transaxle with this condition may exhibit an upshift runaway condition, but have acceptable clutch fill volumes.

Normal Shutdown Routine

When the ignition switch is turned off (column lock, key out position), the TCM will go through a specific shutdown routine.

For the first twenty minutes after ignition off, the CPU remains in the "awake" mode. In tills off-time tracking mode, the TCM continues to perform certain functions such as predicting fluid temperature calculations.

Longer off-time tracking is currently prohibited due to battery drain concerns since the CPU remains powered up during this time.

After 20 minutes have elapsed, the CPU will switch into a Sleep mode. In this mode the TCM does not perform any functions and its Keep Alive Memory uses only a very small amount of current.

The TCM uses a "Keep Alive Memory" that must always remain connected to the battery voltage supply. If the TCM is disconnected, the "Keep Alive Memory" will be lost. This memory is where diagnostic trouble codes and other learned values are stored. These values may be clutch apply and release rates and clutch fill volumes. If the TCM is disconnected from its direct battery voltage supply, initial stored values are substituted for the erased learned values when the CPU is re-initialized. These values will then be updated as new values are learned when operating the transaxle.

A code 12 will also be stored on any initialization following a direct battery feed disconnection. Code 12 lets you know that a direct battery disconnection has occurred.

Fail-Safe Routine

The TCM is designed and programmed with what is called a fail-safe routine. This routine constantly monitors and checks all input and control features for normal operation. The TCM uses inputs from the PCM, transmission range and park neutral switches, input and output speed signals, throttle position, ignition and pressure switches to determine the desired outputs. The primary outputs are to the four solenoid valves which control the transaxle clutches. Changes in these solenoid outputs can result in changes in clutch pressures, pressure switch states and input speeds. These changes become the new input. If they are not as desired, then the solenoid output is adjusted accordingly. This feed-back control is referred to as a closed loop system and is an integral part of fail-safe.

NOTE

The purpose of this section is to cover fail-safe logic. Refer to the Fault Code Explanation section for diagnostic information and probable causes.

When a failure has been identified which prevents continued safe transaxle operation, the TCM eventually goes into limp-in by turning off all of the solenoids. This provides for shift lever controlled operation of SECOND GEAR, NEUTRAL, REVERSE, and PARK. The TCM has logic to ensure the limp-in results in an ORDERLY SHUTDOWN. Certain failures will prevent an orderly shutdown, and an IMMEDIATE SHUTDOWN will occur.

Orderly Shutdown -A Shutdown routine is activated with certain failures prior to opening the transmission control relay. The result of an orderly shutdown is dependent on the operating condition at the time of the failure. If the transaxle is in Park, Reverse, Neutral, or Second Gear, there is no additional action needed by the TCM. The transmission control relay is opened immediately because the power off state of the transaxle has already been achieved.

If the transaxle is in first gear, then the shutdown sequence (default to second gear) begins immediately.

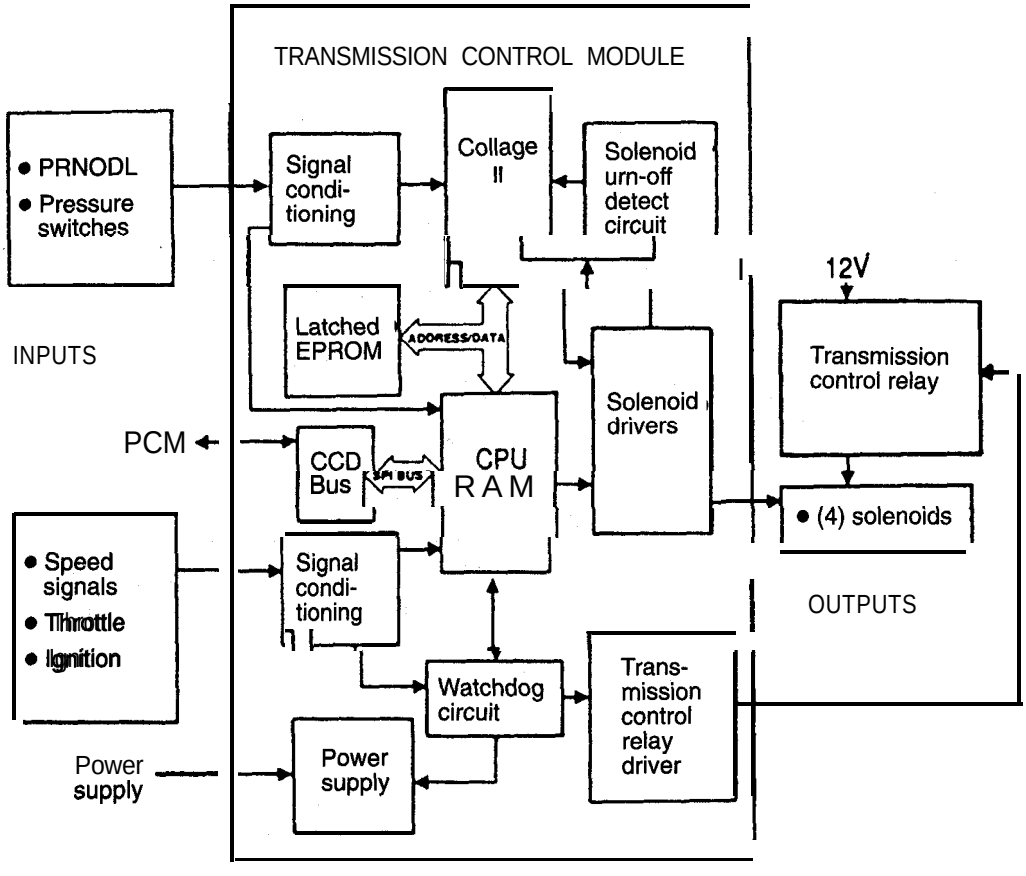
If the transaxle is in third or fourth Gear above 45 mph, then the current gear range is maintained to prevent the possibility of causing high engine rpm and/or **engine braking.**

The actual shutdown sequence to second Gear begins once the vehicle speed drops below 45 mph. The exception to this rule is when the vehicle is at high speed and develops a solenoid circuit error. If this occurs, a temporary "neutral" state is generated by venting all clutches to avoid incorrect clutch combinations – see Codes 41 to 44.

The shutdown sequence reduces the possibility of having engine flare-up or clutch overlap (three clutches applied) as the transaxle defaults to second gear. This is accomplished by releasing the non second gear clutches slightly before the transmission control relay is opened. This will occur when the throttle angle is less than approximately 1/3 full open. At greater throttle angles, the transmission control relay is immediately opened. This is done because second gear clutches typically apply faster than the non second gear clutches. Again, the purpose for this sequence of events is to prevent more than the correct number of clutches from being applied at the same time during moderate throttle angles and to prevent engine flare at higher throttle openings.

Immediate Shutdown -To cause an immediate shutdown to occur, all solenoids are turned off at the same time. To cause an immediate shutdown the transmission control relay is opened at the time of the failure. Default to second gear will take place from first, third, or fourth gear. The immediate shutdown may result in clutch overlap at low to moderate throttle angles and a temporary engine flare with heavier throttle angles. An engine braking condition may also result at high vehicle speeds.

At the end of either shutdown routine, the failure condition will be recorded in memory. The use of the scan tool (MUT-II) is required to determine what the diagnostic trouble code was at the time of the failure.



DIAGNOSTIC FUNCTION CHART

Diagnostic trouble code No.	Item	
11	Internal control module (watchdog circuit test failure)	
12	Battery power was disconnected since last power down	
13	Internal control module (watchdog circuit shutdown)	
14	Relay always On (relay contacts are welded closed)	
15	Relay always Off (relay contacts are stuck open)	
16	Internal control module (ROM checksum failure)	
17	Internal control module (RAM checksum failure)	
18	Engine speed sensor circuit	
19	CCD bus communication with SBEC	
20	Switched battery	
21	Pressure switch circuit	OD
22		2-4
23		2-4/OD
24		LR
25		LR/OD
26		LR/2-4
27		All
28	Check shifter signal	
29	Throttle position signal	
31	Hydraulic pressure switch	OD
32		2-4
33		OD/2-4
35	Check ATF level	
36	Fault immediately after a shift	
37	Solenoid switch valve latched in the LU position	
38	Lockup control out of range	
41	Solenoid circuit error	LR
42		2-4
43		OD
44		UD
45	Internal control module (engine model EEPROM cell failure)	

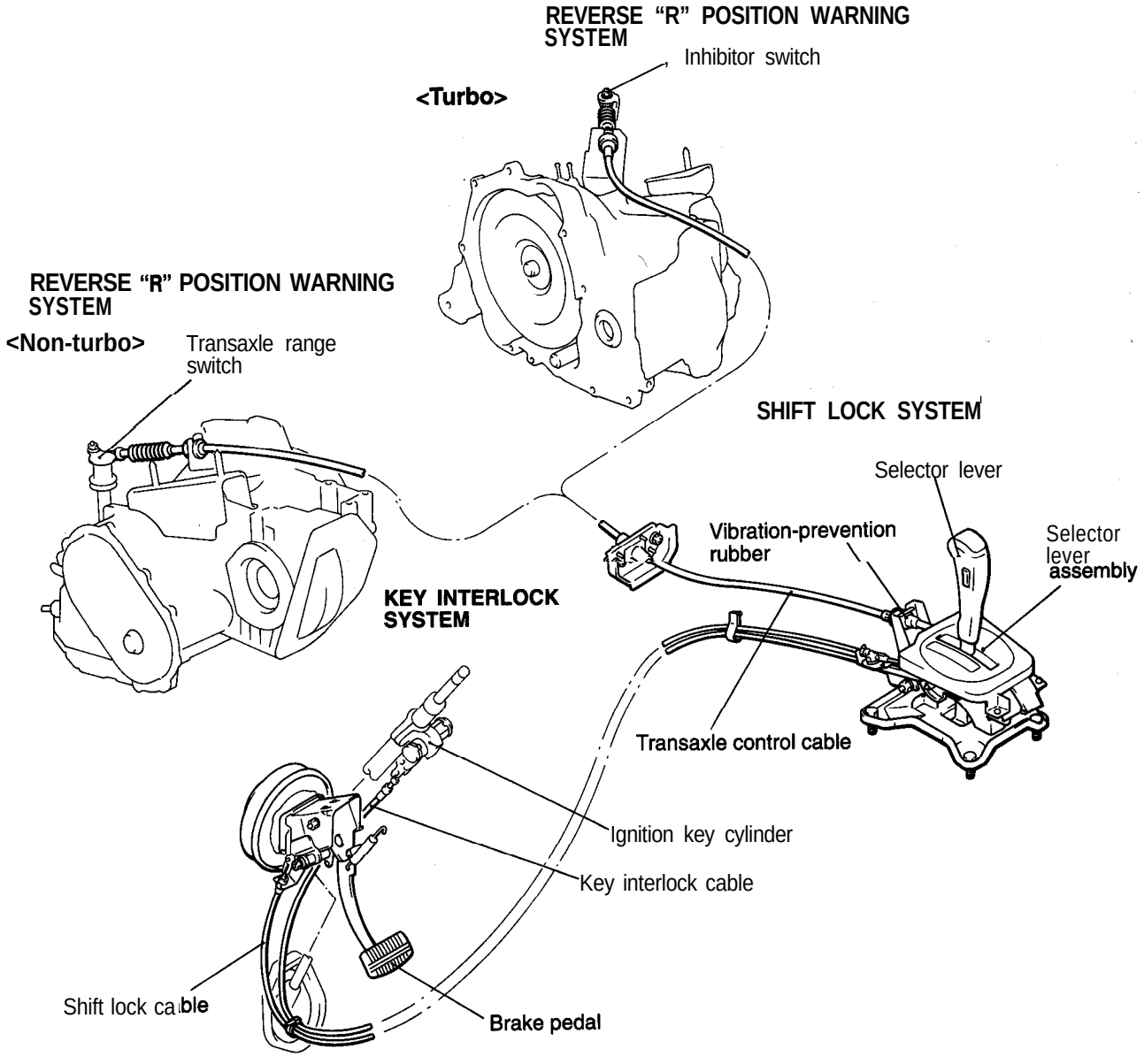
Diagnostic trouble code No.	Item	
46	UD hydraulic circuit failure	
47	Solenoid switch valve latched in the LR position	
50	Speeds error	Gear ratio in Reverse
51		Gear ratio in 1st
52		Gear ratio in 2nd
53		Gear ratio in 3rd
54		Gear ratio in 4th
56		Input speed sensor
57		Output speed sensor
58		Speed sensor's ground
60	Inadequate element volume	LR
61		2-4
62		OD

TRANSAXLE CONTROL

N72ZDIbA

- To prevent abrupt starting made through mistakes in selector lever operation, automatic transaxle fail-safe mechanism (key interlock system, shift lock system and reverse "R" position warning system) has been adopted.
- Vibration-prevention rubber has been installed to the transaxle control cable support area on the transaxle side as well as to that on the selector lever side so as to decrease transmission of vibration to the vehicle body.

NOTE
For the reverse "R" position warning system, refer to GROUP 7 – ETACS.

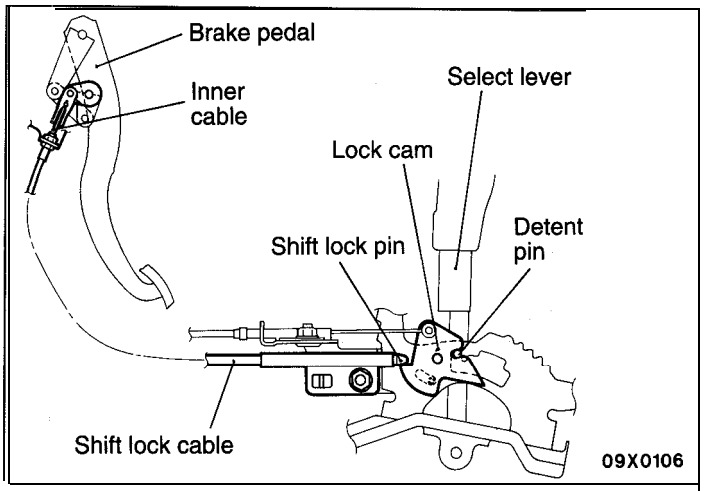


09x0115

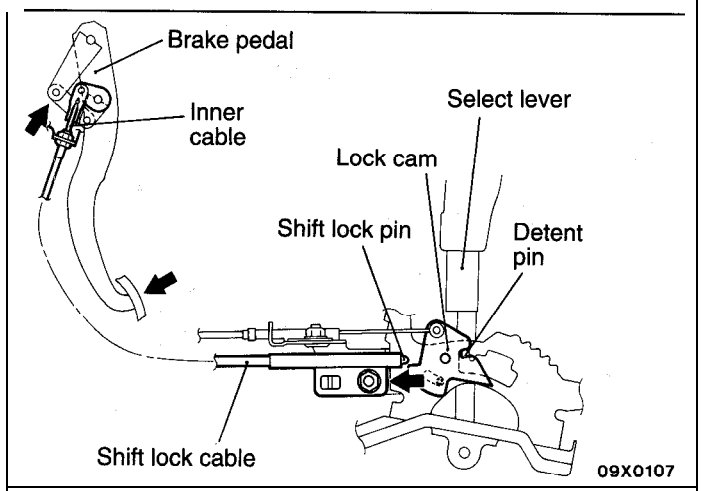
A/T FAULTY OPERATION PREVENTION MECHANISM

Shift Lock System

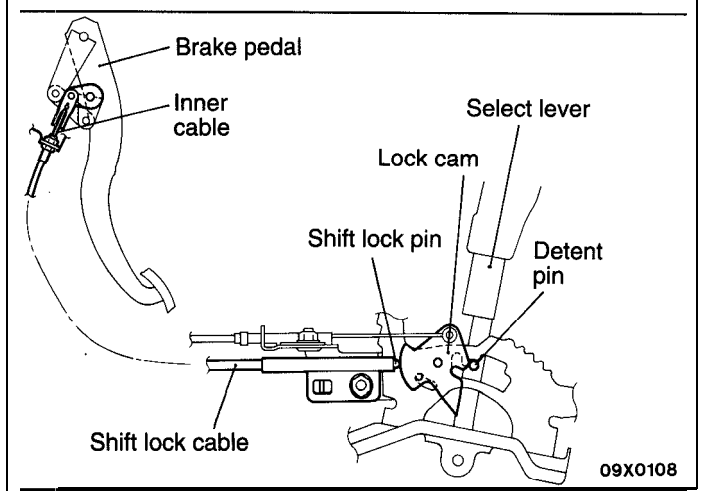
Unless the brake pedal is being depressed, the selector lever cannot be shifted to any other position from the "P" position. Moreover, if the ignition key is in "LOCK" position or if the key has been removed, the selector lever cannot be shifted to any other position from "P" position even if the brake pedal is depressed.



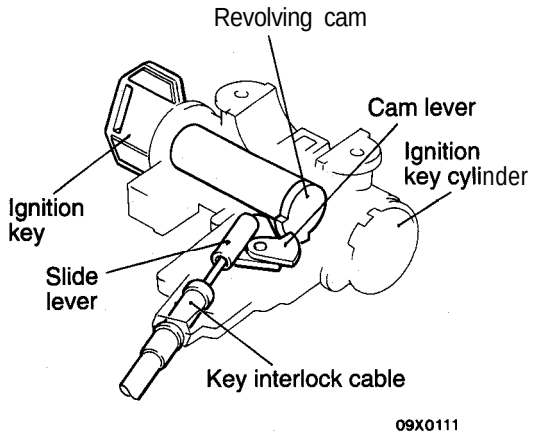
1. WHEN BRAKE PEDAL IS NOT DEPRESSED
When the selector lever is in "P" position and the brake pedal is not depressed, the detent pin is locked because the shift lock pin locks the lock cam, therefore, the selector pushbutton cannot be pressed and the lever cannot be shifted from the "P" position.

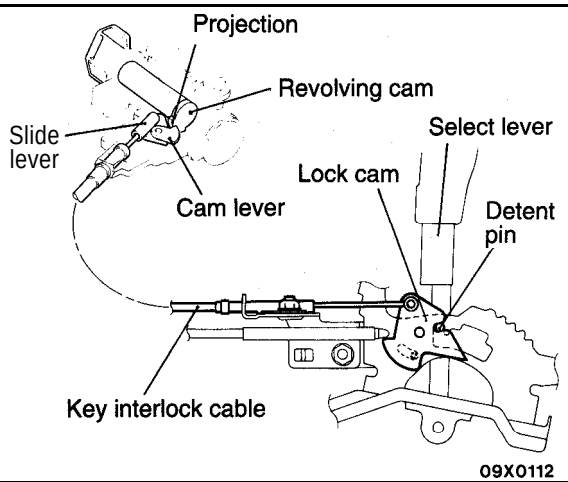


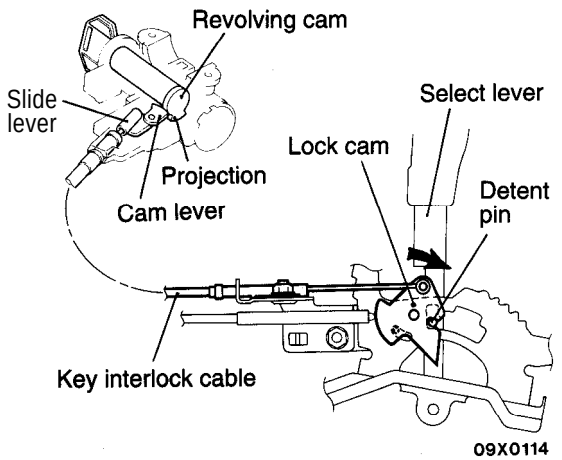
2. WHEN BRAKE PEDAL IS DEPRESSED
When the brake pedal is depressed in the aforementioned condition 1, the inner cable of the shift lock cable is pulled in the direction of the arrow (➡) in the figure and the lock cam, which is interlinked with the shift lock pin, is released. As a result, the selector pushbutton can be pressed and the selector lever can be shifted from "P" position to another position.



3. SHIFTING TO "P" POSITION FROM ANOTHER POSITION
In the case of shifting to "P" position from another position (for example, "R" position), the lock cam is held in the position shown in the figure by the force of the shift lock pin return spring; consequently, there is no need to depress the brake pedal. When the selector lever is shifted to "P" position and the selector lever pushbutton is released, the lock cam is rotated leftward while the detent pin moves upward. Consequently, the shift lock pin is pressed down on by the force of the return spring and the lock cam is locked. In this way, the selector lever is held fixed in the "P" position.







Key Interlock System

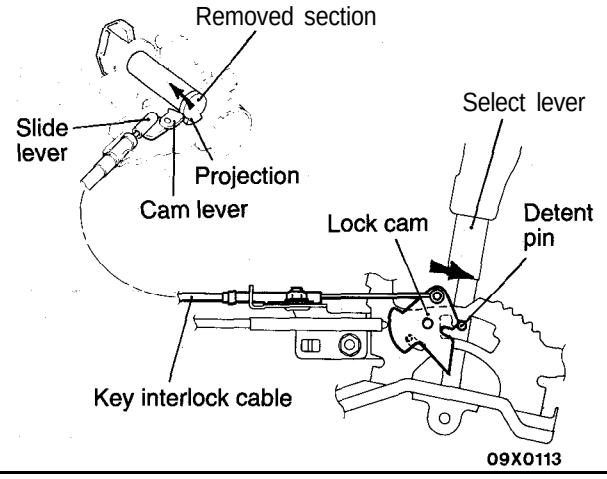
Unless the selector lever is in "P" position, the ignition key cannot be turned to the "LOCK" position, and the key cannot be removed.

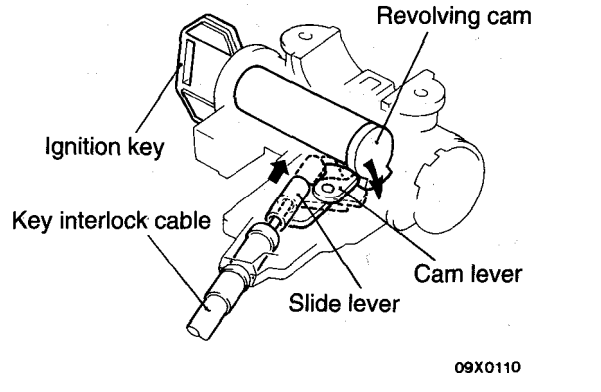
The key interlock device installed in the inside of the ignition key cylinder consists of the slide lever, cam lever and revolving cam.
The slide lever is connected to the key interlock cable. When the selector lever is operated, the slide lever moves to interlock with the cam lever. The revolving cam is designed to interlock with the ignition key.

1. WHEN THE IGNITION KEY IS IN THE LOCK POSITION OR PULLED OUT
   The cam lever meshes with the projection on the revolving cam inside the ignition key cylinder to restrict movement of the slide lever that is connected with the cam lever. As a result, since turning of lock cam is restricted and movement of the detent pin is hindered, the selector lever pushbutton cannot be depressed and the selector lever cannot be moved to any position other than the "P" position.

2. WHEN THE IGNITION KEY IS IN ANY POSITION BUT LOCK POSITION (SELECTOR LEVER IS IN "P" POSITION)
   The projection on the revolving cam inside the ignition key cylinder is in a position where it does not hinder movement of the cam lever and the restriction of the slide lever connected with the cam lever is released. As a result, when the pushbutton of the selector lever is pressed, lock cam is turned in the direction of the arrow shown in the illustration and the detent pin moves down.
   As a result, the selector lever can be moved to any position other than the "P" position.

   NOTE
   While the brake pedal is not depressed, the selector lever cannot be moved to any position other than the "P" position even if the ignition key is not in the "LOCK" position. (Refer to the section of SHIFT LOCK SYSTEM.)





3. WHEN THE IGNITION KEY IS PULLED OUT

Selector Lever is a Position Other than **"P"** Position

Lock cam turns in the direction of the arrow shown in the illustration and stays there.
As a result, the key interlock cable is caught on lock cam and the cam lever inside the ignition key cylinder is turned in the direction of the arrow shown in the illustration (it is in the removed section of the revolving cam).
Consequently, even if one tries to turn the ignition key to the "LOCK" position, the ignition key only turns to the "ACC" position since movement of the revolving cam is restricted by the cam lever and the key cannot be pulled out.

Selector Lever is in "P" Position

The slide lever inside the ignition key cylinder is pushed in the direction of the arrow by the key interlock cable and the cam lever turns in the direction of arrow shown in the illustration.
As a result, the revolving cam removes any restriction to the rotation of the cam lever so it turns freely and the ignition key can be turned to the "LOCK" position and can be removed.

PROPELLER SHAFT

N72ZE00AA

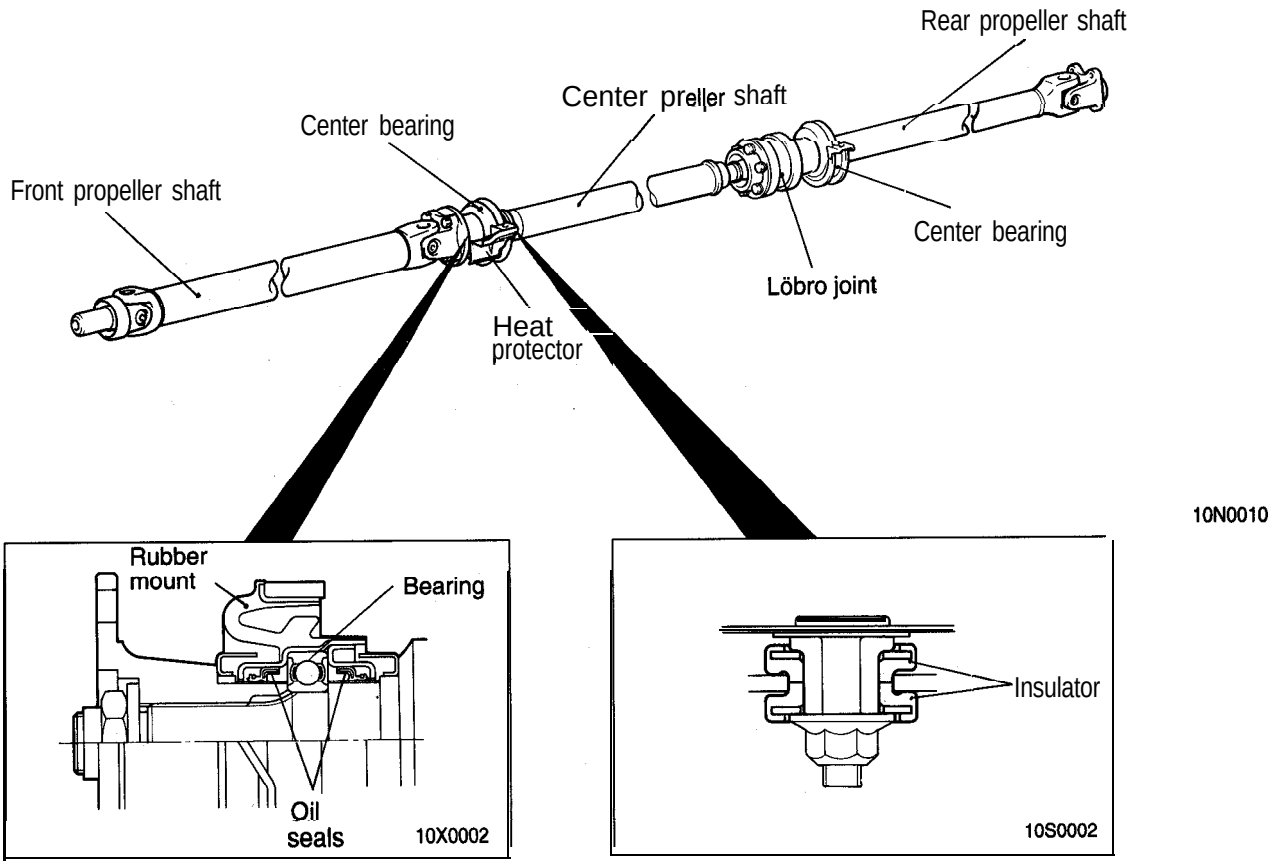
The AWD vehicles have a 3-section, 4-joint type propeller shaft with center bearings. The center bearing, provided with front and rear oil seals, is compact, lightweight and has excellent vibration and noise characteristics, In keeping with adoption of the compact center bearing, the insulator for installation of the bearing to the body has been changed in shape to further reduce vibration.

SPECIFICATIONS

Item			Specifications
Propeller shaft	Type		4-joint propeller shaft
	Lenath x O.D. mm (in.)	Front	676.5 x 65 (26.63 x 2.56)
		Center	642.5 x 65 (25.30 x 2.56)
		Rear	634.5 x 50.8 (24.98 x 2.00)
Universal joint	Type	No. 1, 2, 4	Cross type
		No. 3	Equal velocity type
	Lubrication		Pre-packed
	Cross type joint journal O.D. mm (in.)		14.689 (.5783)
	Constant velocity joint O.D. mm (in.)		94 (3.7)

NOTE
Propeller shaft length indicates the length between center points of each joint.

CONSTRUCTION DIAGRAM



FRONT AXLE

N72ZFOOM

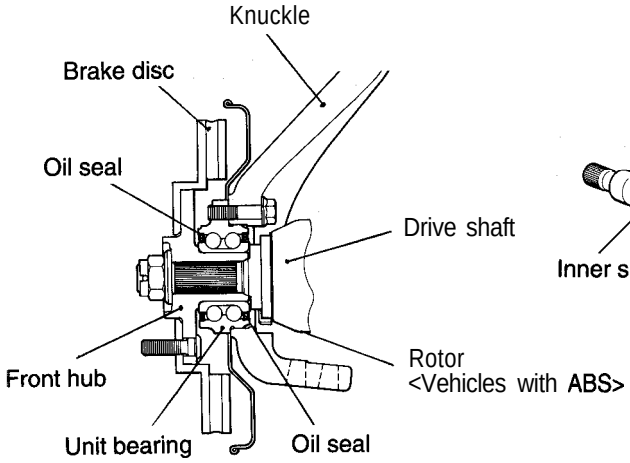
The drive shaft use the BJ-TJ constant velocity joint combination which offers high power transmission efficiency, ensures smooth inward-outward sliding movement and transmits less engine vibration during idling.

FEATURES

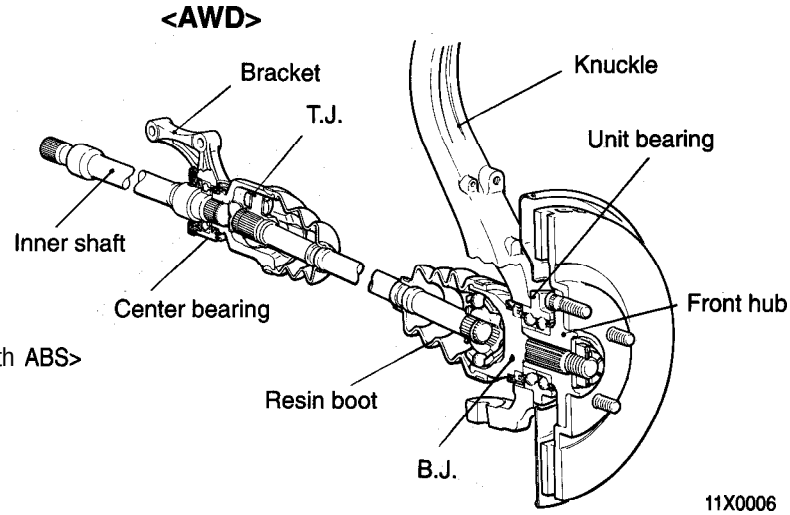
- The front hub has a press-fitted unit bearing.
- The unit bearing consists of inner and outer races and an oil seal. It features low rotating resistance and higher protection against mud.
- The front hub assembly bolted to the knuckle improves serviceability.
- On the AWD vehicles, a center bearing and an inner shaft have been adopted to reduce vibration, noise and torque steer.
- On AWD vehicles, dust seals have been provided on both sides of the center bearing and the inner shaft has been press-fitted in the TJ outer race for higher protection against mud.
- The drive shafts on some model versions have a dynamic damper for reduction of vibration and noise.
- The drive shaft and hub area serration coupled.
- The ABS equipped vehicles have a wheel speed detection rotor on the drive shaft and a speed sensor on the knuckle.
- The BJ boots are highly durable plastic ones.

SPECIFICATIONS

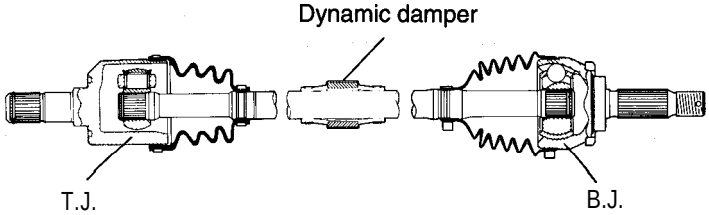
items	Specifications
Wheel bearing type	Double-row angular contact ball bearing
Bearing (outside diameter x inside diameter) mm (in.)	84 x 40 (3.31 x 1.57)



11X0012



11X0006



11X0096

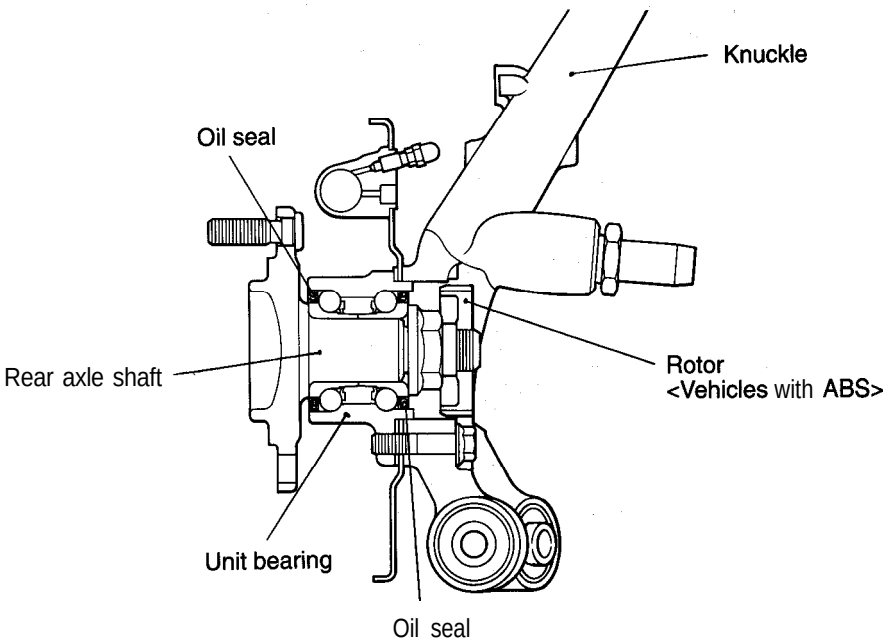
REAR AXLE <FWD>

N72ZGOOAA

The rear axle is of a design having axle shafts with press-fitted unit bearings.

FEATURES

- The unit bearing consists of inner and outer races and an oil seal for lower rotating resistance and higher protection against mud.
- The rear axle shaft bolted to the knuckle improves serviceability.
- ABS equipped vehicles have a wheel speed detection rotor on the rear axle shaft and a speed sensor on the knuckle.



13X0061

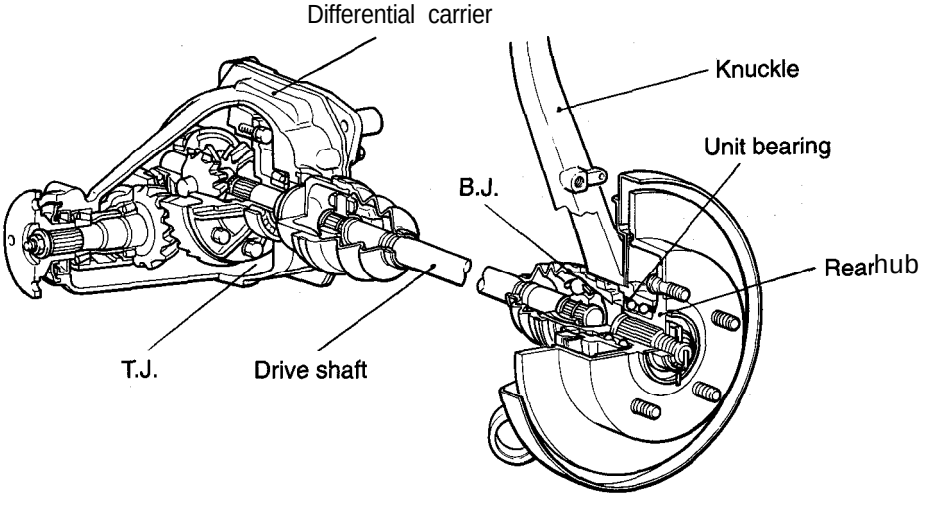
REAR AXLE <AWD>

N72ZH00AA

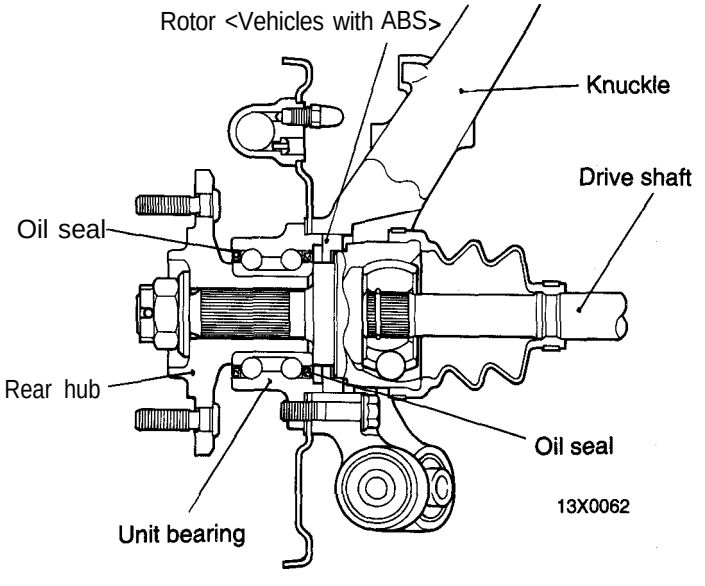
The constant velocity joint on the differential side of the drive shaft is a TJ type one which ensures smooth inward-outward sliding movement. A BJ type joint is used on the hub side.

FEATURES

- The drive shaft is spline coupled on the different side and serration coupled on the hub side, eliminating the need for an axle shaft to allow for simplicity around the hub.
- The R.H. drive shaft on VCU type LSD equipped vehicles has splines provided in two stages on the T.J.
- ABS equipped vehicles have a wheel speed detection rotor on the drive shaft BJ outer race and a speed sensor on the knuckle.
- The unit bearing is press-fitted in the rear hub.
- The unit bearing consists of inner and outer races and an oil seal for lower rotating resistance and higher protection against mud.
- The rear hub assembly bolted to the knuckle improves serviceability.
- The differential carrier is elastically supported via the bushing of the differential mount bracket assembly at the front and via the bushings on the cross member at the rear.

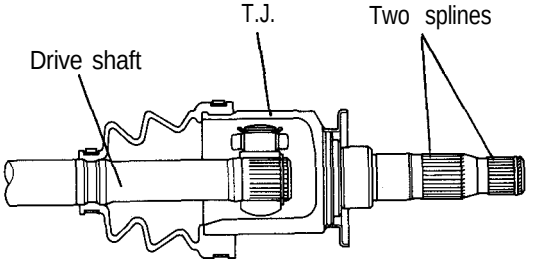


11X0064



13X0062

<Vehicles with LSD>



11X0095

DIFFERENTIAL

N72ZH01AA

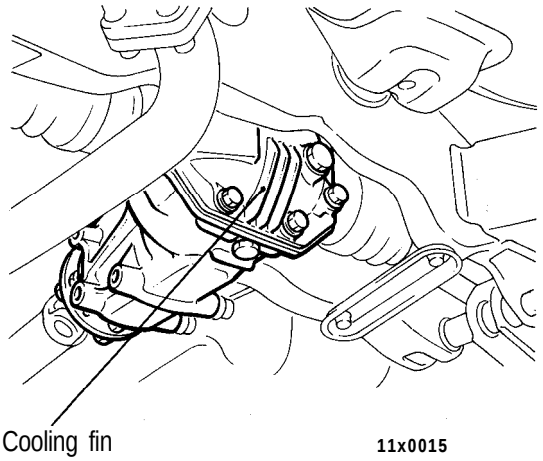
The differential uses a low frictional torque bearing and oil seal to provide improved power and fuel efficiency.

For better cooling of the differential during high-speed operation, the differential carrier has cooling fins.
In addition, VCU type LSD is used on some models.

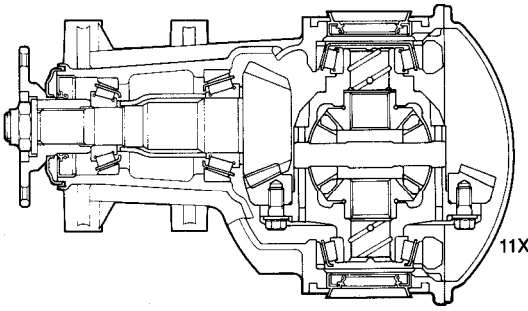
SPECIFICATIONS

Items	Conventional differential		Limited slip differential (VCU type)	
	M/T	AK	M/T	AK
Reduction gear type	Hypoid gear			
Reduction ratio	**3.545**	**3.307**	**3.545**	**3.307**
Differential gear type (Type x number of gears)				
Side gear	Straight bevel gear x 2		Straight bevel gear x 2*	
Pinion gear	Straight bevel gear x 2		Straight bevel gear x 2	
Number of teeth				
Drive gear	39	**43**	**39**	**43**
Drive pinion	11	13	11	13
Side gear	14	14	14	16
Pinion gear	10	10	10	10
Bearing (outside diameter x inside diameter) mm (in.)				
Side	**72 x 35 (2.83** x 1.38)			
Front	**62 x 25 (2.44 x** .98)			
Rear	**72 x 35 (2.83** x 1.38)			

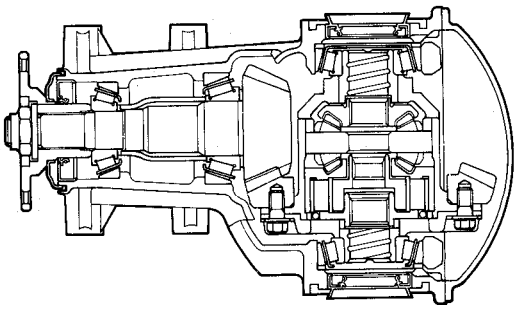
NOTE
*: Denotes the gear (L.H.) which is in a single body with the viscous coupling.



Conventional differential



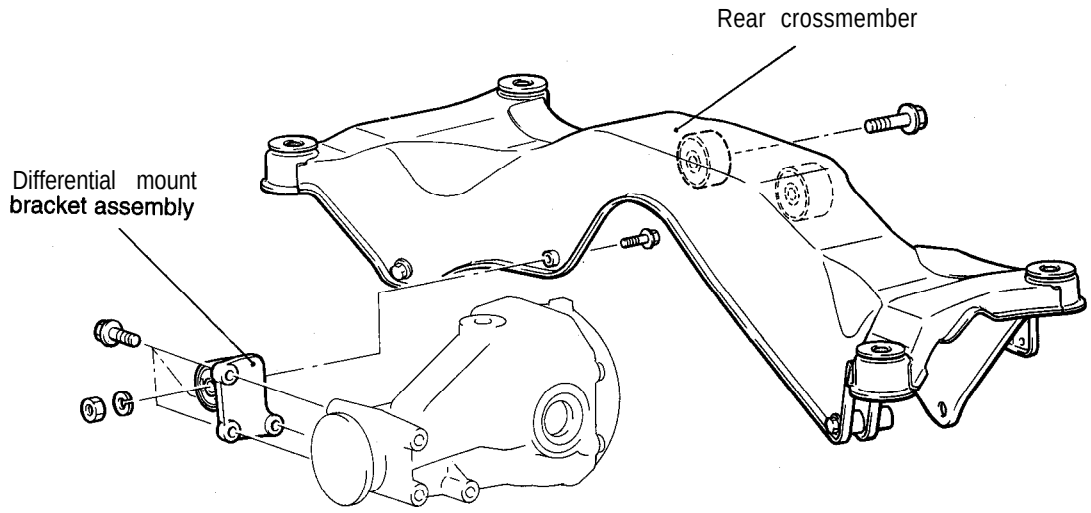
Limited slip differential (VCU type)



DIFFERENTIAL SUPPORT

N72ZH02AA

The front of the differential carrier is elastically supported by the bushing of the differential mount bracket assembly, and its rear is supported by the bushings on the rear cross member.



11x0011

DRIVE-CONTROL COMPONENTS

CONTENTS

N73ZAOOAA

ANTI-LOCK BRAKE SYSTEM (ABS) <AWD> 44
- ABS Electrical Circuit Diagram 46
- ABS Hydraulic Function Schematic 47
- Actuator 50
- Electronic Control Unit (ECU) 51
- Sensor 48
- System Drawing 45

ANTI-LOCK BRAKE SYSTEM (ABS) <FWD> 27
- ABS Electrical Circuit Diagram 29
- ABS Hydraulic Pressure Function Diagram ... 30
- Actuator 32
- Electronic Control Unit (ECU) 34
- Sensor 31
- System Drawing 28

BRAKES 22
- Construction Diagram 22
- Features 22

FRONT SUSPENSION 3
- Construction 5
  - High-mounted upper arm 9
  - Optimized virtual kingpin axis positioning . . . 6
  - Shock absorber with damping force control valve for very low and low speed operation <Turbo> 10
  - Variation in camber during cornering 10
- Features 3
- Specifications 4

PARKING BRAKES 59
- Construction Diagram 59

POWER STEERING 16
- Construction 17
- Features 16
- Oil Pump 20
- Specifications 16
- Steering Gear and Linkage 21
- Steering Shaft and Column 18
- Steering Wheel 18

REAR SUSPENSION 11
- Construction 13
  - Variation in toe angle by rearward force input 14
  - Variation in toe angle by side forces 14
  - Variation in toe angle on turns 14
- Features 11
- Specifications 12

SERVICE BRAKES 23
- Brake Booster 25
- Disc Brakes 26
- Master Cylinder 24
- Rear Drum Brakes 26
- Specifications 23

SUSPENSION 2
- Features 2

WHEELS AND TIRES 15
- Specifications 15

SUSPENSION

N732000AA

Both the front and rear suspension are a new multi-link design which is the result of the development effort for the best compromise between high-level steering stability and ride.

FEATURES

N73ZB01AA

Improved steering stability
1. New multi-link design
2. Increased caster angle, reduced kingpin angle (front)
3. Reduced initial camber (front)
4. Adoption of virtual kingpin axis scheme
5. High-mounted front and rear upper arms
6. Increased rigidity of front cross member
7. Front shock absorbers with a damping force control valve for very low and low speed operation <Turbo>
8. Use of a ball joint type stabilizer link
9. Use of an anti-dive geometry for the front and an anti-lift geometry for the rear
10. Use of an anti-squatting geometry

Improved riding comfort
1. Reduced shock absorber friction
2. Increased wheel stroke

Reduced road noise
Crossmember with vibro-isolating supports

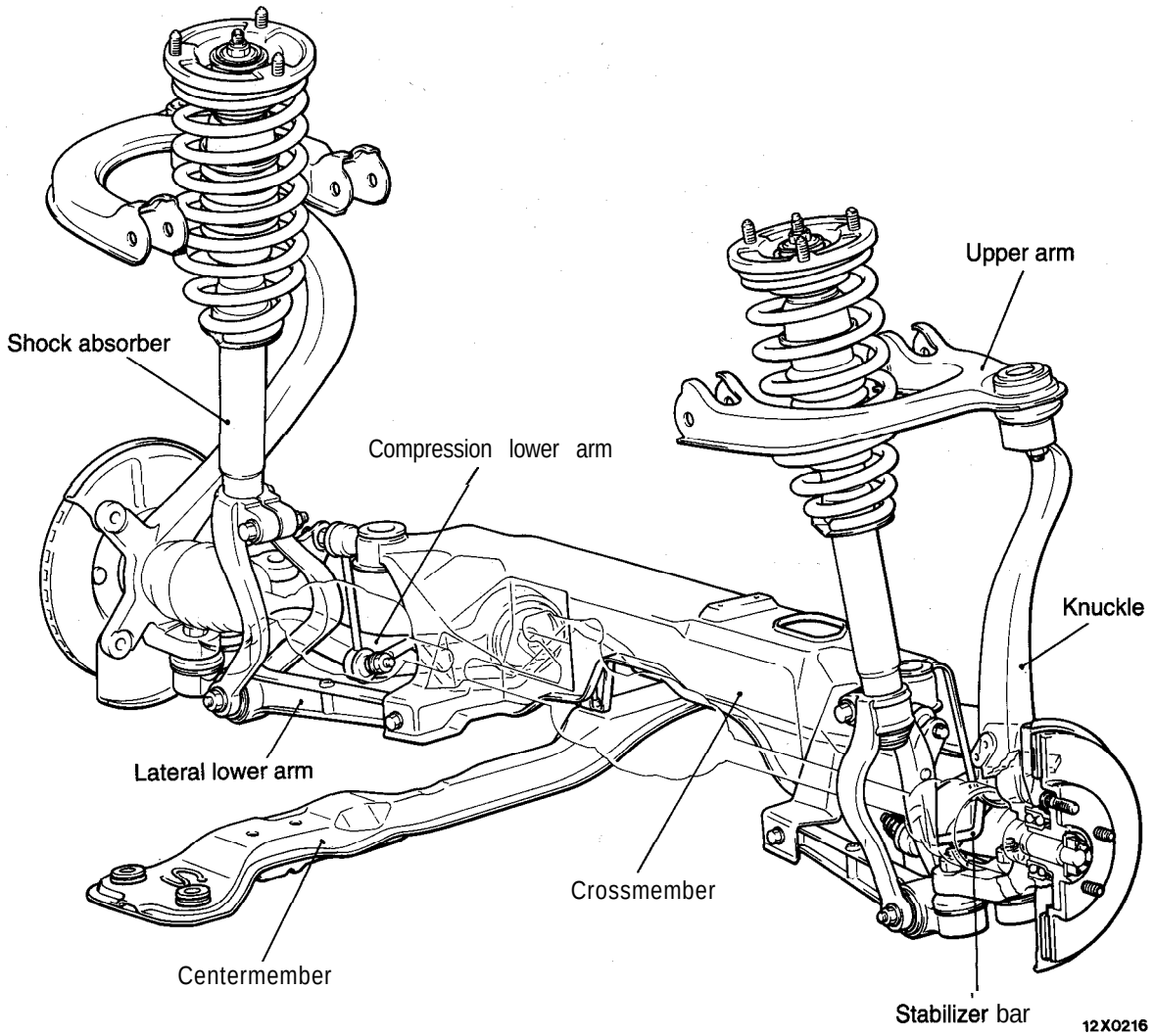
Improved serviceability
Toe adjustment mechanism in front and rear suspensions

FRONT SUSPENSION

N73ZC00AA

FEATURES

The front suspension is similar to that introduced on the 1994 Galant. It is a multi-link structure featuring two lower arms by which an ideal virtual kingpin axis is formed. In addition, the upper arms have been raised above the tire level to improve both directional stability and ride.



SPECIFICATIONS

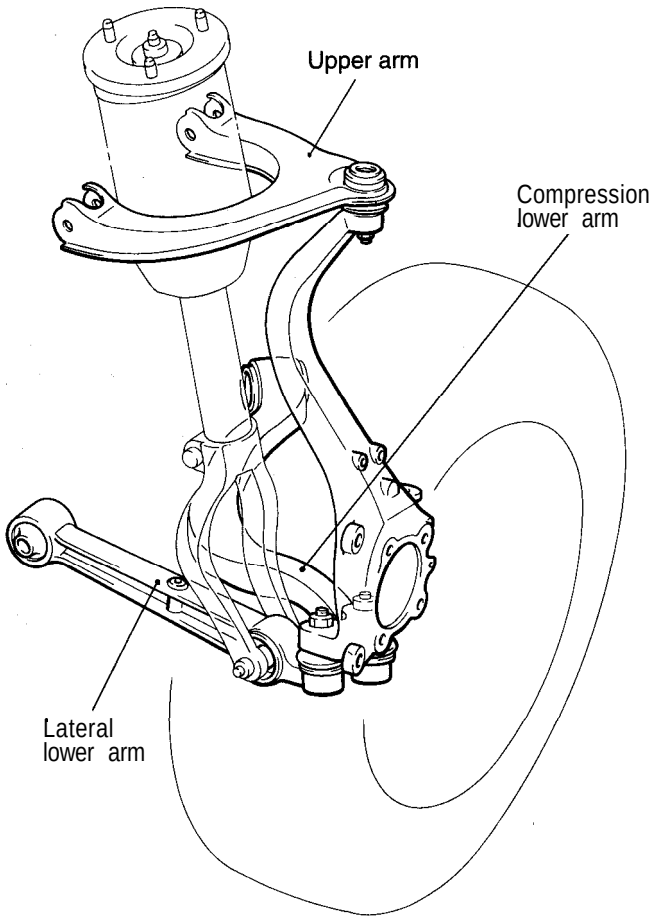
items	Medium price		High price	
	M/T	A/T	M/T	A/T
Suspension type	Multi-link type			
Wheel alignment Camber Caster Toe-in mm (in.)	–0°05' ± 30' 4°40' ± 1°30' 0 ± 3 (0 ± .12)		–0°20' ± 30' 4°40' ± 1°30' 0 ± 3 (0 ± .12)	
Coil spring Wire dia. x O.D. x free length mm (in.) Identification color Spring constant N/mm (lbs./in.)	13.1 x71.1 – 111.1 x 309.5 (.52 x 2.80 – 4.37 x 12.19) White + Pink 43.0 (245)	13.2x71.2- 111.2 x 315.5 (.52 x 2.80 – 4.38 x 12.42) White + Gray 43.0 (245)	12.9 x 70.9 – 110.9 x 300.5 (.51 x 2.79 – 4.37 x 11.83) Yellow + Pink 43.0 (245)	13.1 x 71.1 – 111.1 x 306.5 (.52 x 2.80 – 4.37 x 12.07) Yellow + Gray 43.0 (245)
Shock absorber Type Stroke mm (in.) Damping force [at 0.3 m/sec. (.9 ft./sec.)] Expansion N (lbs.) Contraction N (lbs.)	Hydraulic cylindrical double-acting type 118 (4.65) 1,265 – 1,677 (284 – 377) 431 – 647 (97 – 146)			

Items	Premium price			
	FWD		AWD	
	M/T	A/T	M/T	NT
Suspension type	Multi-link type			
Wheel alignment Camber Caster Toe-in mm (in.)	–0°20' ± 30' 4°40' ± 1°30' 0 ± 3 (0 ± .12)		–0°05' ± 30' 4°40' ± 1°30' 0 ± 3 (0 ± .12)	
Coil spring Wire dia. x O.D. x free length mm (in.) Identification color Spring constant N/mm (lbs./in.)	13.1 x 71.1 – 111.1 x 306.5 (.52 x 2.80 – 4.37 x 12.07) Yellow + Gray 43.0 (245)	13.2x71.2- 111.2 x 312.5 (.52 x 2.80 – 4.38 x 12.30) Yellow + Light Blue 43.0 (245)	13.3x71.3- 111.3 x 312.0 (.52 x 2.81 – 4.38 x 12.28) Green + Light Blue 46.4 (265)	13.5 x 71.5 – 111.5 x 317.5 (.53 x 2.81 – 4.39 x 12.50) Green + Purple 46.4 (265)
Shock absorber Type Stroke mm (in.) Damping force [at 0.3 m/sec. (.9 ft./sec.)] Expansion N (lbs.) Contraction N (lbs.)	Hydraulic cylindrical double-acting type 118 (4.65) 1,432 – 1,902 (322 – 428) 470 – 706 (106 – 159)		Hydraulic cylindrical double-acting type 118 (4.65) 1,471 – 1,961 (331 – 441) 559 – 814 (126 – 183)	

CONSTRUCTION

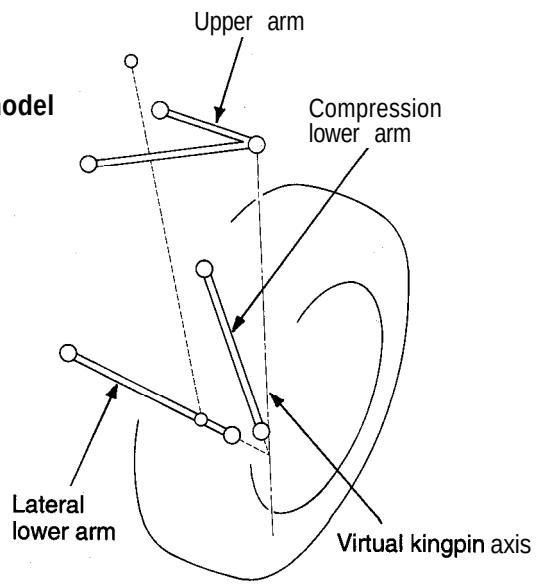
A high mounted upper arm and two lower arms act like a double-wishbone arrangement. In this arrangement, a virtual kingpin axis is formed on the line connecting the external vertex of the upper arm triangle and the point where the lines extended from the two lower arms intersect. This construction provides the following advantages:

- A negative offset geometry is established which assures better stability during braking.
- Reduced offset between the virtual kingpin axis and the wheel center results in a lower steering movement at the time when the vehicle is accelerated or goes over a bump on road, assuring better stability.
- The high-mounted upper arm helps improve the wheel supporting rigidity.
- The multi-link suspension, like a double-wishbone suspension, suffers little change in "camber to ground" when a rolling motion occurs, assuring better stability during cornering.



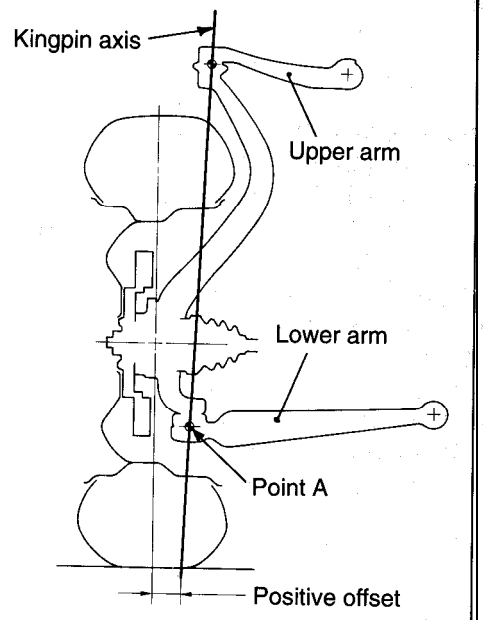
12X0161

Link model



12X0096

Double Wishbone Suspension



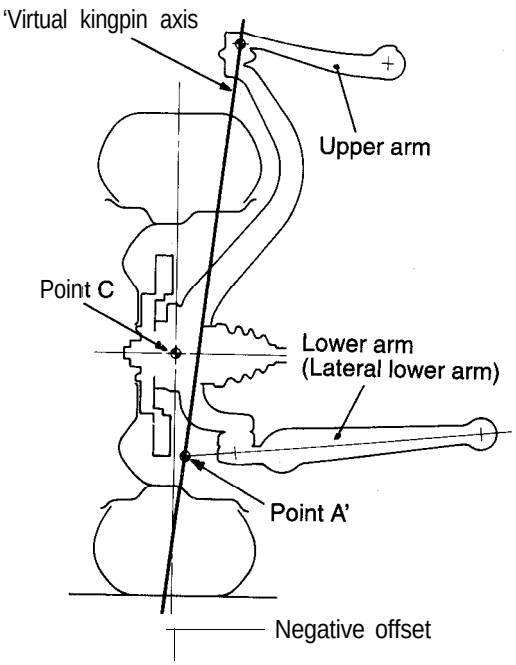
OPTIMIZED VIRTUAL KINGPIN AXIS POSITIONING

In a double-wishbone type suspension, the lower point the kingpin axis passes through is the joint between knuckle and lower arm (point A in the illustration at the left). If the double-wishbone type suspension has a high-mounted upper arm, therefore, the extension of the kingpin axis will meet the ground at a point inside the center of the ground contacting area of the tire as shown in the illustration (positive offset).

In the case of the multi-link suspension, a virtual kingpin axis is formed in such a way that its lower section passes through the intersection (point A' as illustrated below) of the lateral lower arm and compression lower arm extensions. This makes it possible for the virtual kingpin axis ground meeting point to be located outside the center point where the tire contacts the ground surface (negative offset). In addition, the offset between the wheel center (point C in the illustration) and the kingpin axis can be made smaller than that in a strut type or double-wishbone type suspension.

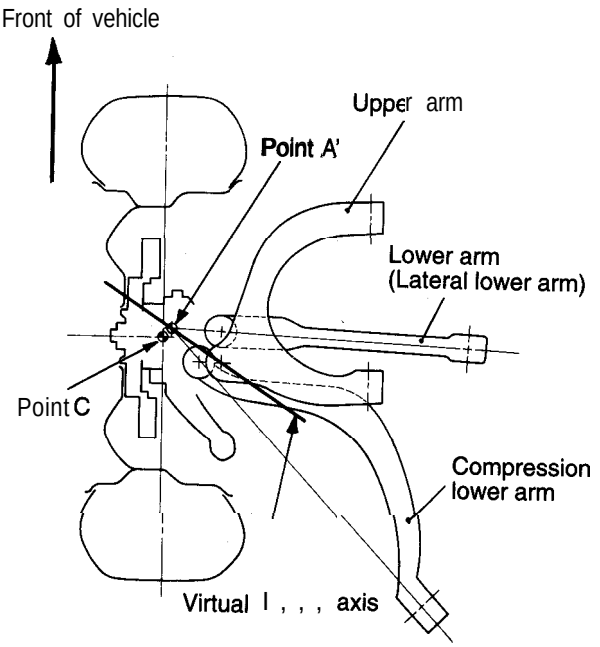
Multi-Link Suspension

Rear View

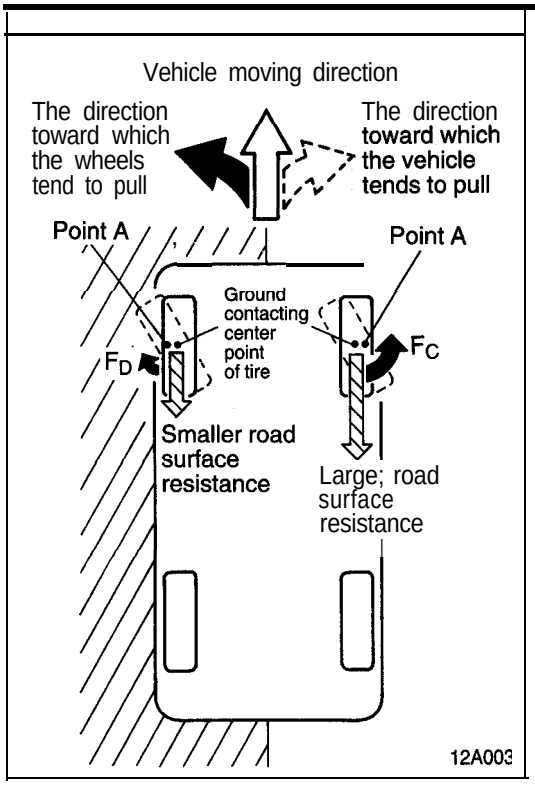


12X0094

Plan View



12x0093



Effects of Negative Offset Geometry

(1) When the brake pedal is depressed on a running vehicle with one wheel on a slippery surface, a force is produced which causes the vehicle to pull toward the side with larger road surface resistance (to the right in the case illustrated at the left).

(2) Because of the dynamics resulting from the negative offset, moments F_C and F_D are generated in both wheels around point A (the point where the kingpin axis meets the ground). Since the magnitude of these moments is proportional to the road surface resistance, a pull force is produced in the wheels to turn them toward the side with either the F_C or F_D moment whichever is greater (to the left in the illustrated case).

(3) This means that the wheels pivot toward the direction in which the vehicle's pull force resulting from the difference in road surface resistance is compensated for, thus maintaining the vehicle's straight-line movement.

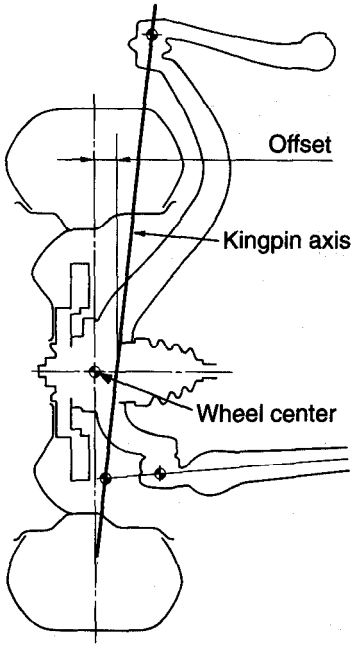
Effects of Reduced Wheel Center to Kingpin Axis Offset

(1) When the vehicle is accelerated or decelerated, or when it goes over a projection on road without braking, the traction acting on the wheel center generates a moment around the kingpin axis that would cause the toe angle to change.

(2) Since the moment is proportional to the magnitude of offset between the wheel center and the kingpin axis, the smaller the offset, the less the change in toe angle, and the better the directional stability.

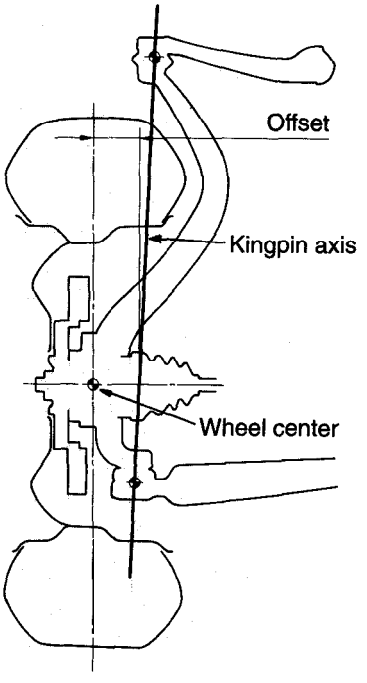
(3) In the multi-link suspension, the offset is as small as about a third of that in a strut type suspension and about one half of that in a double-wishbone suspension. The reduced offset, therefore, assures by far better directional stability when the vehicle is accelerated or decelerated, or when it goes over a projection on road.

<Multi-Link Suspension>



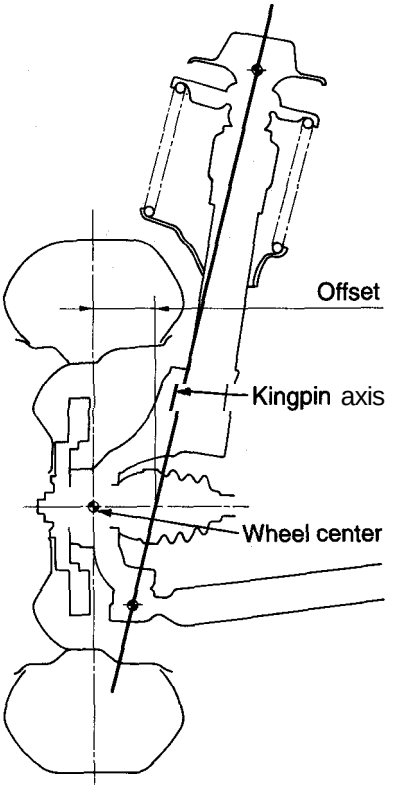
12X0100

<Double-Wishbone Type Suspension>



12X0097

<Strut Type Suspension>



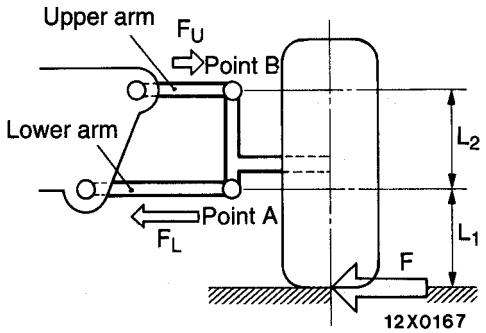
12X0098

HIGH-MOUNTED UPPER ARM

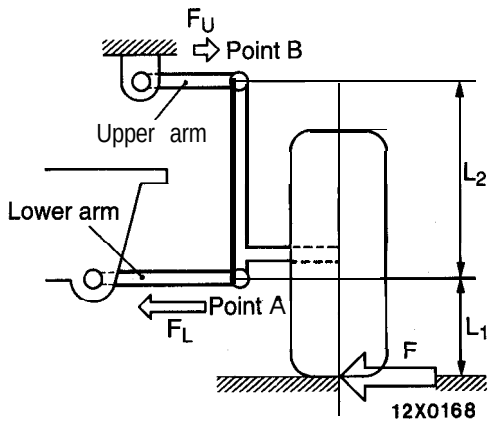
When a side force or any other force acts on the tire in a way to change its camber angle, the degree of the rigidity that supports the tire depends on the hardness of the upper and lower arm rubber bushing. If the hardness of the bushings is increased, however, a larger friction will result during up-and-down motion of the suspension, leading to a poorer ride. The high-mounted upper arm has made it possible to use a softer bushing because the bushing on it receives smaller camber affecting force as compared to the case with a low-mounted upper arm (see the illustrations below), and enough wheel supporting rigidity is ensured even with a softer bushing. The high-mounted upper arm and softer bushing combination, therefore, provides a successful compromise between soft ride and outstanding directional stability.

Comparison of Forces Acting on Upper Arm Bushing between High-Mounted and Low-Mounted Upper Arms

<Low-Mounted Upper Arm>



<High-Mounted Upper Arm>



F: Lateral force acting on tire
F_U: Lateral force caused to act on upper arm by force F
FL: Lateral force caused to act on lower arm by force F

When the equilibrium of moments established at point A in the illustration is considered, the following formulas hold true.

$$F_U \cdot L_2 = F \cdot L_1$$
$$F_U = F \cdot L_1/L_2$$

Also, when the equilibrium of moments established at point B is considered, the following formulas hold true.

$$F_L \cdot L_2 = F \cdot (L_1 + L_2)$$
$$F_L = F \cdot (L_1 + L_2)/L_2$$

Assume that $L_2 = L_1$ in the case of the low-mounted upper arm and that $L_2 = 2L_1$ in the case of the high-mounted upper arm. Then the F_U and FL are expressed as follows:

Low-Mounted Upper Arm

$$F_U = F \cdot L_1/L_1 = F$$
$$F_L = F \cdot 2L_1/L_1 = 2F$$

High-Mounted Upper Arm

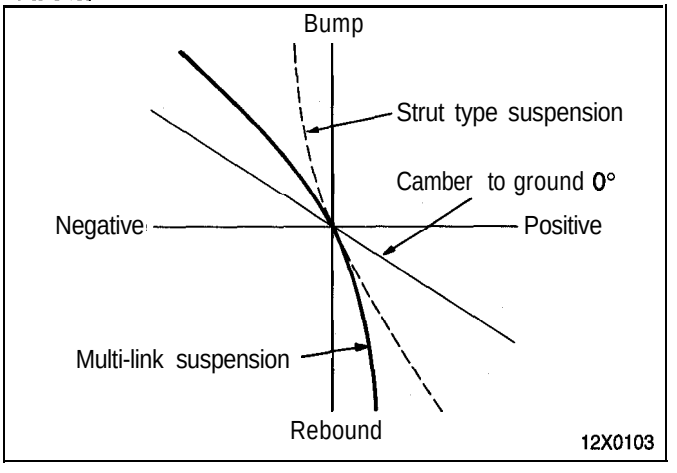
$$F_U = F \cdot L_1/2L_1 = 0.5F$$
$$F_L = F \cdot 3L_1/2L_1 = 1.5F$$

In the case of the high-mounted upper arm, as evident from the above, smaller camber affecting forces are input in both upper and lower arms.

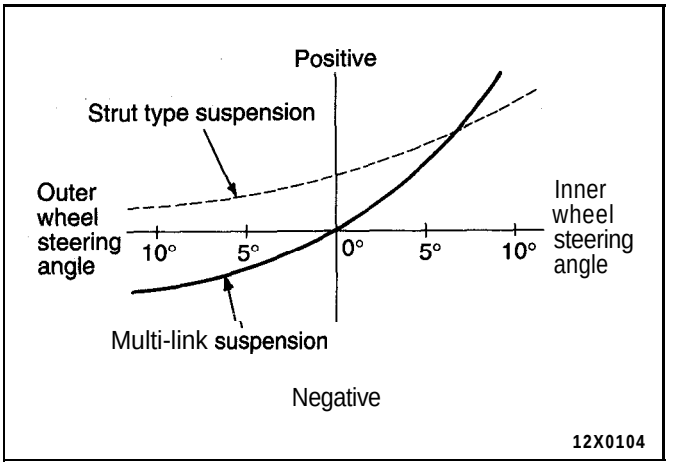
VARIATION IN CAMBER DURING CORNERING

When the steering wheel is turned, camber varies as shown below because of increased caster angle and reduced kingpin angle. On the vehicle with multi-link suspension, the change in "camber to ground" caused by the body rolling during cornering is small by the same action as the one experienced in a double-wishbone suspension. These effects help provide outstanding directional stability by making the most of the tire performance.

<Variation in Camber during Up-and-Down Stroke>



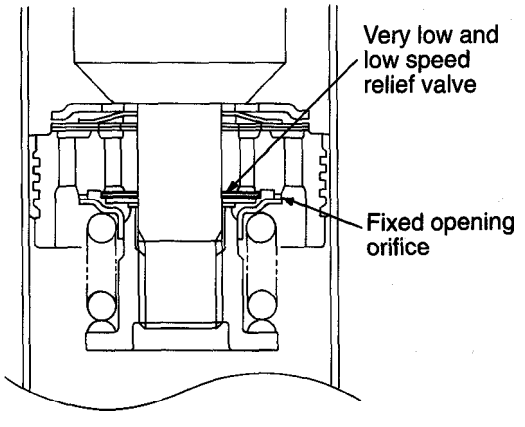
<Variation in Camber during Cornering>



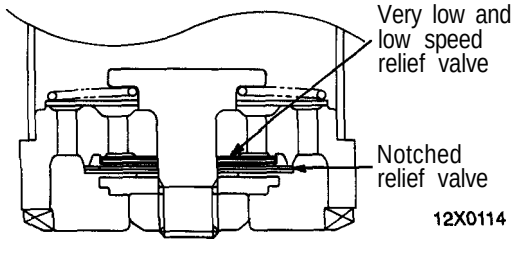
SHOCK ABSORBER WITH DAMPING FORCE CONTROL VALVE FOR VERY LOW AND LOW SPEED OPERATION <TURBO>

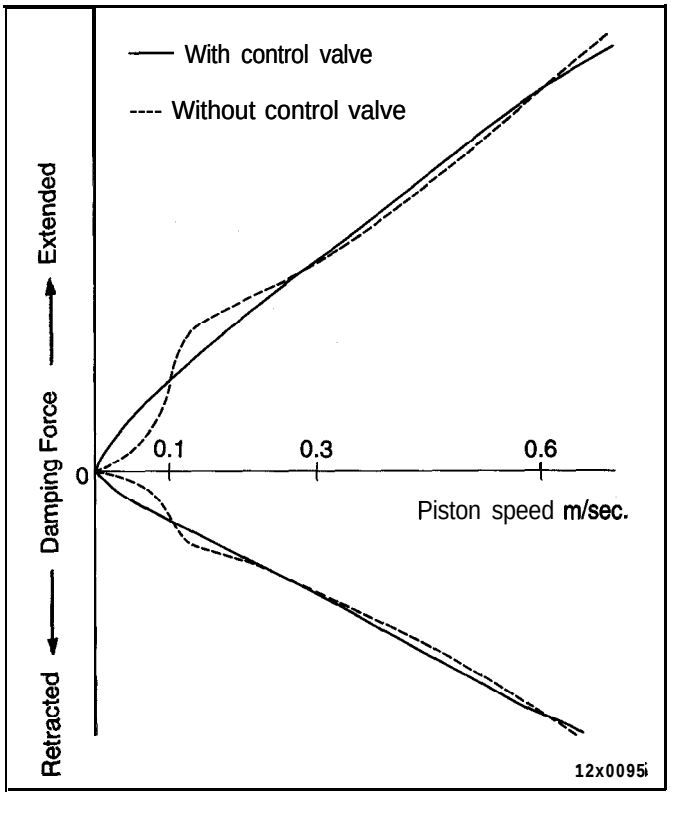
When the shock absorber piston speed is at less than 0.1 m/sec., the control of the damping force is impossible with the conventional fixed opening orifice alone. This control has been made possible by adding a relief valve for very low and low speed range operation. As a result, the damping force characteristics have become linear as shown below, so that the vehicle provides better feeling when it rolls and shows better responsiveness to the steering wheel operation.

Piston section



Base Valve Area





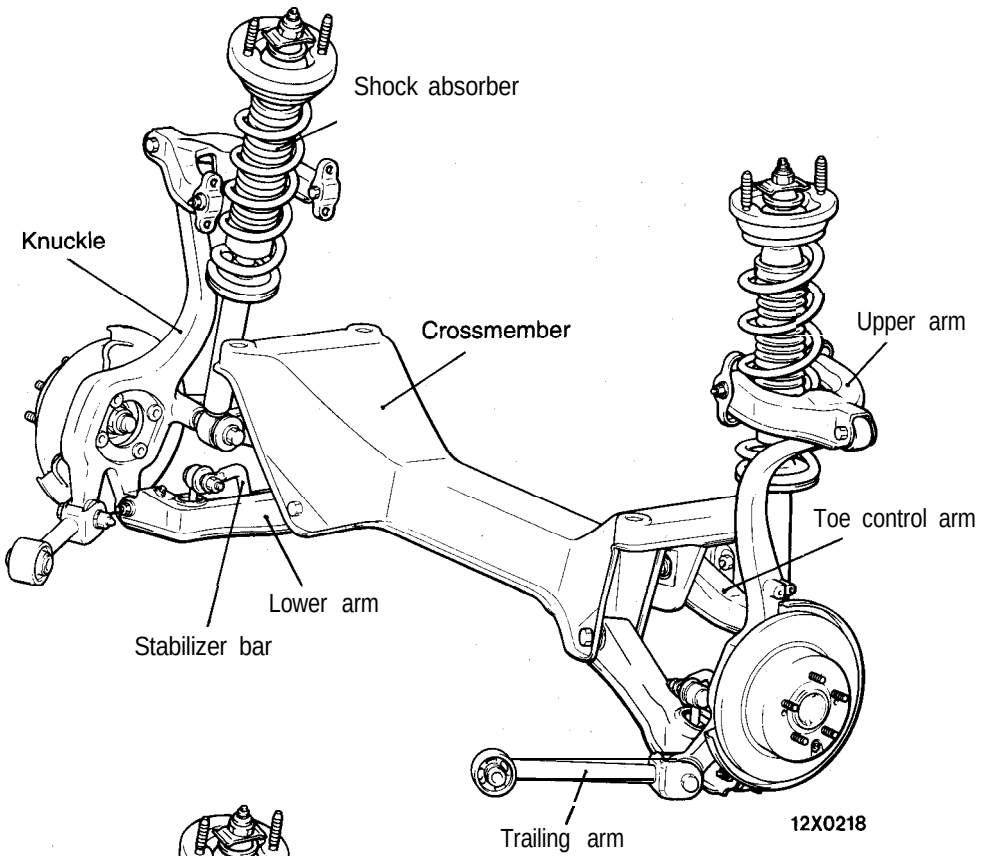
REAR SUSPENSION

N73ZD00AA

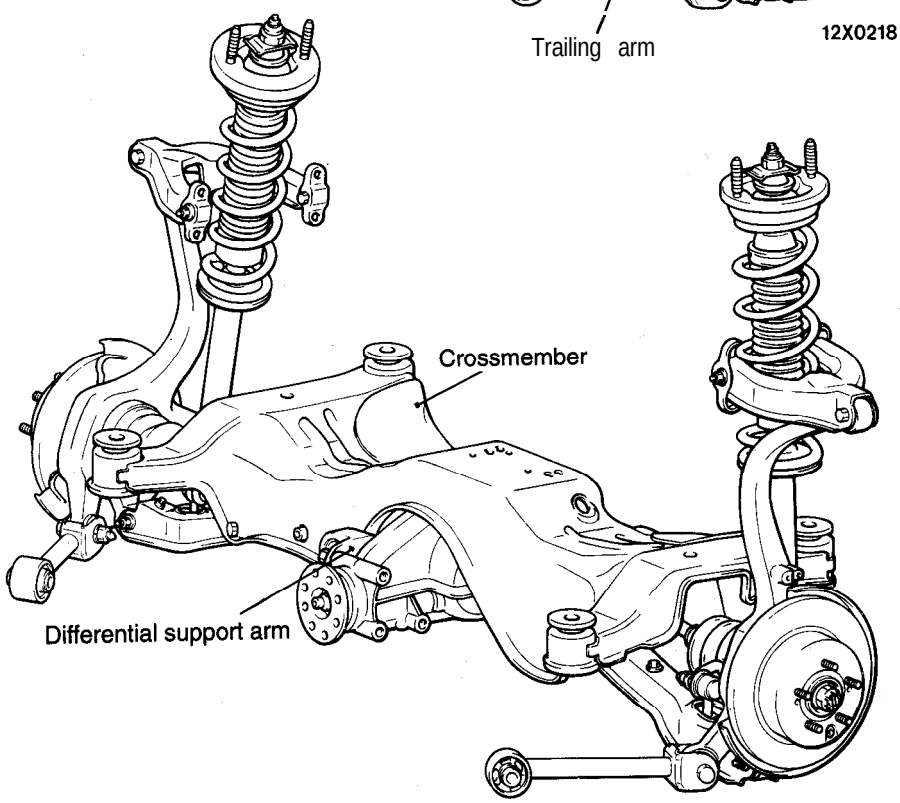
FEATURES

The rear suspension is similar to that introduced on the 1994 Galant. It is a new development in multi-link design. By properly arranging the individual control arms and properly selecting their bushings for well balanced rigidity, a best compromise between high-level directional stability and riding comfort has been realized in the suspension.

<FWD>



<AWD>



12x0214

SPECIFICATIONS

Items	Medium price	High price, Premium price <FWD>	Premium price <AWD>
Suspension type	Multi-link type		
Wheel alignment			
Toe-in mm (in.)	3 ± 3 (.12 ± .12)		
Camber	–1°20' ± 30'	–1°20' ± 30'*1 –1°40' ± 30'*2	–1°20' ± 30'*3 –1°40' ± 30'*4
Coil spring			
Wire dia. x O.D. x free length mm (in.)	11.0x75.0- 117.0 x 297.0 (.433 x 2.953 – 4.606 x 11.692)	10.8 x 74.6 – 116.6 x 288.0 (.425 x 2.937 – 4.591 x 11.339)	11.2x75.4- 117.4 x 294.5 (.441x 2.968 – 4.622 x 11.594)
Identification color	Light Blue + Purple	Light Blue + Green	Light Blue + Orange
Spring constant N/mm (lbs./in.)	28 ± 1.4 (173 ± 8)	28 ± 1.4 (173 ± 8)	30.4 ± 1.5 (162 ± 8)
Shock absorber			
Type	Hydraulic cylindrical double acting type	Hydraulic cylindrical double acting type	Hydraulic cylindrical double acting type
Stroke mm (in.)	164 (6.5)	154 (6.1)	154 (6.1)
Damping force [at 0.3 m/sec. (.9 ft./sec.)]			
Expansion N (lbs.)	834 – 1,128 (187 – 254)	834 – 1,128 (187 – 254)	834 – 1,128 (187 – 254)
Contraction N (lbs.)	314 – 471 (71 – 106)	314 – 471 (71 – 106)	314 – 471 (71 – 106)

NOTE
(1) *1: Vehicles with 14-inch wheels
(2) *2: Vehicles with 16-inch wheels
(3) *3: A/T
(3) *4: M/T

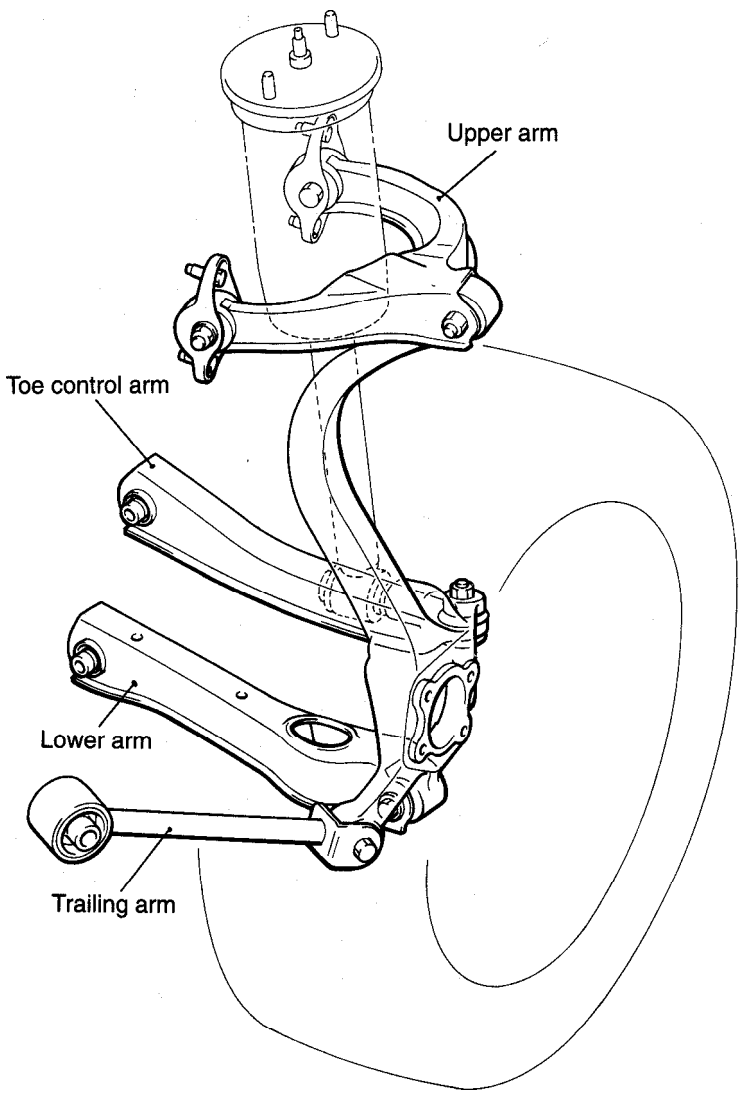
CONSTRUCTION

A high-mounted upper arm and a combination of lower arm and trailing arm act like a double-wishbone configuration having a virtual kingpin axis. This construction, like that of the front suspension, provides the following features:

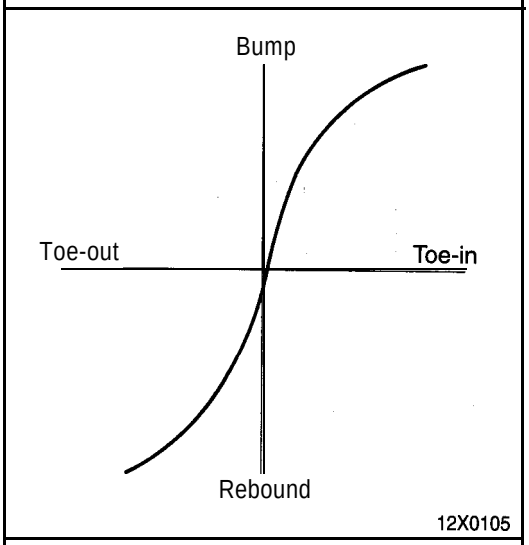
- Small offset between the virtual kingpin axis and wheel center provides better directional stability.
- The high-mounted upper arm helps improve the tire supporting rigidity and riding comfort.
- Like a double-wishbone suspension, the multi-link suspension features small change in "camber to ground" at the time of a roll, which assures better stability during cornering.

In addition, optimum arrangement of the individual arms and proper selection of the individual bushings for well balanced rigidity have provided the following effects:

- Changes in toe angle caused by the up and down strokes of the suspension are properly controlled for better stability during cornering.
- Changes in toe angle caused by a lateral force acting on the tire are properly controlled for better stability during cornering.
- Even under the effect of a rearward force on the tire, the wheel alignment does not increase the "toe-out" tendency. This helps retain the straight-line motion of the vehicle.

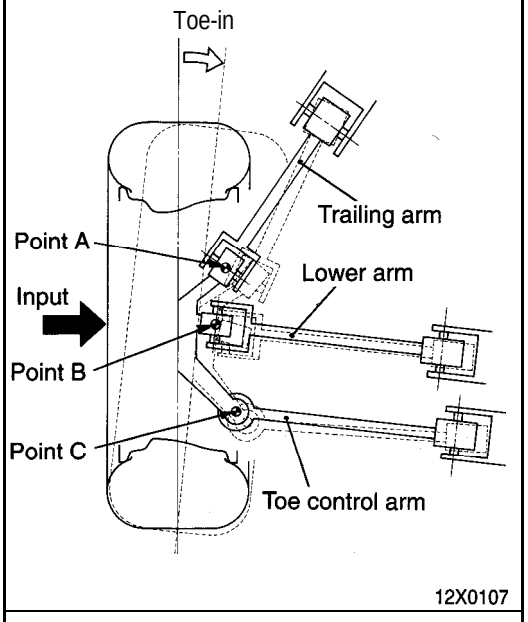


12X0106



VARIATION IN TOE ANGLE ON TURNS

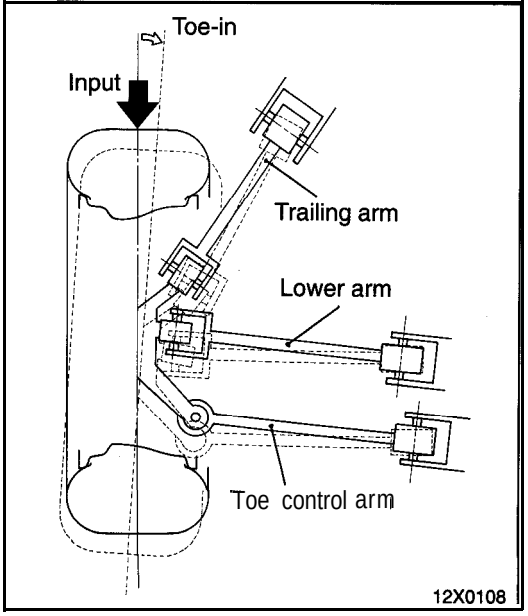
When the vehicle rolls as it makes a turn, the toe geometry changes as shown by the characteristics curve at the left under the effect of the toe control arm action. Also, under the side forces that are generated during a turn, the toe angle of the outer wheel changes in such a way that the toe-in state will be maintained thanks to the balance in rigidity of the individual arms' bushings properly selected for that effect. These characteristics allow the rear wheels to make directional changes in phase with the front wheels (steered wheels) during a turn, assuring better steering stability.



VARIATION IN TOE ANGLE BY SIDE FORCES

Since the side force acting on the tire causes the bushings at both ends of the trailing arm to twist in an oblique direction, point A in the illustration is caused to shift toward the center of the vehicle. The force also acts on the bushings at both ends of the lower arm in their diametric direction, and point B is consequently displaced toward the center of the vehicle by the amount equivalent to the total deflection of the two bushings (at both ends of the lower arm). The force exerted to the bushing of the toe control arm also acts in the diametric direction as in the case of the lower arm bushings, but point C is displaced toward the center of the vehicle only by the amount equivalent to the one bushing's deflection since point C is a ball joint.
The amount of the displacement of these points are compared below.

(Large displacement) Point A > Point B > Point C > (Small displacement)



Such being the displacement relationship of the three points, a toe-in state is maintained even in side force conditions.

VARIATION IN TOE ANGLE BY REARWARD FORCE INPUT

Generally, when the vehicle goes over a projection on road or when braking, rearward forces will act on the tires and a toe-out condition will occur because of the resulting compliance steer. The multi-link suspension, however, maintains a toe-in state as shown at the left thanks to its proper arrangement of the individual control arms even when the vehicle goes over a bump or it is braked and its wheels are subject to rearward forces.

WHEELS AND TIRES

N73ZG00AA

SPECIFICATIONS

Items	Medium price	High price	Premium price		
			FWD	AWD	
				A/T	M/T
Wheel					
Tire size	P195/70R14 90H	P205/55R16 89H	P205/55R16 89V		215/55R16 91V
Wheel type	Steel type Aluminum type*1	Steel type Aluminum type*1	Aluminum type		Aluminum type
Wheel size	14 x 5.5JJ	16 x 6JJ	16 x 6JJ		16 x 6JJ
Amount of wheel offset mm (in.)	46 (1.8)	46 (1.8)	46 (1.8)		46 (1.8)
Tire inflation pressure kPa (psi.)					
Front	220 (32)	220 (32)	220 (32)		220 (32)
Rear	200 (29)	200 (29)	200 (29)		200 (29)
Spear wheel					
Tire size	T125/70D15 T125/80D16*2			T125/90D16	
Wheel size	15 x 4T 16 x 4T*2			16 x 4T	
Amount of wheel offset mm (in.)	46 (1.8)			46 (1.8)	
Tire inflation pressure kPa (psi.)	420 (60)			420 (60)	

NOTE
(1) *1: Option
(2) *2: Option in combination with ABS

POWER STEERING

N73ZE00AA

All models come standard with an engine speed sensitive power steering system.

FEATURES

N73ZE01AA

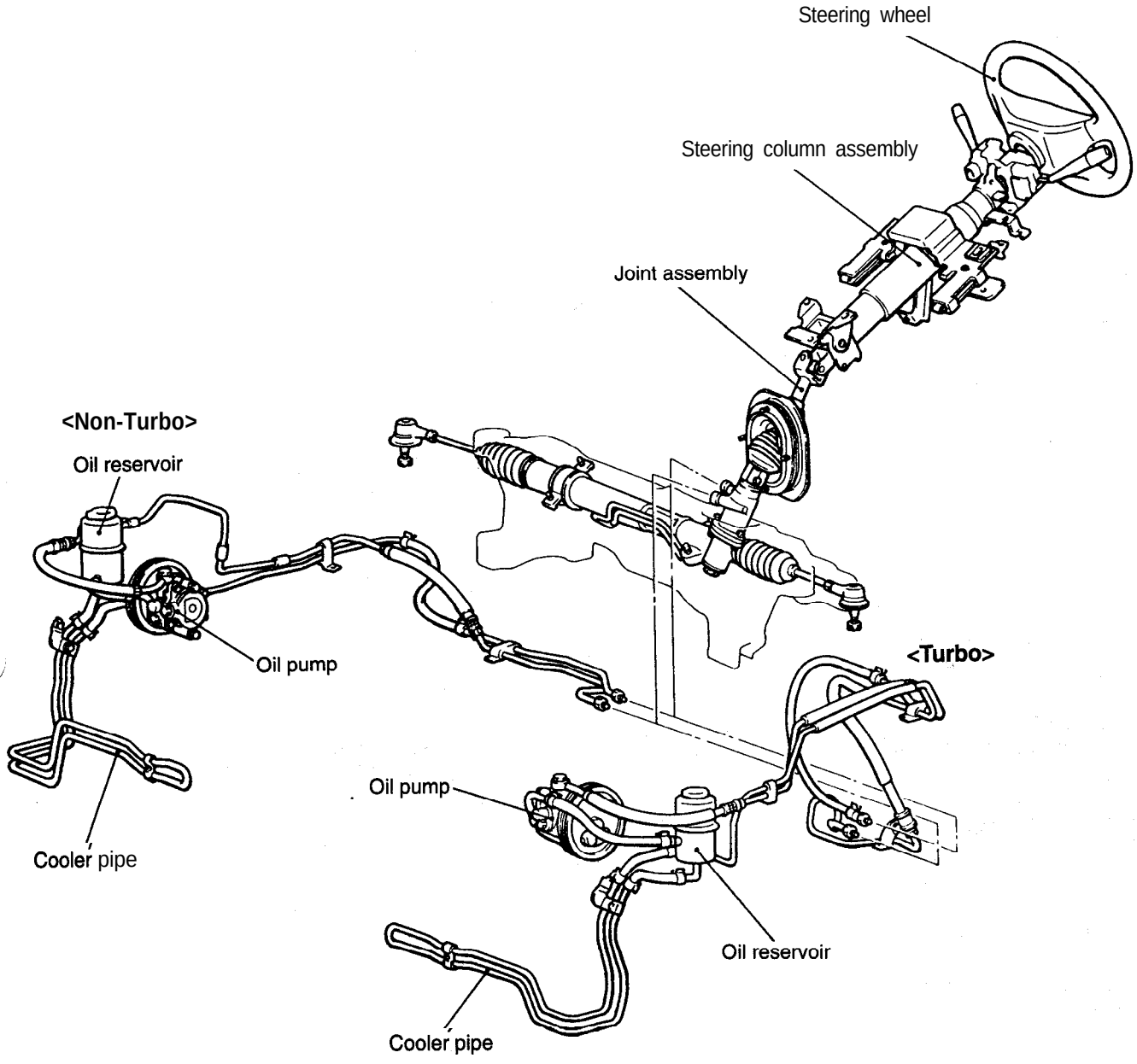
High Steering Stability	Engine speed sensitive power steering
Improved Safety	1. Impact absorption mechanism 2. Supplemental Restraint System (SRS)
Upgraded Serviceability and Reliability	Double-lip oil seals used in power cylinder

- The 4-spoke type steering wheel with SRS unit is adopted on all models.
  [For information on the SRS, refer to the "Interior – Supplemental Restraint System (SRS)" section.]
- The steering column incorporates both a shock absorbing mechanism and a tilt steering mechanism.
- The steering system uses a vane oil pump with fluid flow control system.
- The steering gear and linkage system is highly reliable integral rack and pinion type which features light weight and compact size.

SPECIFICATIONS

Items		Non-turbo	Turbo
Steering wheel maximum turns		2.41	
Steering angle (vehicle in unladen) Inner wheel Outer wheel		 32°30' ± 2" 27°00	
Steering gear and linkage Type Gear type Gear ratio Rack stroke	 mm (in.)	 Integral type Rack and pinion ∞ (infinity) 124 (4.9)	
Oil pump type Displacement Relief set pressure	 cm^3/rev. (cu.in./rev.) MPa (psi.)	Vane type with fluid flow control system 10.5 (.64) 8.8 (1,277)	Vane type with fluid flow control system 9.6 (.59) 8.8 (1,277)

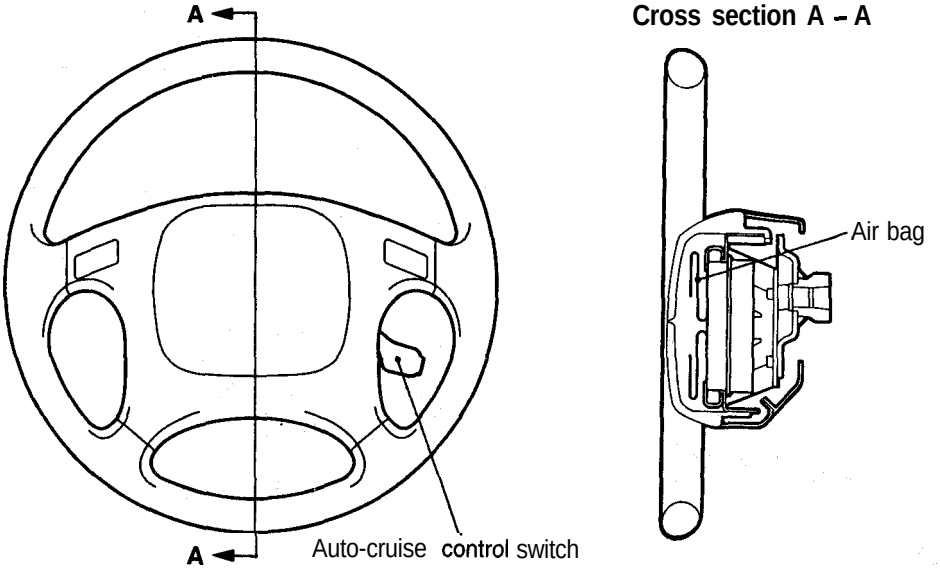
CONSTRUCTION



STEERING WHEEL

The steering wheel have the following features to provide excellent maneuverability and stability.

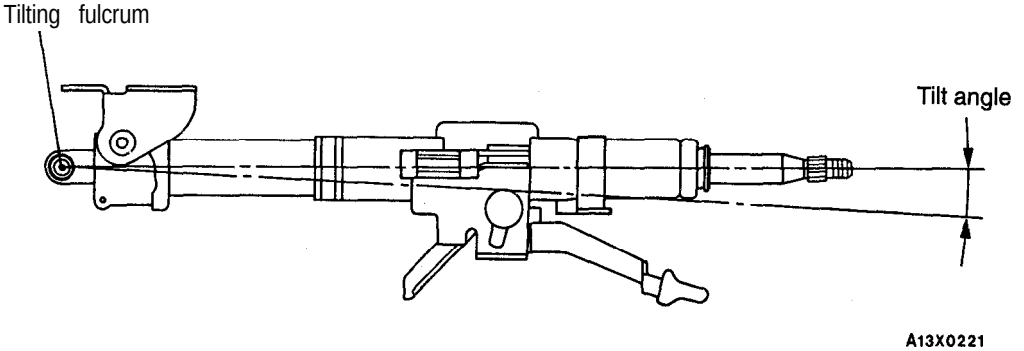
- The steering wheel has been specially designed for improved maneuverability and good view of meters. Some model versions come with a steering wheel with auto-cruise control switches on it.
- The air bag incorporated in the steering wheel provides the driver with additional protection against the shock from a front-end collision.



A13X0218

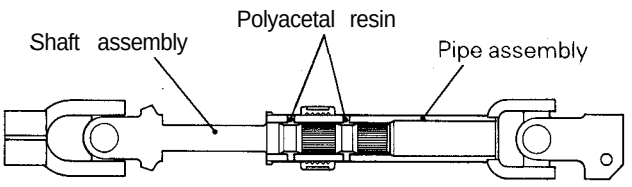
STEERING SHAFT AND COLUMN

All model versions come standard with a tilt steering mechanism which allows the driver to select an optimum driving position. Also adopted is an impact absorption mechanism to absorb impact energy in a collision, thereby ensuring the safety of the driver.



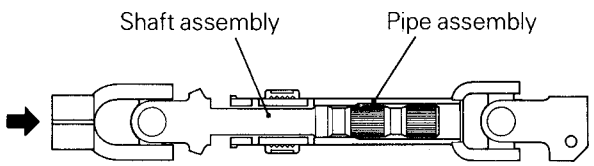
A13X0221

BEFORE SHOCK



13x0057

AFTER SHOCK

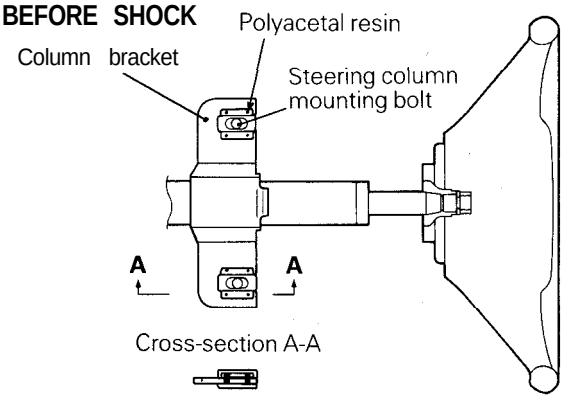


13X0056

SHOCK ABSORBING STRUCTURE

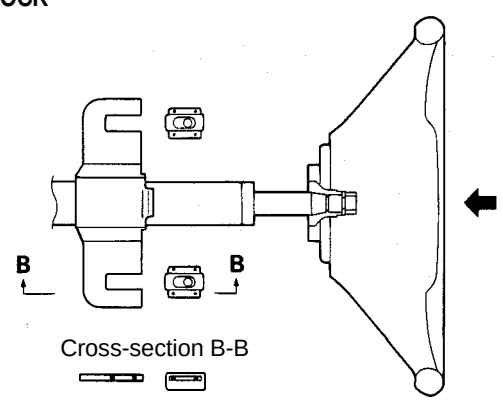
(1) When the vehicle collides with something and there is a load added to the steering shaft from the gear box (primary shock), the polyacetal resin in the joint assembly is separated, and the shaft assembly slides into the pipe assembly, absorbing the shock load.

BEFORE SHOCK



13X0053

AFTER SHOCK

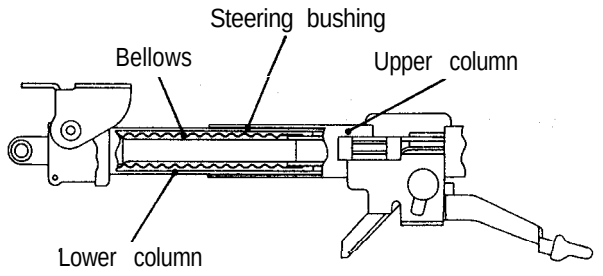


13X0072

(2) If the driver's body falls against the steering wheel (secondary shock), the shock load is absorbed in the following two steps.

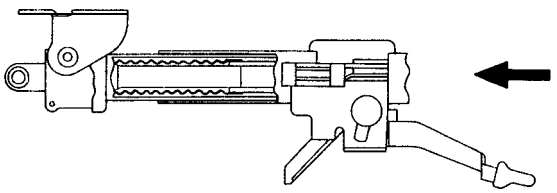
① When a load is added to the steering wheel, the column bracket crushes the polyacetal resin and slides forward, absorbing the shock load.

BEFORE SHOCK



AI 3X0223

AFTER SHOCK



AI 3X0222

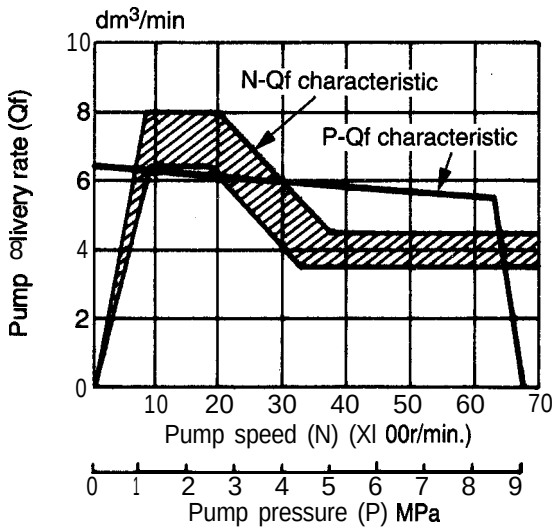
② When a shock load is applied to the steering wheel, the upper column slides forward. At the same time, the bellows of the steering shaft are deformed. During this process, the shock load is absorbed by the friction between the lower column and the inside surface of the steering bushing attached to the upper column.

OIL PUMP

The oil pump is an engine speed sensitive type which changes its delivery rate so that the steering wheel turning effort will always be optimized.

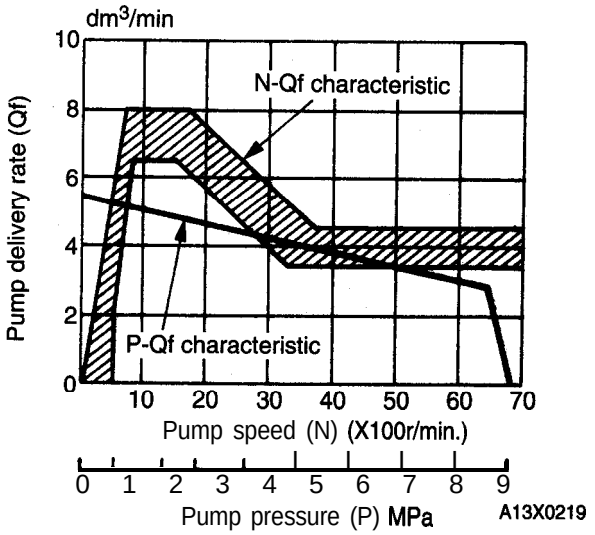
OIL PUMP PERFORMANCE

<Non-turbo>



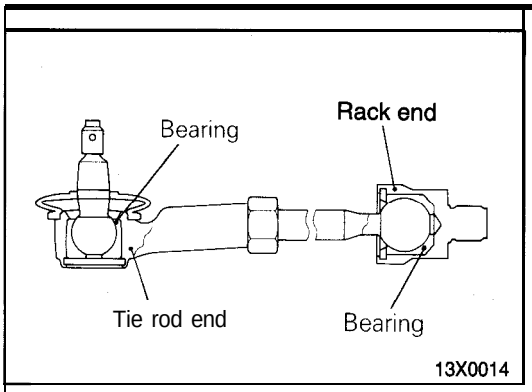
AI 3X0220

<Turbo>



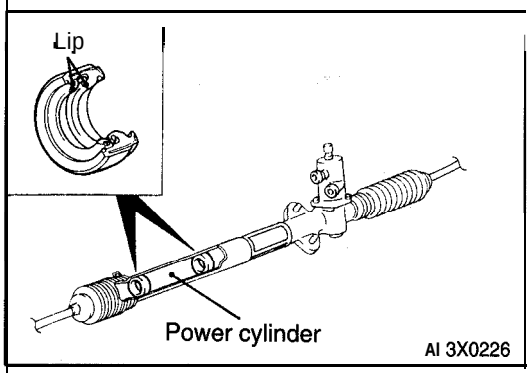
A13X0219

NOTE
(1) P-Qf characteristic: Pump pressure and pump delivery rate.
(2) N-Qf characteristic: Pump speed and pump delivery rate.

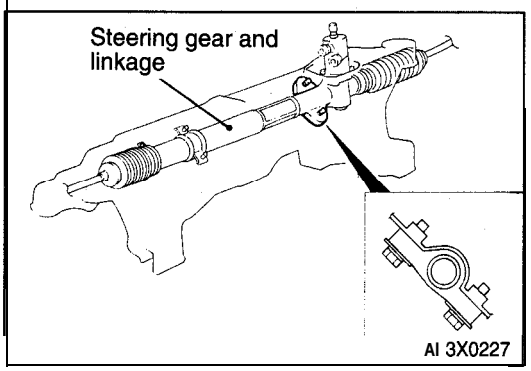


STEERING GEAR AND LINKAGE

(1) The bearings used in the rack end and the tie rod end ball joints are one-piece type bearings which ensure higher rigidity.



(2) Double-lip type oil seals are used in the power cylinder to improve the reliability.



(3) The pinion shaft side of the steering gear and linkage assembly has been secured directly to the cross member for higher rigidity and positional accuracy.

BRAKES

N73ZL00AA

The brake system offers high dependability and durability along with improved braking performance and brake sensitivity.

FEATURES

Improved braking performance

1. The 4-wheel anti-lock brake system (4ABS) prevents skidding that may result from locked wheels, thereby assuring safe braking.
2. For some models, 2-piston type ventilated disc brakes have been adopted for front wheels to provide more stable braking and better braking feel.
3. For some models, a tandem brake booster has been adopted which provides powerful braking with a light foot pressure.
4. For some models, drum-in-disc brakes have been adopted for rear wheels. This type of brakes have built-in parking brakes which provide outstanding braking stability.

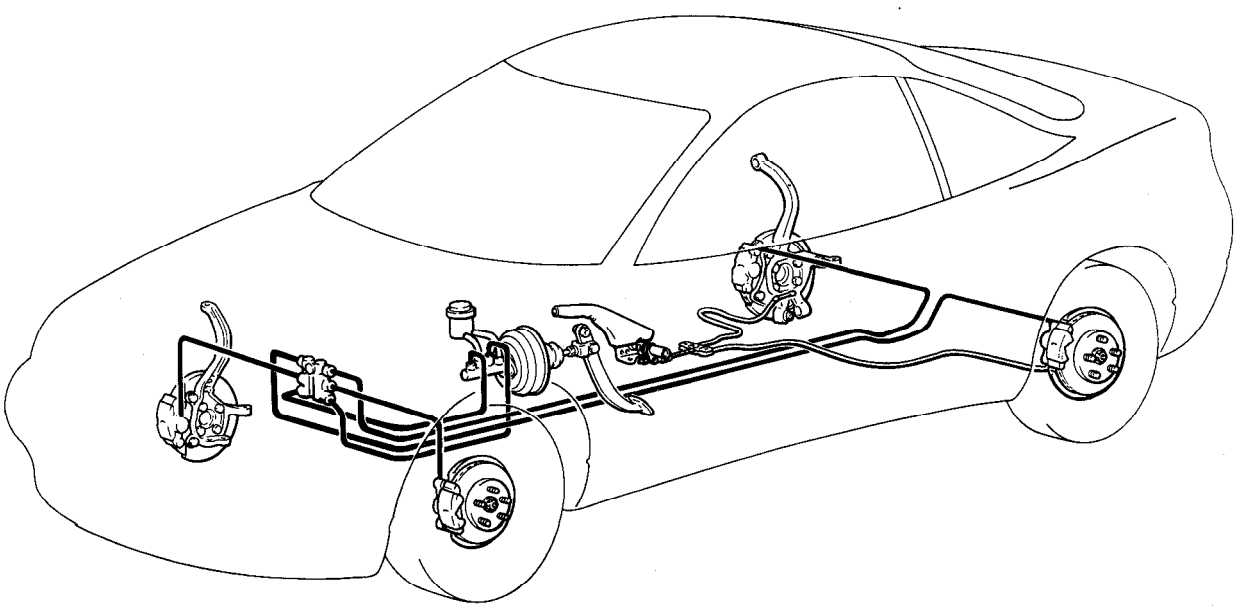
Improved serviceability

1. For ease of inspection, a self-diagnosis capability has been adopted for the 4ABS.
2. Both the front and rear brakes use a lug nut mounted outer disc design for ease of removal and installation
3. The master cylinder reserve tank cap is white for easy recognition

Higher safety

1. An audible wear indicator alerts the driver to the brake pad limit.
2. Proportioning valves prevent the rear wheels from locking too quickly
3. Front and rear X brake lines.

CONSTRUCTION DIAGRAM



14X0271

SERVICE BRAKES

SPECIFICATIONS

Items	FWD			AWD
	Non-Turbo		Turbo	
	Medium price	Except medium price		
Master cylinder				
Type	Tandem type (with level sensor)	Tandem type (with level sensor)	Tandem type (with level sensor)	Tandem type (with level sensor)
I.D. mm (in.)	23.8 ($^{15}/_{16}$) 25.4 (1)*	23.8 ($^{15}/_{16}$) 25.4 (1)*	23.8 ($^{15}/_{16}$) 25.4 (1)*	25.4 (1)
Brake booster				
Type	Vacuum type	Vacuum type	Vacuum type	Vacuum type
Effective dia. of power cylinder mm (in.)	230 (9) 180 + 205 (7 + 8)*	230 (9) 180 + 205 (7 + 8)*	180 + 205 (7 + 8) 205 + 230 (8 + 9)*	180 + 205 (7 + 8) 205 + 230 (8 + 9)*
Boosting ratio	6.0, 6.5*	6.0, 6.5*	6.5, 7.0*	6.5, 7.0*
Proportioning valve				
Type	Dual type	Dual type	Dual type	Dual type
Decompression ratio	0.25	0.25	0.25	0.25
Front brakes				
Type	Floating caliper, single-piston, ventilated disc	Floating caliper, single-piston, ventilated disc	Floating caliper, single-piston, ventilated disc	Floating caliper, single-piston, ventilated disc
Disc effective dia. mm (in.)	204 (8)	204 (8)	204 (8)	228 (9)
Wheel cylinder I.D. mm (in.)	60.3 (2 $^{3}/_{8}$)	60.3 (2 $^{3}/_{8}$)	60.3 (2 $^{3}/_{8}$)	42.9 x 2 (1 $^{11}/_{12}$ x 2)
Rear drum brakes				
Type	Leading-trailing	–		–
Drum I.D. mm (in.)	203 (8)	–	–	–
Wheel cylinder I.D. mm (in.)	20.6 ($^{13}/_{16}$)		–	–
Lining thickness mm (in.)	4.4 (.17)		–	–
Rear disc brakes				
Type	Floating caliper,* single piston, solid disc	Floating caliper, single piston, solid disc	Floating caliper, single piston, solid disc	Floating caliper, single piston, ventilated disc
Disc effective dia. mm (in.)	222 (8.7)*	222 (8.7)	222 (8.7)	237 (9.3)
Wheel cylinder I.D. mm (in.)	34.9 (1 $^{3}/_{8}$)*	34.9 (1 $^{3}/_{8}$)	34.9 (1 $^{3}/_{8}$)	38.1 (1 $^{1}/_{2}$)
ABS				
Rotor teeth				
Front	43	43	43	43
Rear	43	43	43	43
Speed sensor	Magnet coil type	Magnet coil type	Magnet coil type	Magnet coil type

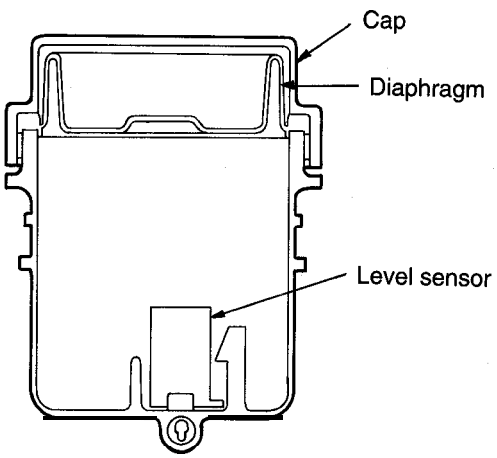
NOTE *: Vehicles with ABS

MASTER CYLINDER

Constructed to provide a maximum measure of safety, the master cylinder offers the following features.

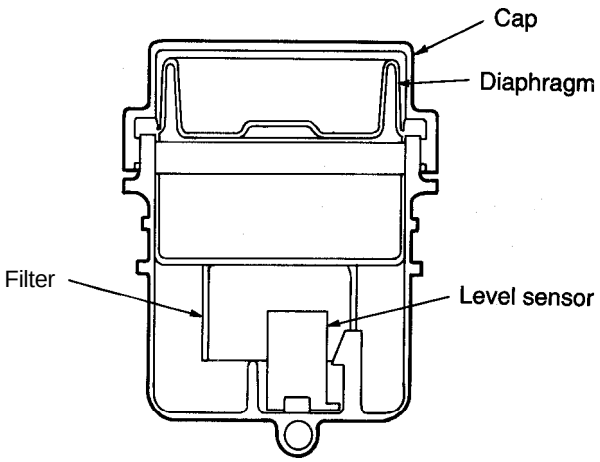
- A tandem type master cylinder.
- On ABS equipped vehicles, a filter is provided in the reserve tank to prevent foreign matter from entering when adding or replacing brake fluid.
- The reserve tank cap is white for easy recognition which improves serviceability.
- The master cylinder for the ABS equipped vehicles incorporates a center valve to cope with a high pressure that is generated when the ABS is in operation.

<Vehicles without ABS>

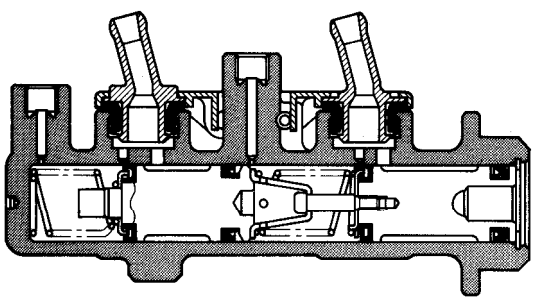


14X0308

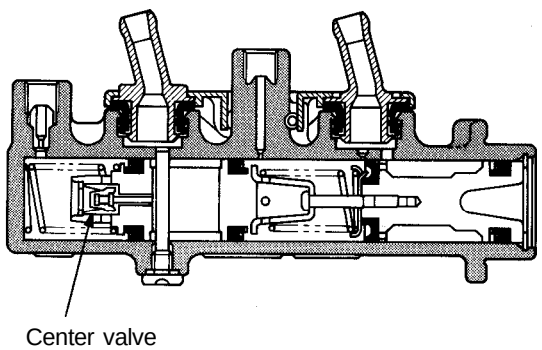
<Vehicles with ABS>



14X0309



14X0230

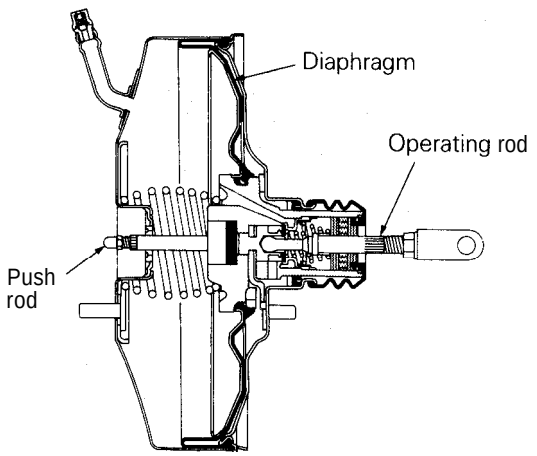


14X0231

BRAKE BOOSTER

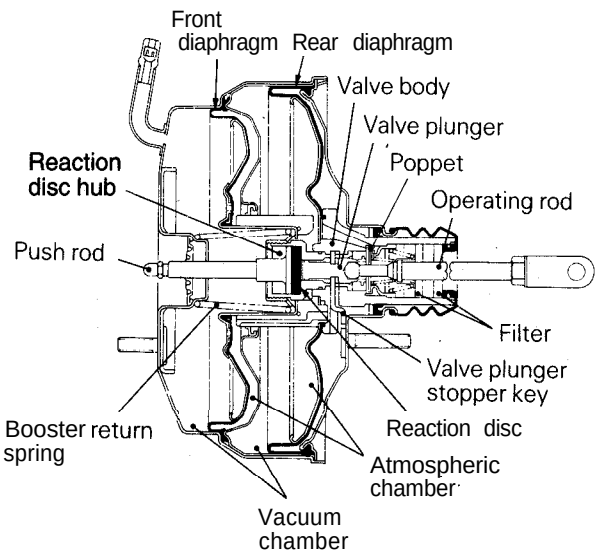
Brake booster comes in three types: 230 mm (9 in.), 180 + 205 mm (7 + 8 in.) and 205 + 230 mm (8 + 9 in.) diameter ones. An appropriate one of them is used to each model variation. The tandem type boosters have two diaphragms each. The two-diaphragm configuration can utilize a doubled pressure difference between the vacuum and the atmospheric pressure, so that a large boosting effect can be obtained with a small outside diameter, thereby contributing to size and weight reduction.

<230 mm (9 in.) Brake Booster>



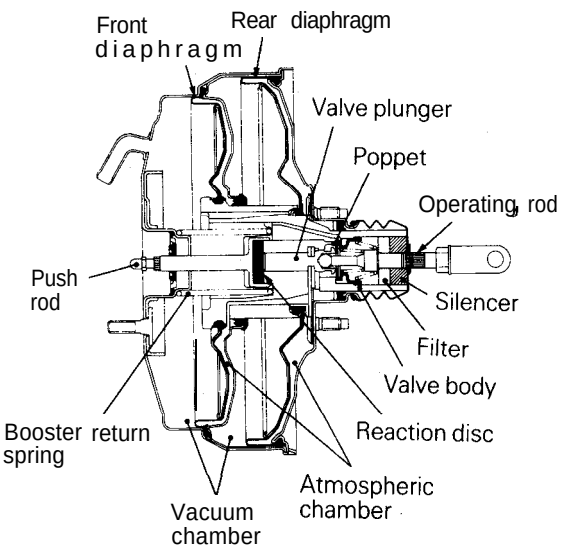
14P0075

<180 + 205 mm (7 + 8 in.) Tandem Brake Booster>



14A0124

<205 + 230 mm (8 + 9 in.) Tandem Brake Booster>



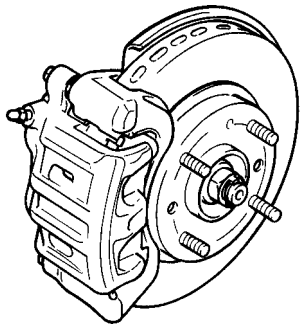
14C0062

DISC BRAKES

Either single- or double-piston type disc brakes are used for the front wheels, and the single-piston type disc brakes are used for the rear wheels.

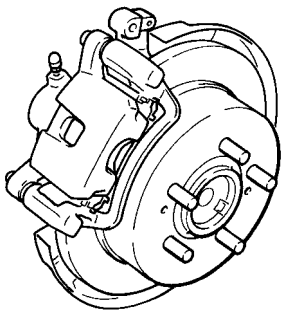
- Drum in-disc brakes with dedicated parking brake shoes and drum.
- The outer disc system, which jointly tightens the wheel and brake disc, improves serviceability.
- For improved safety, the brake pad employs an audible wear indicator (inside the body).

<Double-piston type>

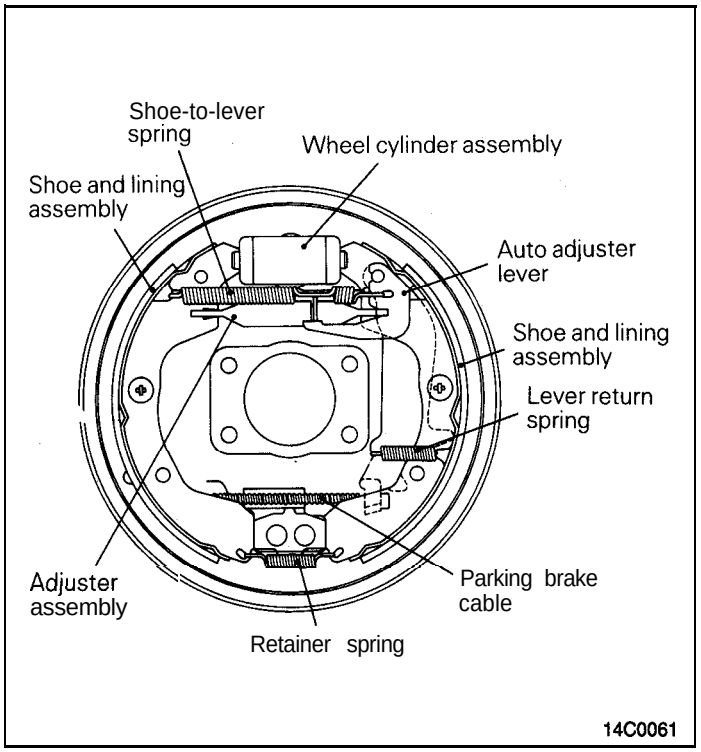


14X0060

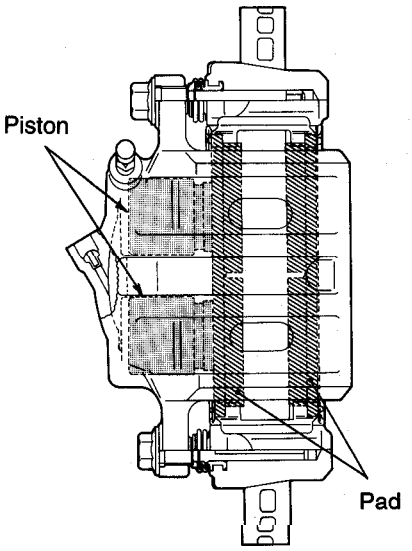
<Single-piston type>



14X0228

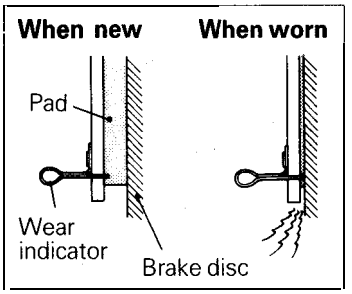


14C0061



14A0545

<Wear indicator>



REAR DRUM BRAKES

The rear drum brakes are 205 mm (8 in.)-diameter leading-trailing type brakes which always provide stable braking during a forward or reverse movement.

The drum brakes incorporates an automatic adjuster mechanism which automatically adjusts the shoe clearance when the brake pedal is depressed.

ANTI-LOCK BRAKE SYSTEM (ABS) <FWD>

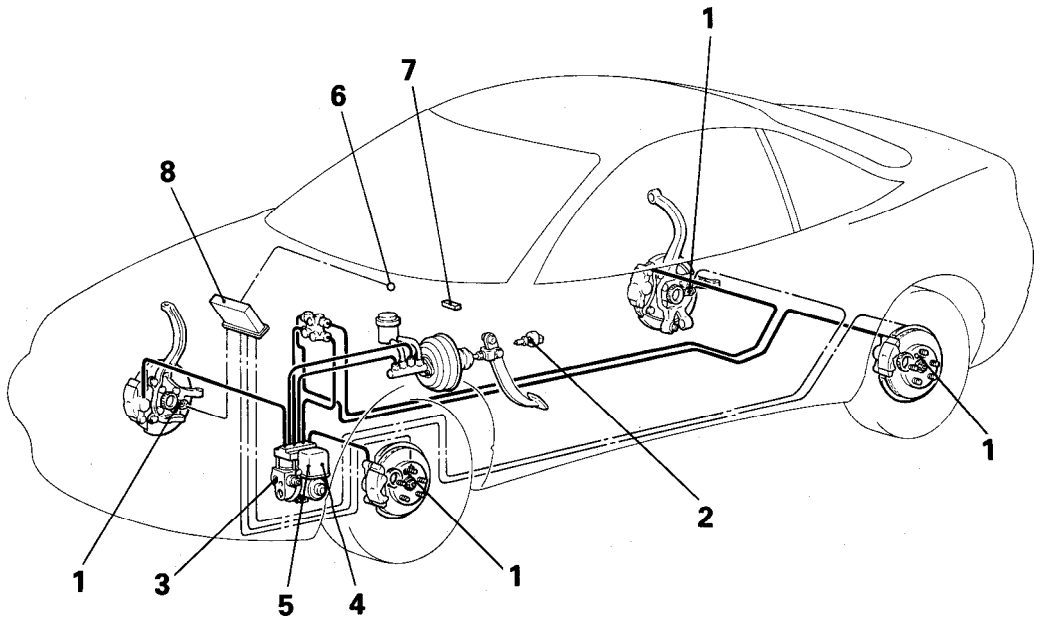
N73ZM00AA

The ABS used in the 1995 Eclipse is similar to the previous one.

The ABS is a brake system which detects skids that could be caused by abrupt brake application or by brake application on a slippery road surface, and adequately controls the brake fluid pressure to prevent skids caused by locked wheels. It assures directional stability and steerability during brake application and reduces the brake stopping distance. The basic principles and effects of the ABS are the same as those of the conventional system.

The major features of the ABS are described below.

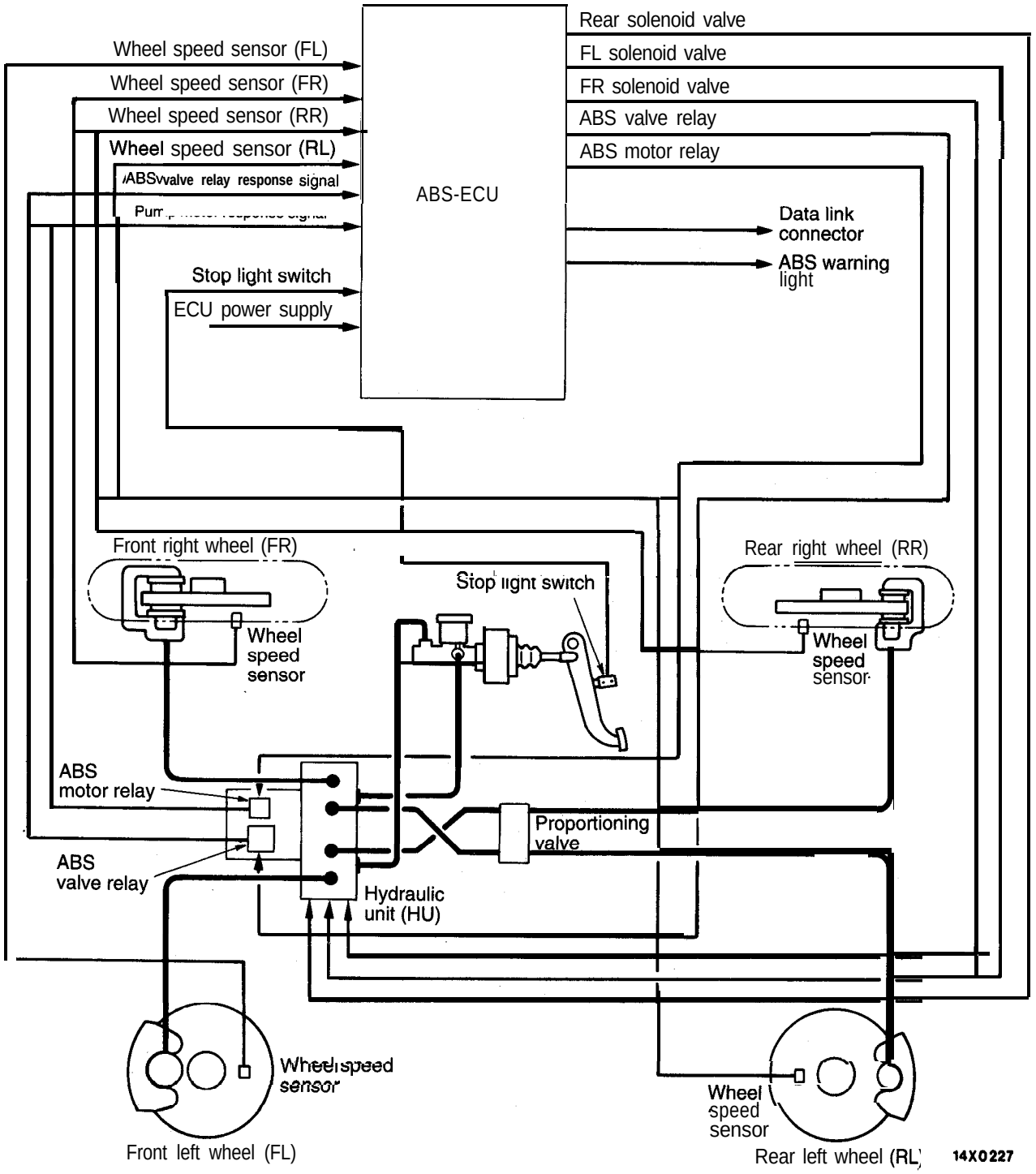
- When a failure occurs in the system, you can identify the faulty area in the diagnostic test mode. The failure data stored in memory is not erased even if the ignition switch is placed in the OFF position. Use of the scan tool enables you to read the diagnostic trouble code or clear the memory. In addition, you can read the sensor data (data list) stored in the electronic control unit (ECU) and test the hydraulic unit (HU) and other actuators. (Refer to P. 3-43.)



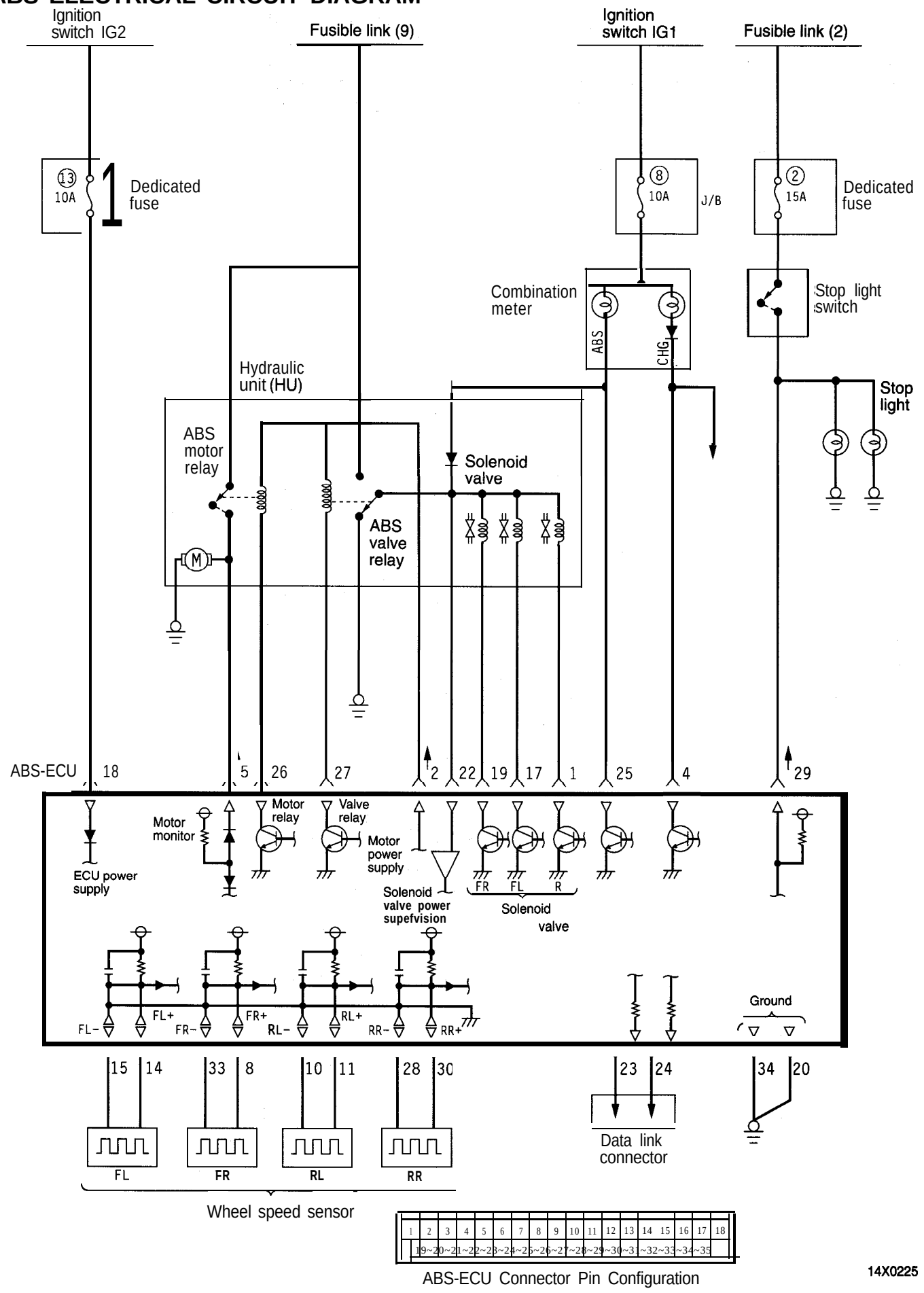
14X0269

Part name		No.	Function
Sensor	Wheel speed sensor	1	Sends an AC signal with a frequency proportional to the rotating speed of the individual wheel to the ABS-ECU.
	Stop light switch	2	Sends a signal to the ABS-ECU indicating whether the brake pedal is pressed or not.
Actuator	Hydraulic unit (HU)	3	Controls braking pressure for each wheel depending on the signal from the ABS-ECU. Includes built-in plunger valve
	Motor relay	4	Closes contact in response to a signal from the ABS-ECU to allow the power to be supplied to the motor in the HU.
	Valve relay	5	Is turned ON by the ABS-ECU signal and supplies power to the solenoid valve in HU.
	ABS warning light	6	Is in the combination meter and lights up when there is trouble in ABS.
	Data link connector	7	Outputs diagnostic trouble codes.
Electronic control unit (ECU)		8	Controls the actuators such as HU according to the signals from the individual sensors.

SYSTEM DRAWING



ABS ELECTRICAL CIRCUIT DIAGRAM

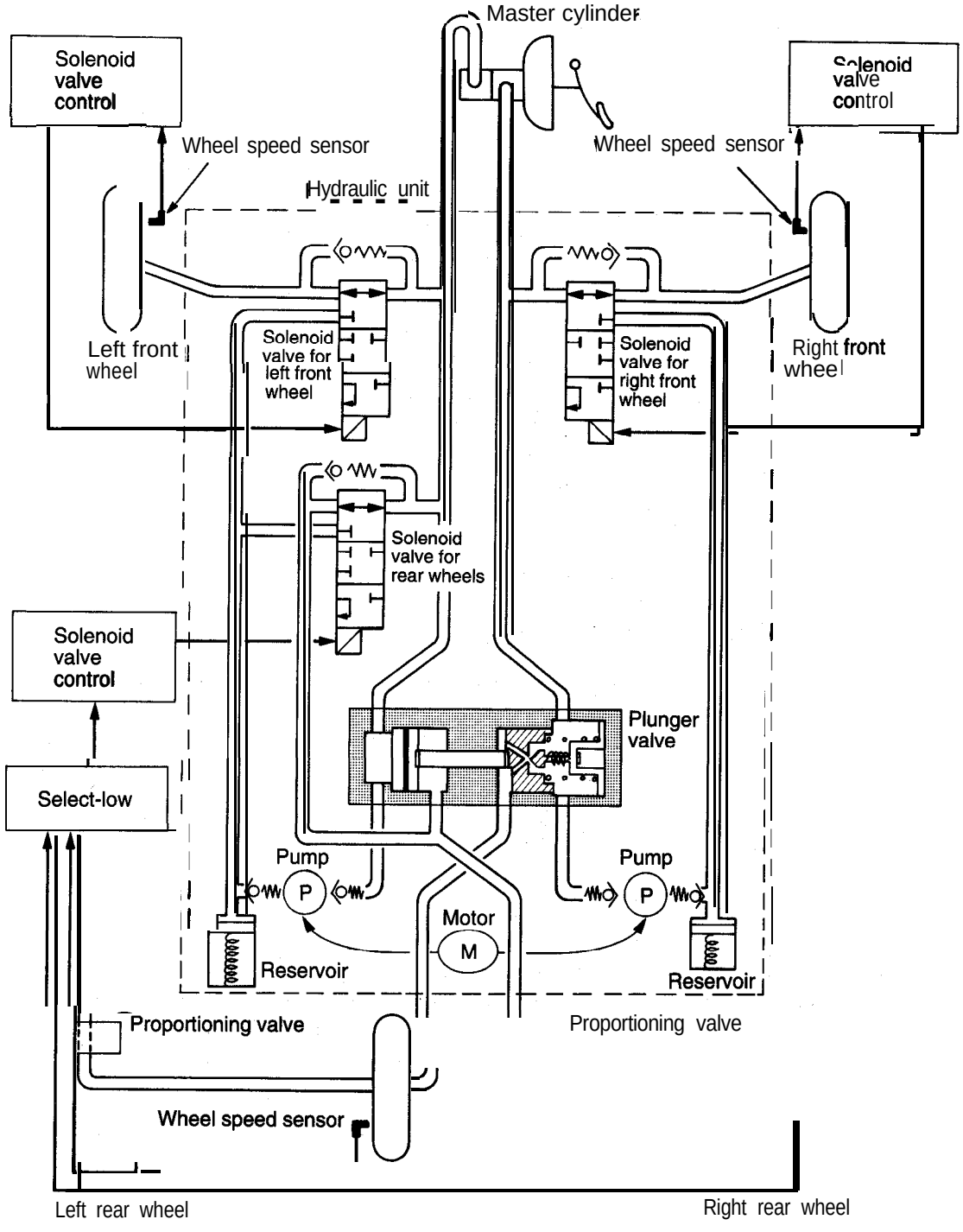


ABS-ECU Connector Pin Configuration

14X0225

ABS HYDRAULIC PRESSURE FUNCTION DIAGRAM

The ABS for FWD operates independently on the right and left front wheels and controls each solenoid valve by sensing each wheel speed sensor. It controls the solenoid valve for the rear wheels by using the rear wheel speed sensor select-low for the right and left rear wheels. In other words, when either the right or left rear wheel is about to lock, the solenoid valve for the rear wheels is activated and hydraulic pressure is simultaneously reduced in both rear wheels through the use of a plunger valve.
Select-low: this is a method of providing the same hydraulic control to both wheels when either wheel is about to lock, matching it to the side about to lock, or a method to control by matching pressure to the low side.



14F0013

SENSOR

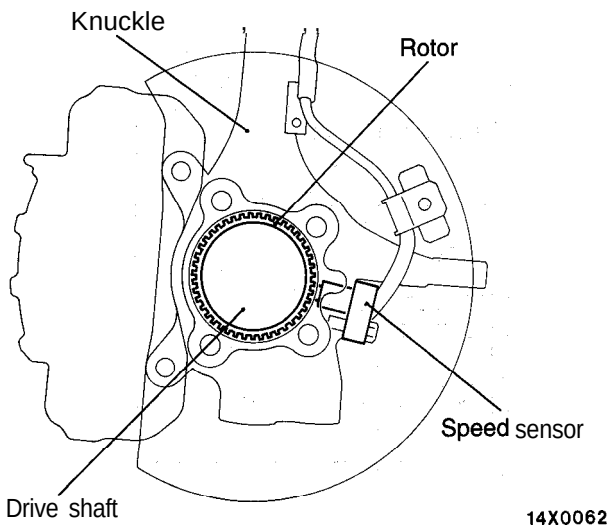
N73ZM01AA

WHEEL SPEED SENSOR

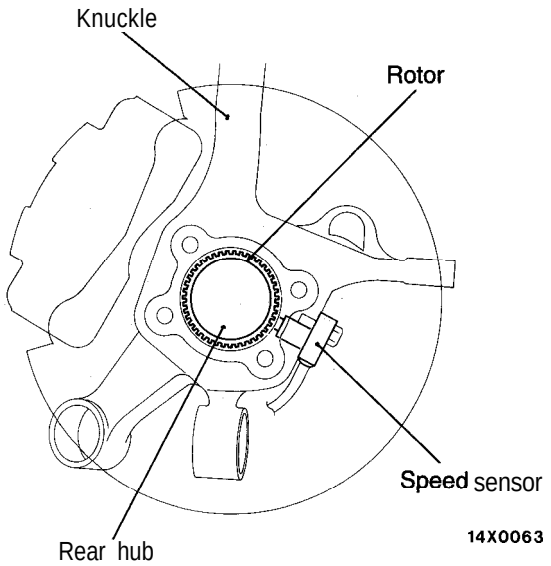
The wheel speed sensor is a type of pulse generator consisting of a rotor rotating at the same speed as the wheel and a speed sensor secured to the knuckle.

- For a front wheel, the rotor (43 teeth) is mounted on the front drive shaft and the speed sensor mounted on the knuckle.
- For a rear wheel, the rotor (43 teeth) is mounted on the rear hub, and the speed sensor mounted on the knuckle.
- For both front and rear wheels, the spacing between the sensor and rotor is adjustment-free.

FRONT

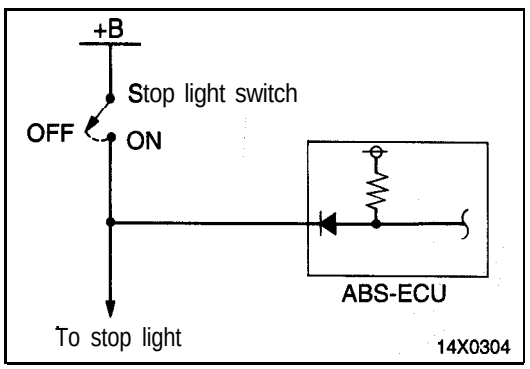


REAR



14X0062

14X0063



STOP LIGHT SWITCH

The signal from the stop light switch is input to the ABS-ECU as a brake pedal movement signal.
When the brake pedal is depressed, the stop light switch circuit contact closes (ON), and when the brake pedal is released, it opens (OFF). When the contact is closed, the output voltage is at the battery voltage level (HIGH), and when it is opened, the output voltage is at about 0 V (LOW).

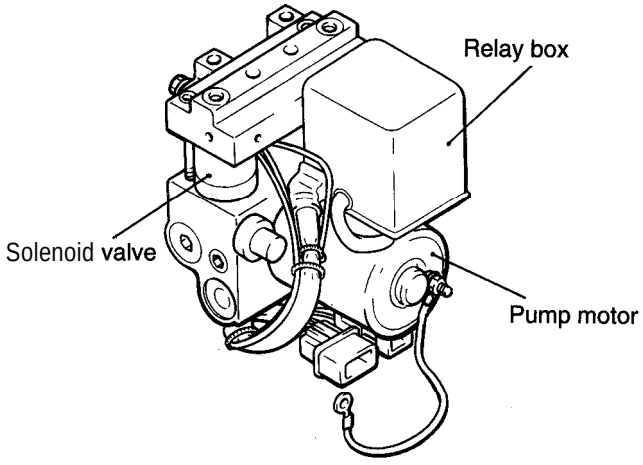
ACTUATOR

N73ZM02AA

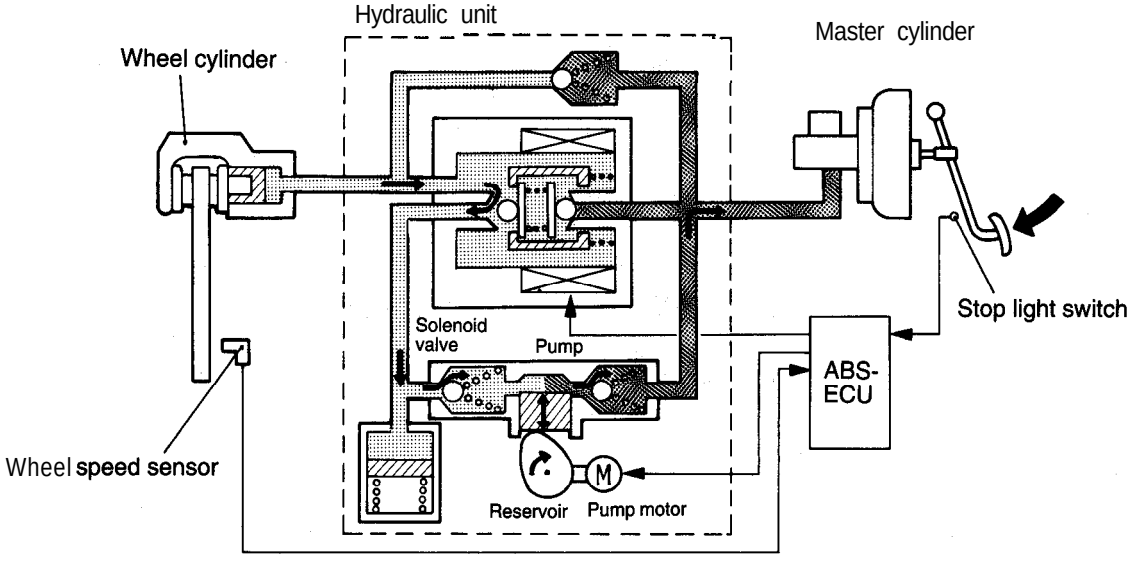
HYDRAULIC UNIT (HU)

- The HU, elastically supported by the shield plate at the front left of the engine room, consists of a motor pump, plunger valve, reservoir and three solenoid valves.
- The HU, positioned between the brake master cylinder and each wheel cylinder, is a hydraulic circuit split into two systems associated with the normal X pipings when the ABS is inactive.

When the ABS is active, the motor is operated by a signal from the ABS-ECU to let the pump generate a hydraulic pressure required to return fluid against master cylinder pressure. At the same time, three solenoid valves are operated to control the hydraulic pressure that acts on the wheel cylinder.



14X0305

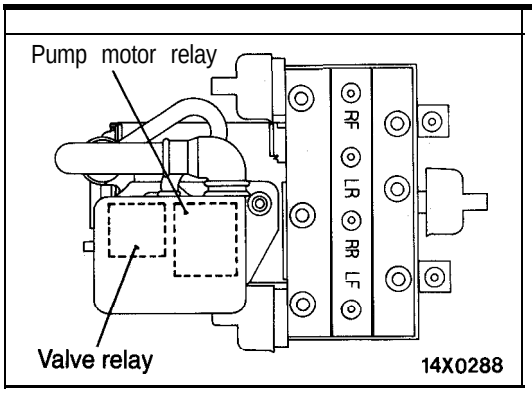


14F0054

14F0054

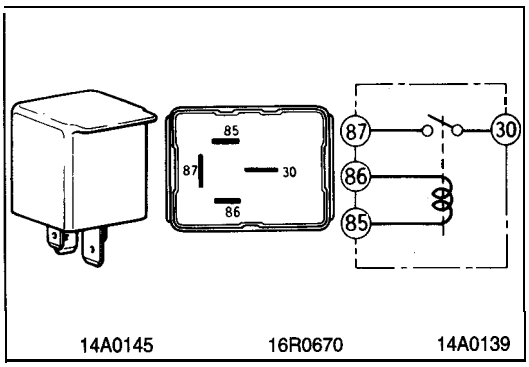
Solenoid valve and plunger valve

Refer to 1991 3000GT Technical Information Manual (Pub. No. PXSE9001).



Relay Box

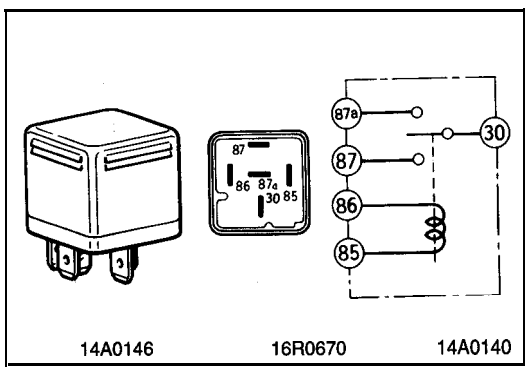
The motor relay and valve relay are mounted on the hydraulic unit.



MOTOR RELAY

This relay turns the pump motor in the HU ON and OFF.

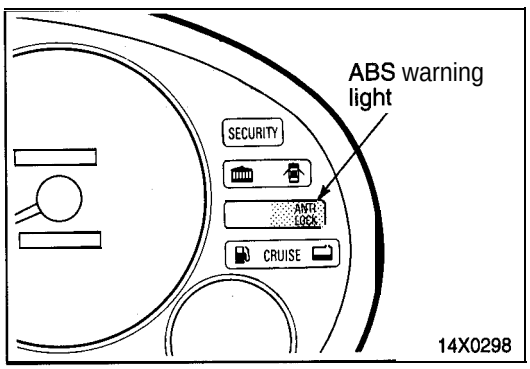
NOTE
Refer to the section on ECU control for ON/OFF control.



VALVE RELAY

This relay turns current to the solenoid valve in the HU ON and OFF.

NOTE
Refer to the section on ECU control for ON/OFF control.



ABS WARNING LIGHT

This light lights up in case if there is a breakdown in the ABS. Furthermore, it checks whether the bulb is burnt out when the engine is started.

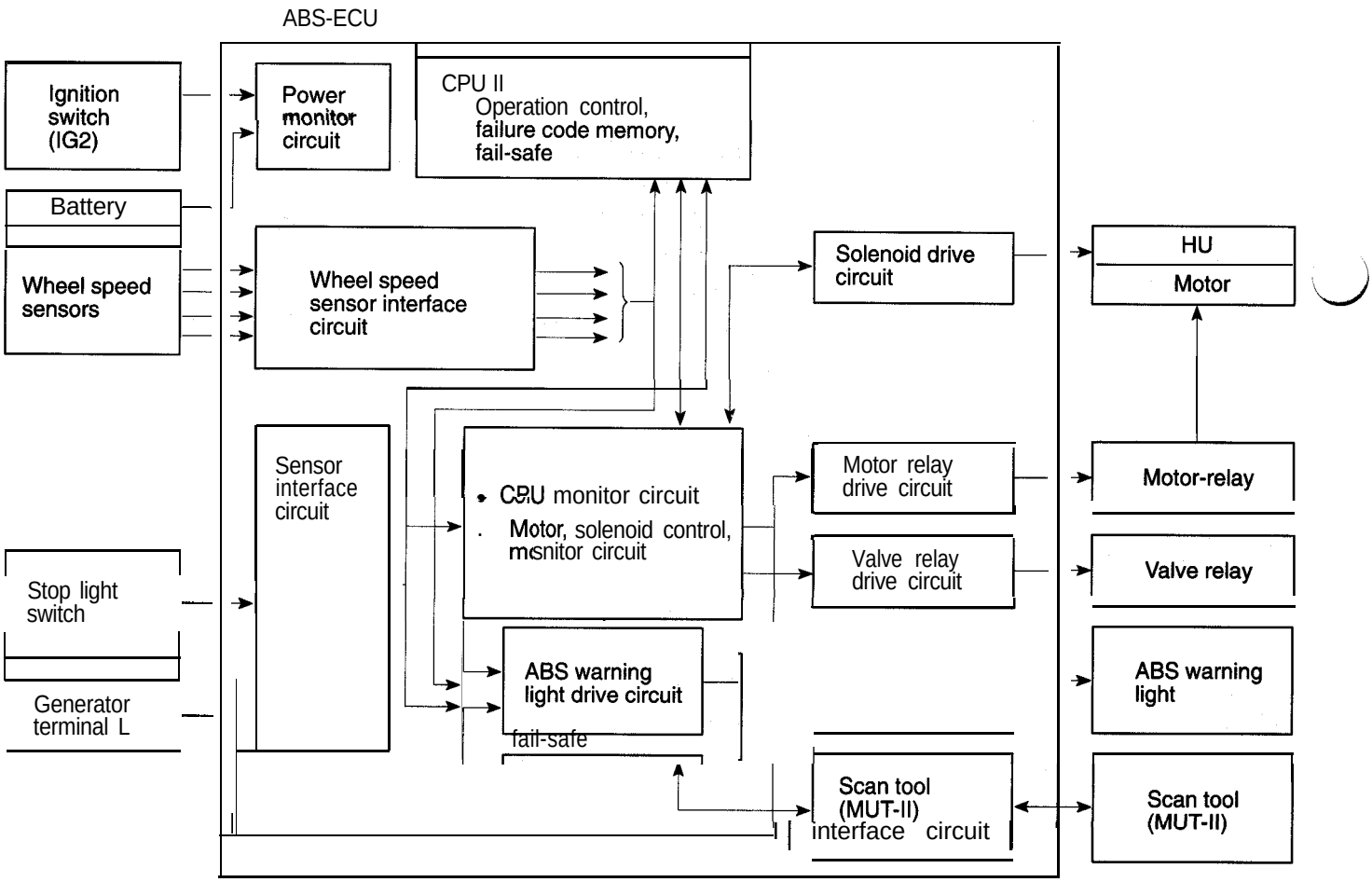
NOTE
Refer to the section on ECU Control for warning light control.

ELECTRONIC CONTROL UNIT (ECU)

N73ZM03AA

- The ABS-ECU detects the vehicle speed in terms of a signal from the wheel speed sensor to determine the rotating condition of the wheel, estimates the skidding condition of the wheel on the basis of the predetermined theory, and outputs a signal to move the solenoid valve in the HU in such a way as to prevent locking the wheel.
- The ABS-ECU has diagnostic and memory functions.
  If any failure is found by diagnostic test mode, the fail-safe function is activated and the ABS warning light will illuminate.

BLOCK DIAGRAM



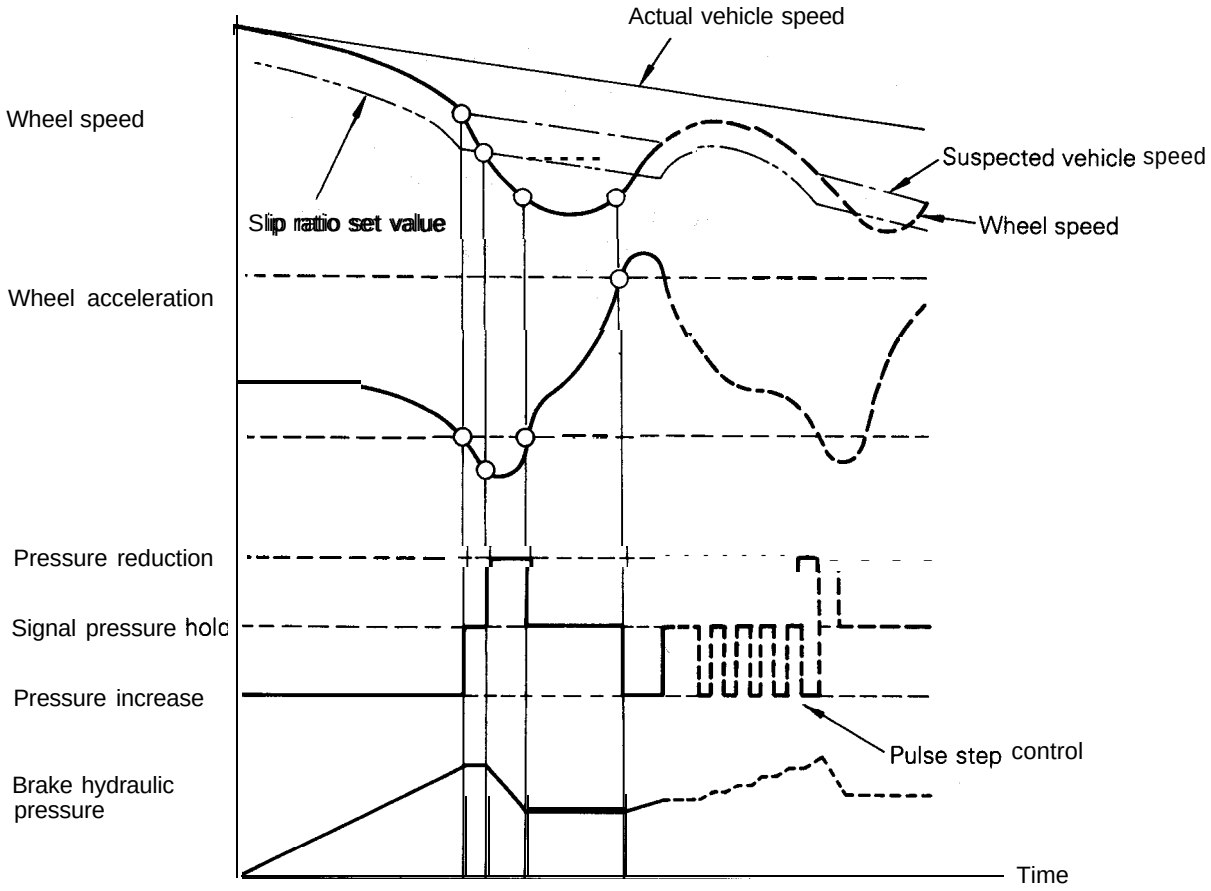
FUNCTION OF INDIVIDUAL CIRCUITS

(1) The wheel speed sensor interface circuit converts the AC voltage signal into DC pulse signal.
(2) The power monitor circuit, sensor interface circuit and motor drive monitor interface circuit are electrical converters for inputting the stop light switch and other vehicle condition signals.
(3) The CPU I and II are microcomputers which perform wheel speed, wheel deceleration and other calculations required for anti-lock control on the basis of the wheel speed signals input from the wheel speed sensors, and provides anti-lock controls according to the calculated data. The two microcomputers, CPU I and II, monitor each other to detect a failure in the system.
They also have diagnostic test mode and failure detection fail-safe functions.
(4) The solenoid drive circuit, motor relay drive circuit, valve relay drive circuit and ABS warning light drive circuit are electrical converters for ON/OFF control of the HU solenoid valves to control the brake fluid pressure, and for ON/OFF control of the motor for producing a high fluid pressure in the HU, and also for lighting the warning light to alert the driver to a system error.
(5) The failure code memory stores the codes of failures that occurred in the system and does not clear the data even if the battery power supply is disconnected.

EXPLANATION OF ECU CONTROL

Braking Hydraulic Pressure Control

The figure below shows the relation between the wheel speed, wheel acceleration, control signal from the ECU and braking hydraulic pressure.
The ECU uses the signal from each wheel speed sensor to calculate wheel speed and wheel acceleration, calculates suspected vehicle speed from these and monitors the slipping of the wheels. If it seems the wheels are about to lock during sudden braking, a signal to reduce pressure or a signal to hold pressure is sent to control wheel locking. On the other hand, if the danger of the wheel locking disappears, a signal to increase pressure is sent and the braking hydraulic pressure is increased to normal master cylinder pressure. Furthermore, in order to prevent a sudden increase in hydraulic pressure at this time, a pulse step control is performed to repeat the signal to increase pressure and the signal to hold pressure. By repeating this cycle and controlling the output braking hydraulic pressure, the wheel is kept in a narrow slipping ratio to assure the ideal braking force. This hydraulic pressure control is applied independently to the left front wheel, right front wheel and both rear wheels.



4-wheel Control

The ABS for FWD is a 4-sensor/3-channel method for independent control of the right and left front wheels and select-low control of the rear wheels.

Control Speed

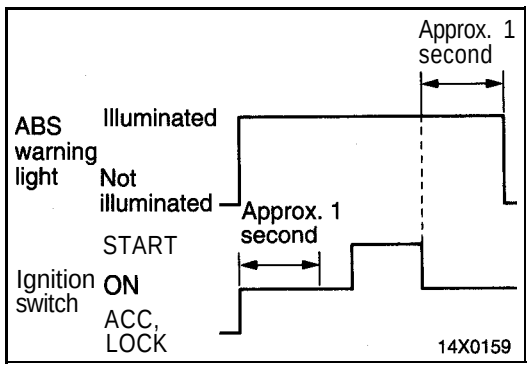
Brake pressure is controlled at a vehicle speed of approximately 8 km/h (5 mph) or higher. When vehicle speed falls below approximately 3 km/h (2 mph), control ends.

ABS MOTOR RELAY CONTROL

When a drive signal is output from the ABS-ECU to any of the solenoid valves, the motor relay is placed in the ON state to operate the pump motor.

ABS VALVE RELAY CONTROL

If the system is found O.K. after an initial check, the ABS valve relay is placed in the "ON" state to supply power to the solenoid valves of the HU to prepare for operation of ABS.



ABS Warning Light Control

In the following cases the ABS warning light lights up.

- If lights up when trouble in the system is recognized.
- It illuminates in the pattern shown in the figure on the left when the ignition switch is turned ON, to check the ABS warning light circuit.

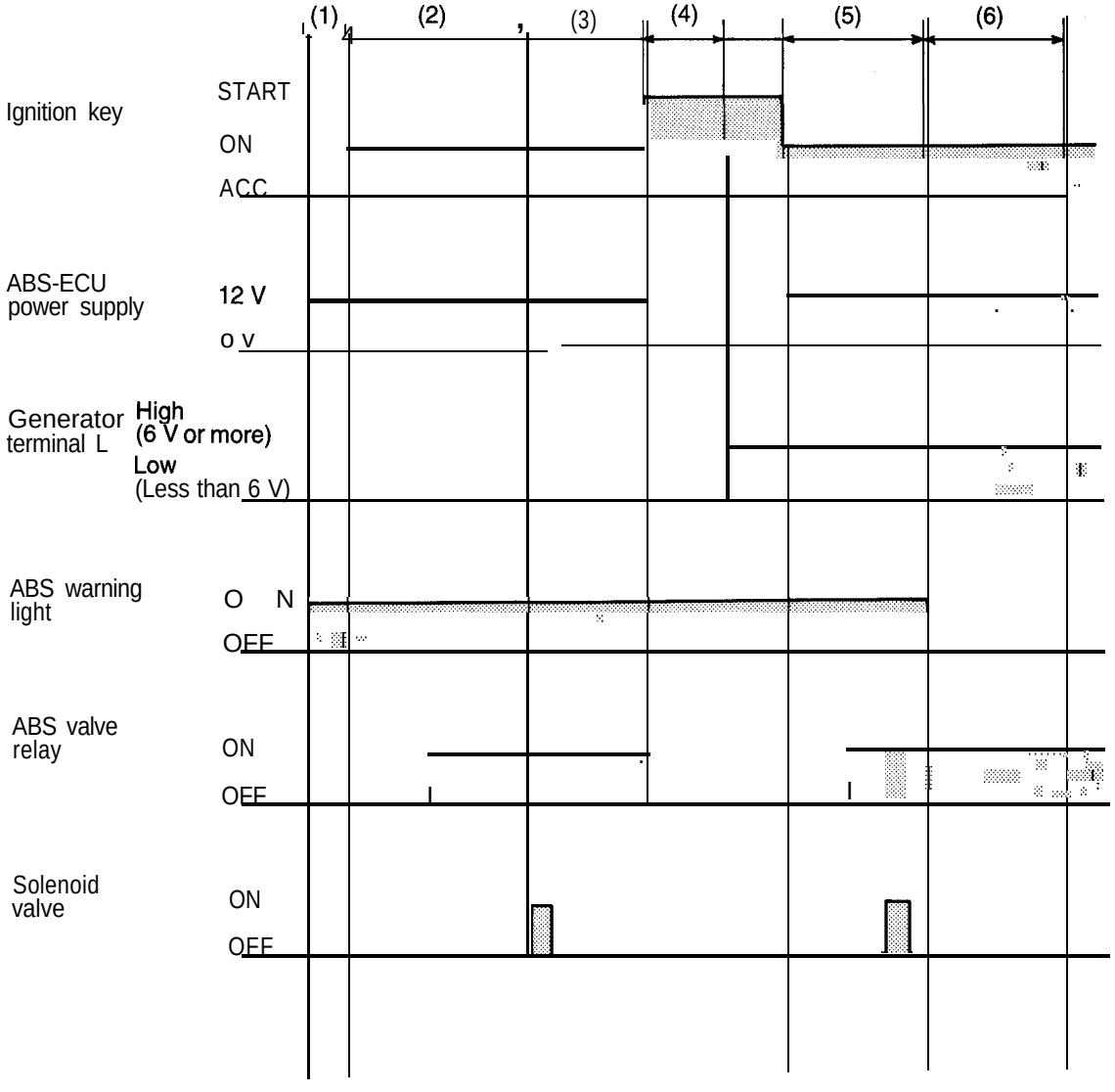
INITIAL CHECK FUNCTION

The ECU always performs an initial check on the ABS system with the on-board diagnostic function. If it detects an error, it illuminates the warning light, and disables the ABS system.

1. Initial Check Operation

(1) When the ignition key is placed in the ON position, the power is supplied to the ABS-ECU, and the ABS-ECU starts a diagnostic sequence. During the diagnostic period, the ABS valve relay stays in the "OFF" state and the warning light continues to light.
(2) Then, the ABS-ECU forces the ABS valve relay into the "ON" state and executes diagnostic test mode of the ABS valve relay to detect an ON or OFF failure.
(3) All the solenoid valves are caused to be ON and OFF to make sure that the valves are not sticking.
(4) With the ignition key placed in the "START" position and engine started, the voltage at the generator terminal L rises. At the moment, the ABS-ECU power supply is cut off, but since the ABS valve relay is caused to be "OFF", the warning light is kept in the ON state by the ground contact circuit of the ABS valve relay.
(5) If the engine starts and the ignition key is returned to the "ON" position, the ABS-ECU power supply is resumed, and initial checks in (1) through (3) are performed again.
(6) When the initial checks are satisfactorily completed, the ABS becomes ready for operation. The warning light goes out upon detection of a high voltage at the generator terminal L.

NOTE
An operation check for the motor relay and the motor is performed when the vehicle is put in motion after starting the engine. This check is performed only one whenever the ignition switch is turned "ON".



14X0242

DIAGNOSIS OF THE WHEEL SPEED SENSOR SYSTEM

On-board diagnosis of the wheel speed sensor system is accomplished by executing the diagnostic program stored in the computer. U&g the program, the ABS-ECU monitors each wheel speed sensor system (wheel speed sensor, rotor, etc.) to detect a failure. In addition, the ABS-ECU monitors a short or open circuit in the sensor system by using its voltage monitoring circuit and voltage monitoring program.
The former is called “software failure detection”, whereas the latter is called “hardware failure detection”.

(1) Software failure detection

In this diagnostic test mode, the speeds of the four wheels calculated from the sensor outputs are compared. If there is any sensor system that outputs an abnormal speed or an abnormal decelerated speed, the ABS-ECU determines that the system is out of order. Such a failure is detectable only when the vehicle is put into motion or when it is running.

(2) Hardware failure detection

The ABS-ECU monitors the sensors, harness, etc. by using its open/short circuit monitoring circuit and voltage monitoring program to detect a failure such as an open or short circuit. A major feature of the open/short circuit monitoring circuit is that an open or short circuit failure is always detectable (even when the vehicle is stationary).
When the vehicle is in motion, however, a failure may be detected by software failure detection function before the same open or short circuit failure is detected by the hardware failure detection function. Such a situation may occur depending on the condition of vehicle and the nature of the failure.

FAIL-SAFE FUNCTION

Should a failure occur in the ABS system, the ABS-ECU isolates the system to retain the vehicle’s ordinary braking function, thus assuring a high measure of safety.

- If the ABS-ECU determines that the system is defective as the result of diagnosis, it causes the ABS warning light to light, drives the valve relay to interrupt control of the solenoid valves in the HU, and restores the ordinary braking mode.

DIAGNOSTIC FUNCTIONS

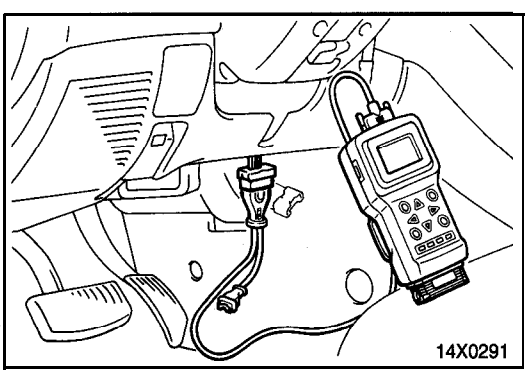
To facilitate inspection of the ABS system, the ABS-ECU offers the following facilities:

- Diagnostic trouble code output and erasure
- Data list output
- Actuator tests

All of the items described above can be checked by the scan tool.

Scan Tool – ABS Interface

The scan tool function is entered by connecting the scan tool to the data link connector. At this time, the vehicle must be stopped, and the ignition should be OFF.
The ABS scan tool mode is entered when you select the ABS system on the scan tool. In this mode, diagnostic output, data list output and actuator test functions are available. During an actuator test, however, the ABS warning light illuminates and anti-lock control is inhibited to prevent ABS operation when a brake is temporarily inactivated during the actuator test.



Scan tool mode entry condition	① Wheel speeds of 0 km/h (0 mph), parked condition ② Check harness of scan tool connected to data link connector of vehicle ③ ABS system selected by control switch of scan tool (Specified serial data received)

NOTE
No communications with the ABS-ECU can be made by connecting the scan tool while the vehicle is in operation [wheel speeds not 0 km/h (0 mph)]

Diagnostic Trouble Codes

Conditions detected as a result of diagnosis are associated with a total of 18 codes including that for normal state, and the codes are stored in the volatile memory.
Even if the ignition key is placed in the "OFF" position, the contents of the memory are not cleared, as the memory remains powered by a backup power supply.

These codes are readable by connecting the scan tool. When the scan tool is not used, they are also readable from the ABS warning light which is turned ON and OFF repeatedly in a pattern specific to each code.

1. Diagnostic items, diagnostic trouble codes and detection condition

Code No. display on Scan tool	Inspection item	Diagnostic content	Detection conditions	
			A	B
11*1	Front right wheel speed sensor	Open circuit or short in +wire	x	x
12*1	Front left wheel speed sensor			
13*1	Rear right wheel speed sensor			
14*1	Rear left wheel speed sensor			
15*1	Wheel speed sensor system	Abnormal output signal		X
16*2	Power supply system	Abnormal battery positive voltage	x	x
21*1	Front right wheel speed sensor	Excessive gap Long-time radio interference		X
22*1	Front left wheel speed sensor			
23*1	Rear right wheel speed sensor			
24*1	Rear left wheel speed sensor			
38*3	Stop light switch system	Open circuit or ON malfunction	x	x
41	Front right solenoid valve	No response to solenoid valve drive signal	×	×
42	Front left solenoid valve			
43	Rear solenoid valve			
51	Valve relay	Valve relay OFF failure	x	x
53*4	Motor relay or Motor	Motor relay OFF failure and motor drive failure		X
63	ABS-ECU	ABS-ECU internal failure (program maze, etc)	×	×
No fault code displayed	(The system is in order)			

Detection conditions
A: During system check immediately after starting
B: During driving

NOTE
*1: The ABS-ECU can detect only an open circuit from the moment the ECU power supply is ON.
The ABS-ECU lights the ABS warning light when it detects an open circuit, but it does not immediately store the trouble code in memory and does not cause the system to shut down.
When an open circuit is detected, the trouble code is stored in memory and the system caused to shut down when the vehicle starts and the wheel speed reaches 6 km/h (4 mph) (the first acceleration after the IG has been placed in the ON state).
Troubles other than an open circuit cannot be detected until the wheel speed reaches 6 km/h (4 mph). When the ABS-ECU detects any of these troubles, it causes the system to shut down and simultaneously lights the ABS warning light.
When the ABS ECU detects a wheel speed sensor error during ABS control, it causes the system to shut down and simultaneously lights the ABS warning light.

*2: The ABS-ECU detects a power supply error when the supplied voltage is a low voltage (approx. 9V or less). When the power supply error is detected, it causes the system to shut down and simultaneously lights the ABS warning light, but does not store the trouble code in memory. The trouble code is stored in memory when the voltage returns to normal.
When the power voltage is low (approx. 9V or less), none of the trouble codes is stored in memory.

*3: The ABS-ECU takes more than 15 minutes from when it detects an error to when it determines that the fault has occurred.

*4: The ABS-ECU makes an initial check on the motor relay and motor when the wheel speed reaches 6 km/h (4 mph) for the first time after engine start. If anything wrong is detected, it causes the system to shut down and simultaneously lights the ABS warning light.

<Diagnostic Trouble Code Display by ABS Warning Light>

(1) The codes for the currently present or previously occurred failures are displayed. Each code is displayed once. After all the codes in store have been displayed, they are repeatedly displayed, beginning with the first one.
(2) If the vehicle is put in motion and any of the wheels reaches a speed of more than 10 km/h (6 mph) during display of diagnostic trouble codes, the system stops displaying the diagnostic trouble codes and goes back to the normal control mode. Thereafter, if the ABS system is in order, the ABS control is available. If the system is out of order, the warning light illuminates and the brake system is placed in the ordinary braking mode. No more codes will be output until the ignition key is placed in the ON position again.

2. Diagnostic Trouble Code Indication Method

Diagnostic trouble codes are indicated as described below, depending on failure conditions in the system.

System failure condition	Display on scan tool	Display by ABS warning light
No failure detected in the past	No diagnostic trouble code displayed.	ON/OFF at 0.5 sec. intervals (no-failure code)
Failure detected in the past	All codes associated with the failures that occurred in the past are displayed, beginning with the most recent one.	All codes associated with the failures that occurred in the past are displayed, beginning with the most recent one.

NOTE
Even if failures of a same code repeatedly occur, the code that is displayed is the one stored for the first time only.

3. Diagnostic Trouble Code Clearing Procedure

NOTE

(1) When the ABS-ECU system is out of order, the diagnostic trouble codes in the memory cannot be cleared by use of the scan tool.

(2) To check whether the memory has been cleared, the diagnostic trouble code reading procedure should be performed.

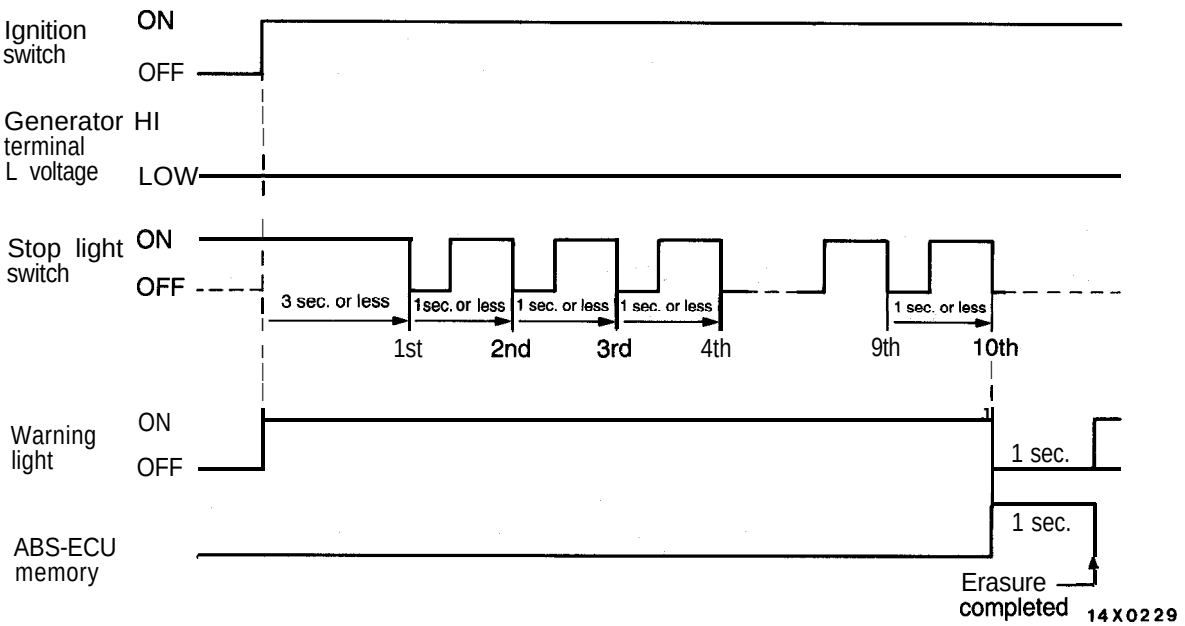
(3) Even after the memory has been cleared, an instruction from the scan tool can be accepted. To confirm a diagnostic trouble code, the scan tool should be re-operated.

<When the scan tool is used>

Clear the memory according to the message that appears on the scan tool. (For details, refer to the instruction manual for the scan tool.)

<When scan tool is not used>

To erase the trouble codes in memory, place the stop light switch in the ON state and then set the ignition switch to ON (generator terminal L voltage: LOW) and change over the stop light switch 10 times within the following time intervals. The trouble codes in memory will then be erased in about a second.



If any of the following conditions is true, the trouble codes in memory will not erase.

- When the stop light switch is not ON before the ignition switch is set to ON
- When the first stop light switch input change (ON-OFF) does not occur in less than three seconds, or when the second and subsequent change does not occur in less than one second
- When the generator terminal L voltage goes "HI" before erasure is completed

Data List Output

Of the ABS-ECU input data, the following items can be read by the scan tool.

1. When the System is in Order

Code No.	Items	Displayed unit
11	Front right wheel speed	km/H
12	Front left wheel speed	km/H
13	Rear right wheel speed	km/H
14	Rear left wheel speed	km/H
21	ABS-ECU power voltage	V
22	Generator power voltage	V
23	Stop light switch ON/OFF state	ON/OFF

2. When the System is in the ABS-ECU Isolated State

When the ABS-ECU is placed in the out of service state by the on-board diagnostic program, the wheel speeds of No. 11 through 14 described above are not displayed. The data displayed by the scan tool is always “0.0 km/h (0 mph)“.

Actuator Test

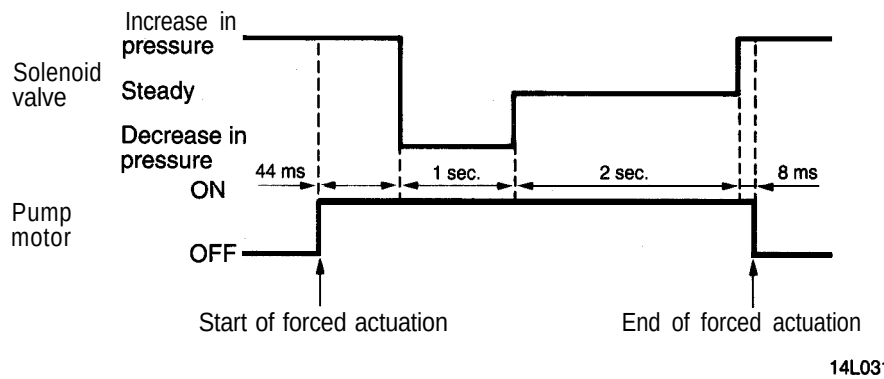
The actuator can be force-driven using the scan tool for easy operation inspection.

NOTE

(1) If the ABS-ECU function has been cancelled, an actuator test cannot be performed.

(2) Actuator testing is only possible when the vehicle is stationary. If the vehicle speed during actuator testing exceeds 10 km/h (6 mph), forced actuation will be cancelled.

(3) The following item numbers are those to be entered on the scan tool to give an actuator test instruction.

Item No.	Drive object	Drive pattern
01	F.R. solenoid valve and pump motor	
02	F.L. solenoid valve and pump motor	
03	Rear solenoid valve and pump motor	

SYSTEM OPERATION

Refer to 1991 3000GT Technical Information Manual (Pub. No. PXSE9001).

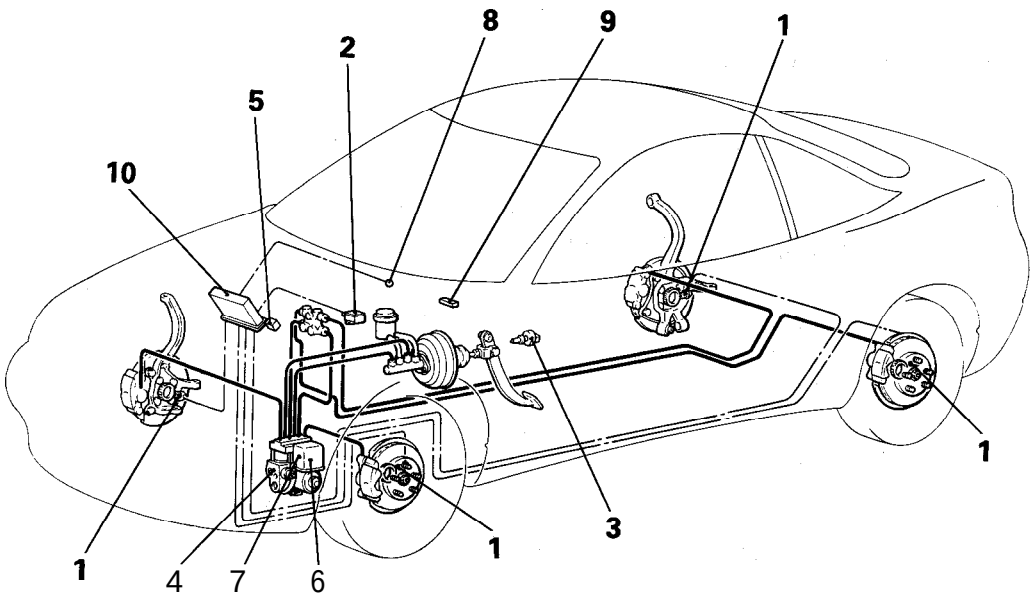
ANTI-LOCK BRAKE SYSTEM (ABS) <AWD>

N73ZNaQM

The ABS used in the 1995 Eclipse is similar to the previous one.
Combining the ABS with the AWD system has significantly improved the "stopping" as well as "running" performance of the AWD vehicles. It assures a high level of running performance under any conditions, not only on a dry pavement but also on a slippery road surface.

The AWD version ABS is a 4-sensor, 2-channel type and is the same as the FWD system except for the following respects.

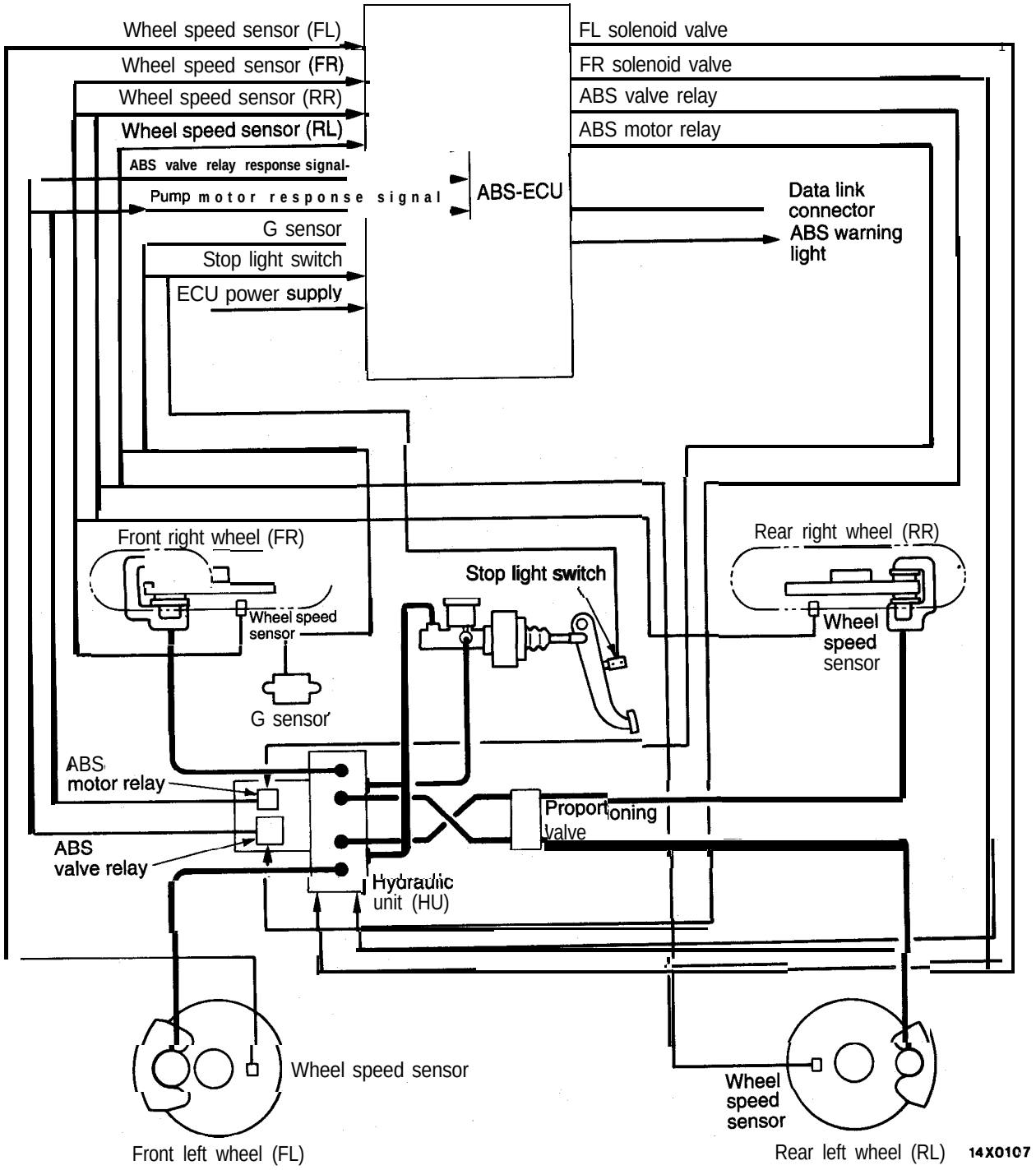
- Wheel speed sensor rotor (rear) press-fitted in drive shaft
- Gap adjustment-free wheel speed sensor and rotor
- Semiconductor type G sensor



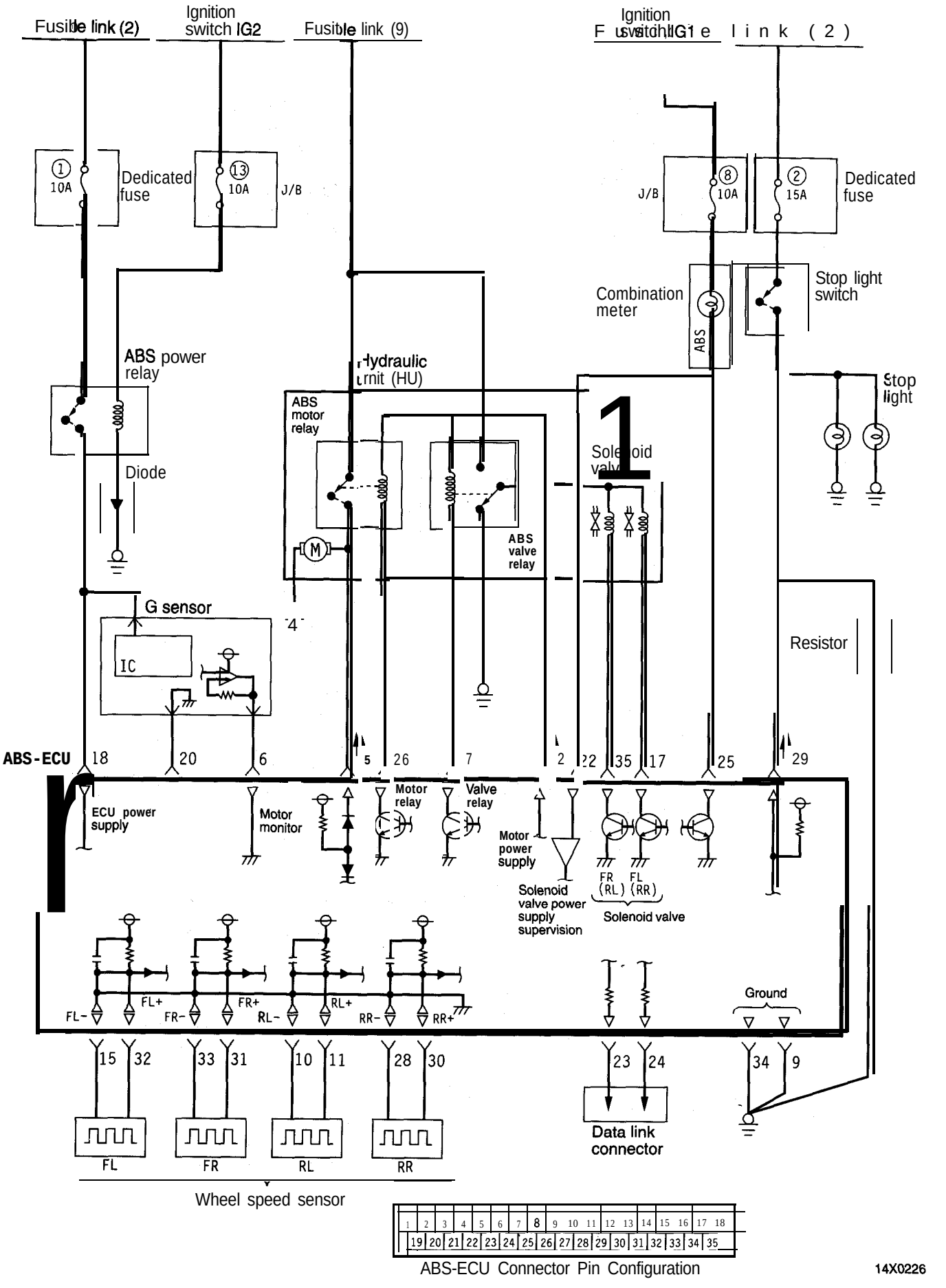
14X0268

Part name		No.	Function
Sensor	Wheel speed sensor	1	Sends an AC signal with a frequency proportional to the rotating speed of the individual wheel to the ABS-ECU.
	G-sensor	2	Sends an ON/OFF signal to the ABS-ECU depending on vehicle acceleration/deceleration.
	Stop light switch	3	Sends a signal to the ABS-ECU indicating whether the brake pedal is pressed or not.
Actuator	Hydraulic unit (HU)	4	Controls braking pressure for each wheel depending on the signal from the ABS-ECU. Includes built-in select-low valve
	ABS power relay	5	Supplies power to the ABS-ECU.
	Motor relay	6	Closes contact in response to a signal from the ABS-ECU to allow the power to be supplied to the motor in the HU.
	Valve relay	7	Is turned ON by the ABS-ECU signal and supplies power to the solenoid valve in HU.
	ABS warning light	8	Is in the combination meter and lights up when there is trouble in ABS.
	Data link connector	9	Outputs diagnostic trouble codes.
Electronic control unit (ECU)		10	Controls the actuators such as HU according to the signals from the individual sensors.

SYSTEM DRAWING



ABS ELECTRICAL CIRCUIT DIAGRAM



ABS-ECU Connector Pin Configuration

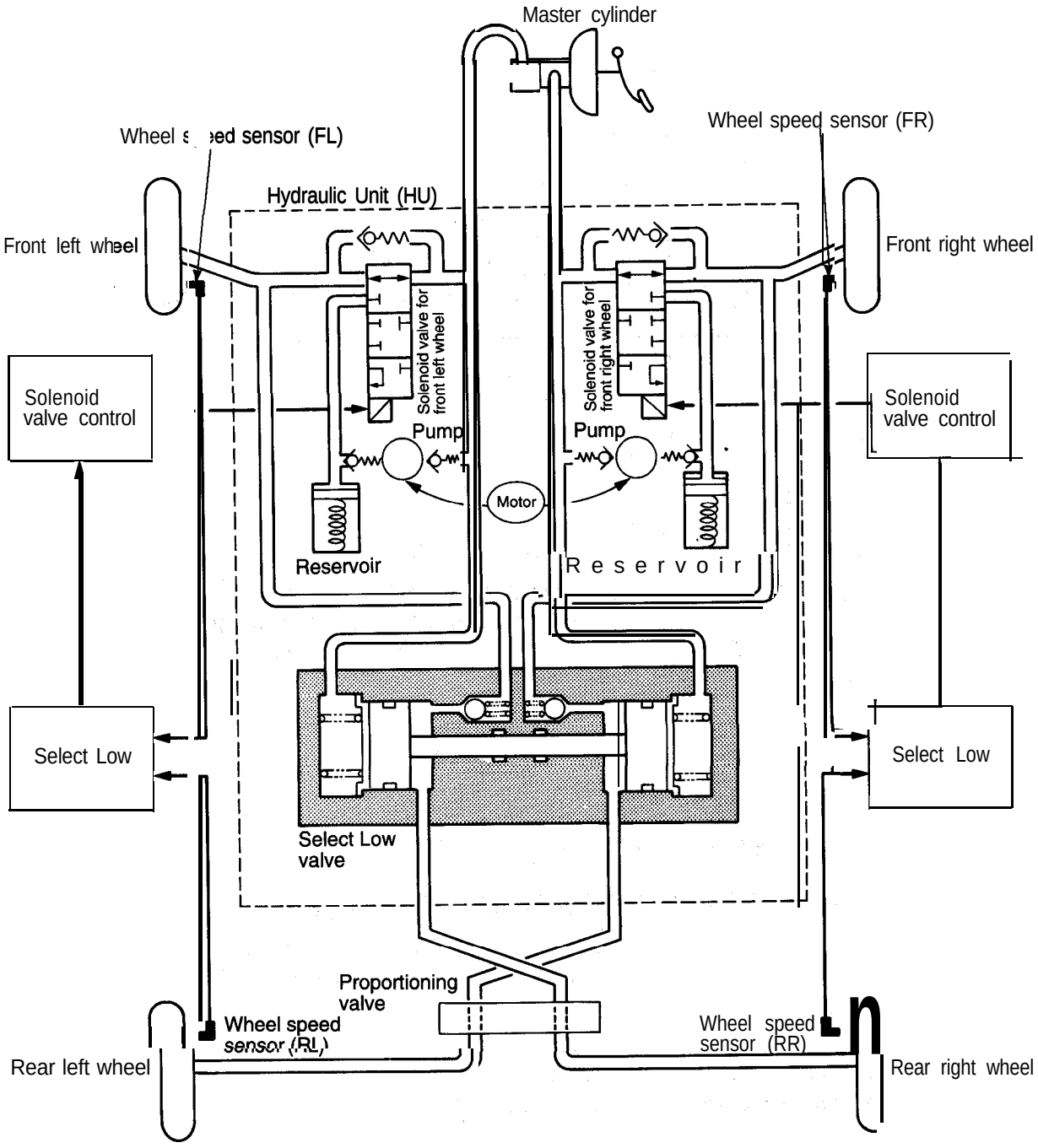
14X0226

ABS HYDRAULIC FUNCTION SCHEMATIC

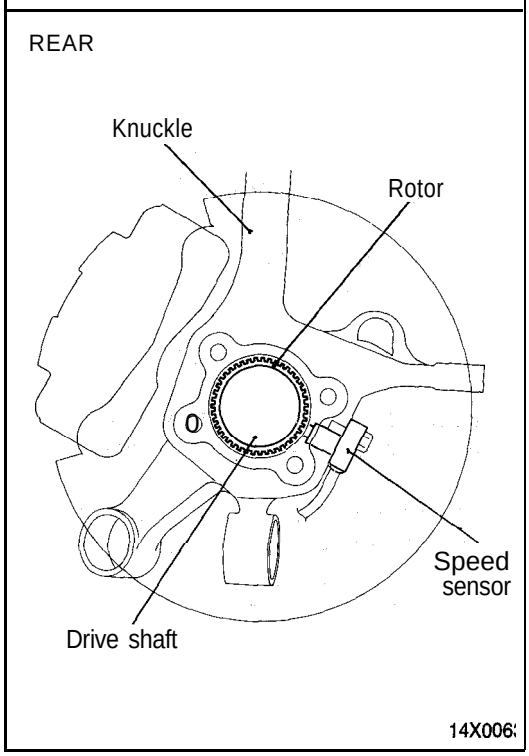
The ABS in the AWD models is of two-channel system (two-fluid pressure system). In this system, the solenoid valves are energized or de-energized so that the front and rear wheel brakes on the same side are controlled on the "Select Low" rule.

For example, when either the front or rear wheel on the right side is about to be locked, all the solenoid valves on the right side, including those on the front right wheel, are controlled to hold or slightly reduce the fluid pressure. In order to prevent one wheel locking state in the rear wheels, it is necessary to control the rear wheels by Select Low as in the FWD vehicles. In the case of the AWD vehicles, the rear right and left wheels are subject to Select Low control by the Select Low valves. As a result, the fluid pressure for a total of three wheels (the front right wheel and the rear right and left wheels) are under simultaneous control.

Select-low: this is a method of providing the same hydraulic control to both wheels when either wheel is about to lock, matching it to the side about to lock, or a method to control by matching pressure to the low side.



14A0629



SENSOR

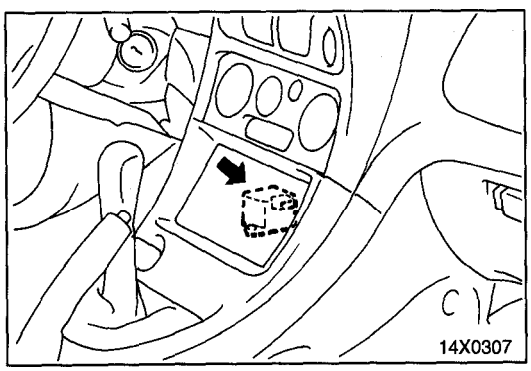
N73ZN01AA

WHEEL SPEED SENSOR

The wheel speed sensor of the AWD vehicle is the same as in the FWD vehicle, except that the rear rotor is mounted on the drive shaft. (Refer to P. 3-31.)

STOP LIGHT SWITCH

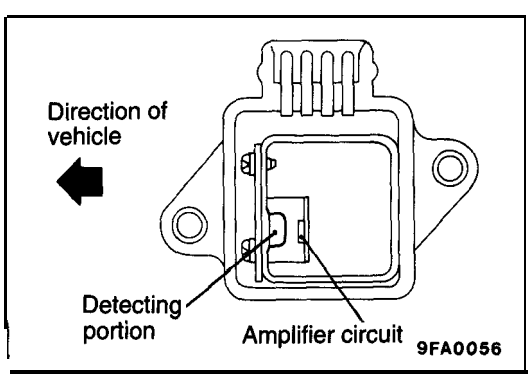
The same as in the FWD vehicle. (Refer to P. 3-31.)



G SENSOR

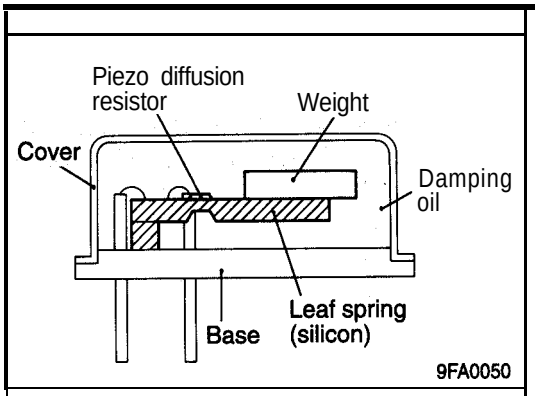
N73ZN04AA

The G sensor, mounted inside the center console panel, detects the longitudinal acceleration/deceleration (body G) of the vehicle body.

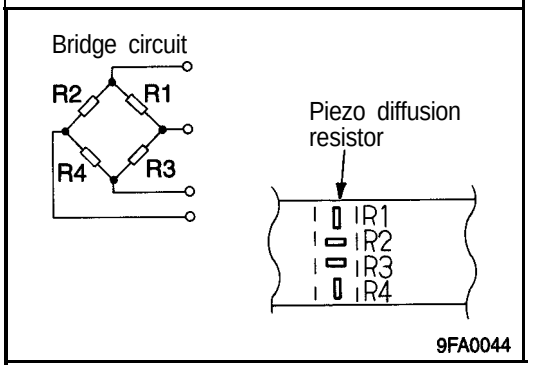


Construction and operation

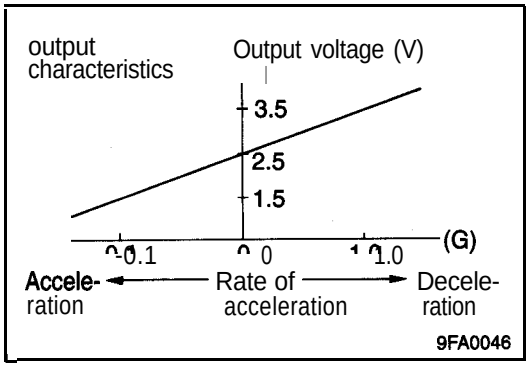
The inside of the sensor is shown at left. A semiconductor strain gauge has been adopted as the sensor.



The semiconductor strain gauge type sensor, constructed as shown at the left, consists of a weight mounted at the free end of an N-type silicon leaf spring, and four P-type diffusion layers made on the surface of the leaf spring to constitute piezo diffusion resistors. The case is filled with a damping oil to prevent breakdown that may be caused by resonance.



The piezo diffusion resistors, arranged as shown at the left, complete a bridge circuit which constitutes a semiconductor strain gauge.
When the sensor is placed under strain by acceleration, the piezoelectric effect changes its electrical resistance, causing the bridge circuit to go out of balance.
If a voltage is applied across the bridge circuit, the acceleration can be measured by detecting the amount the bridge circuit goes out of balance in terms of a change in the voltage.



The output characteristics vary as shown at the left in the direction of acceleration with 2.5 V as 0 G.

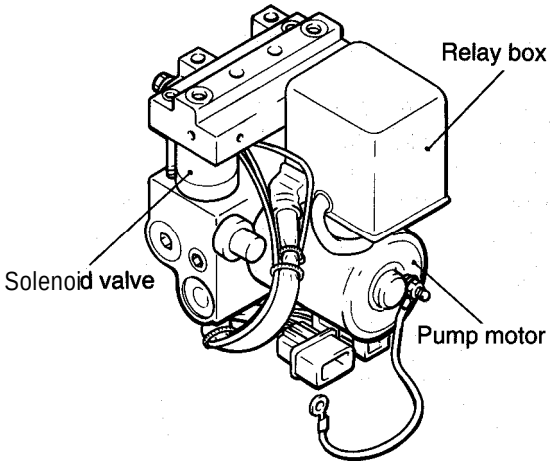
ACTUATOR

N73ZN02AA

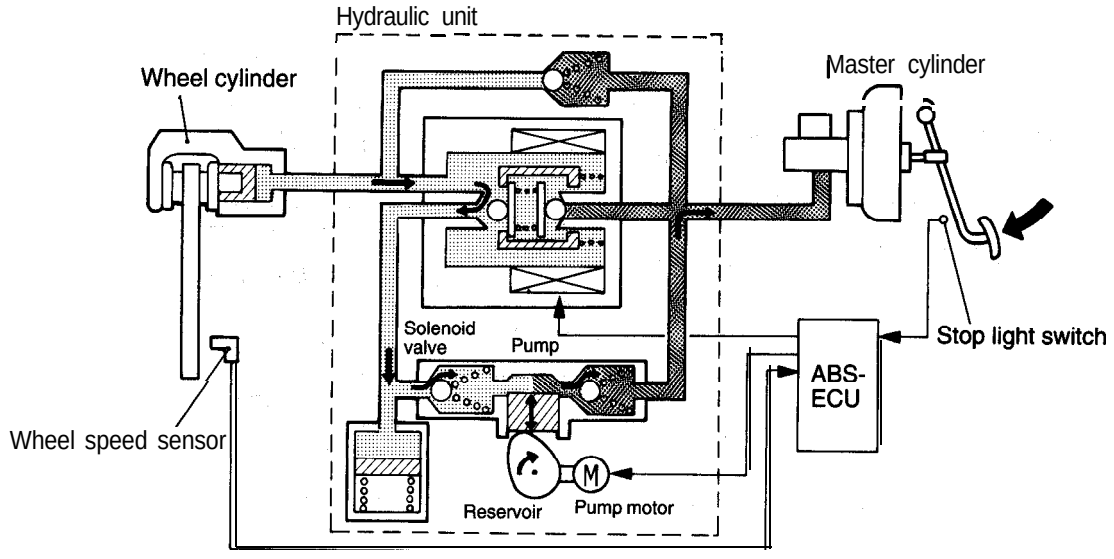
HYDRAULIC UNIT (HU)

- The HU, elastically supported by the shield plate at the front left of the engine compartment, consists of a motor pump, plunger valve, reservoir and three solenoid valves.
- The HU, positioned between the brake master cylinder and each wheel cylinder, is a hydraulic circuit split into two systems associated with the normal X pipings when the ABS is inactive.

When the ABS is active, the motor is operated by a signal from the ABS-ECU to let the pump generate a hydraulic pressure required to return fluid against master cylinder pressure. At the same time, three solenoid valves are operated to control the hydraulic pressure that acts on the wheel cylinder.



14x0305



14F0054

Solenoid valve and select-low valve

Refer to 1991 3000GT Technical Information Manual (Pub. No. PXSE9001).

Relay box

Refer to P. 3-33.

MOTOR RELAY

Refer to P. 3-33.

VALVE RELAY

Refer to P. 3-33.

ABS WARNING LIGHT

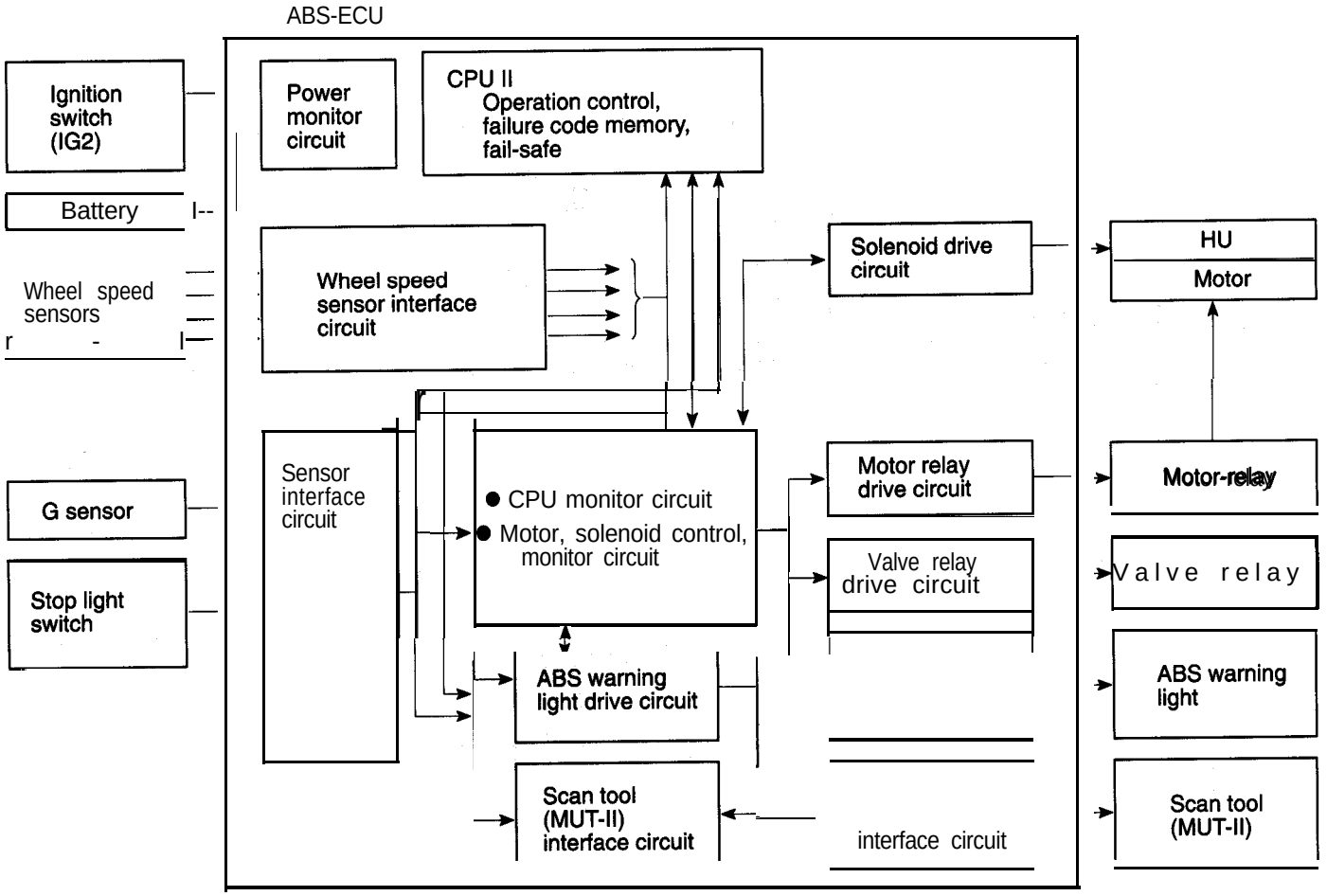
Refer to P. 3-33.

ELECTRONIC CONTROL UNIT (ECU)

N73ZN03AA

- The ABS-ECU detects the vehicle speed in terms of a signal from the wheel speed sensor to determine the rotating condition of the wheel, estimates the skidding condition of the wheel on the basis of the predetermined theory, and outputs a signal to move the solenoid valve in the HU in such a way as to prevent locking the wheel.
- The ABS-ECU has diagnostic and memory functions.
  If any failure is found, the fail-safe function is activated and the ABS warning light will illuminate.

BLOCK DIAGRAM



FUNCTION OF INDIVIDUAL CIRCUITS

The function of each circuit is the same as in the FWD vehicle. (Refer to P. 3-35.)

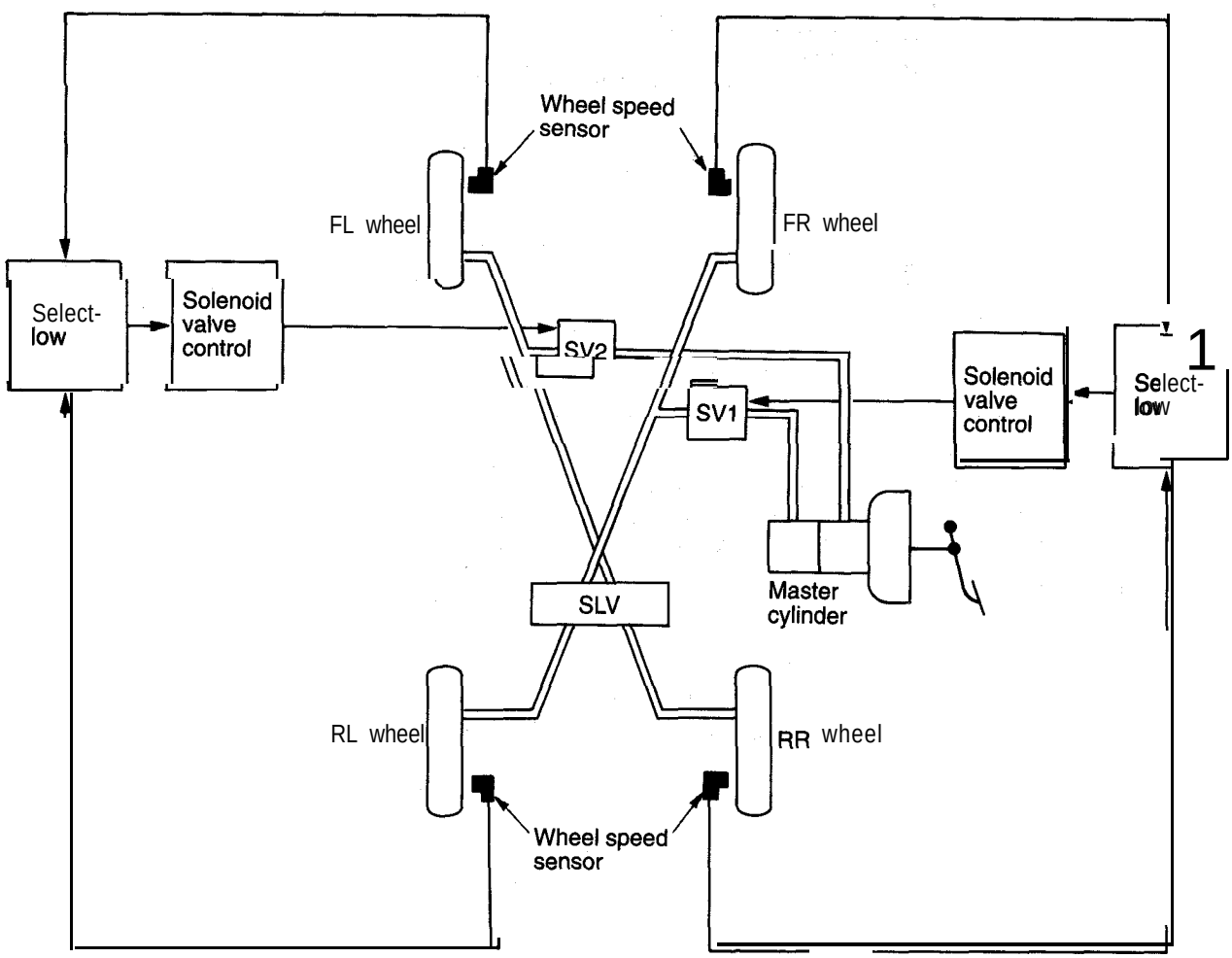
EXPLANATION OF ECU CONTROL

Braking Hydraulic Pressure Control

Braking hydraulic pressure control is the same as in the FWD vehicle. (Refer to P. 3-36.)

4-wheel Control

ABS on AWD models controls the front and rear wheels using select-low and activates the solenoid valve on one side, including either of the front wheels. Furthermore, since the rear right and left wheels are controlled mechanically in select-low by the select-low valve, there is, as a result, pressure control of three wheels (either front wheel and the rear right and left wheels) at a time.



SLV: Select-low valve

14A0135

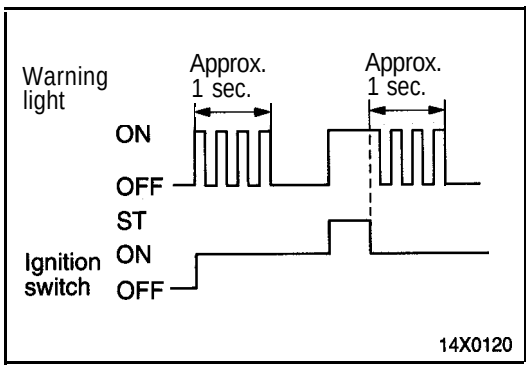
Control Speed

The control speed is the same as in the FWD vehicle. (Refer to P. 3-36.)

Control with G-sensor

Since four wheels are connected in AWD models, the four wheels may decelerate almost in phase. This tendency is especially strong on a low frictional resistance road; suspected vehicle speed does not match actual speed, the road is judged to be a high frictional resistance road and the ABS control becomes unreliable. At such a time, the G-sensor distinguishes* between low frictional resistance road and a high frictional resistance road and makes the ABS control reliable by switching the method of calculating suspected vehicle speed.

* When braking on a low frictional resistance road, the rate of vehicle deceleration is slow. On the other hand, when braking on a high frictional resistance road, the rate of vehicle deceleration is fast.



ABS Warning Light Control

In the following cases the ABS warning light lights up.

- It lights up when trouble in the system is recognized.
- It illuminates in the pattern shown in the figure on the left when the ignition switch is turned ON, to check the ABS warning light circuit.

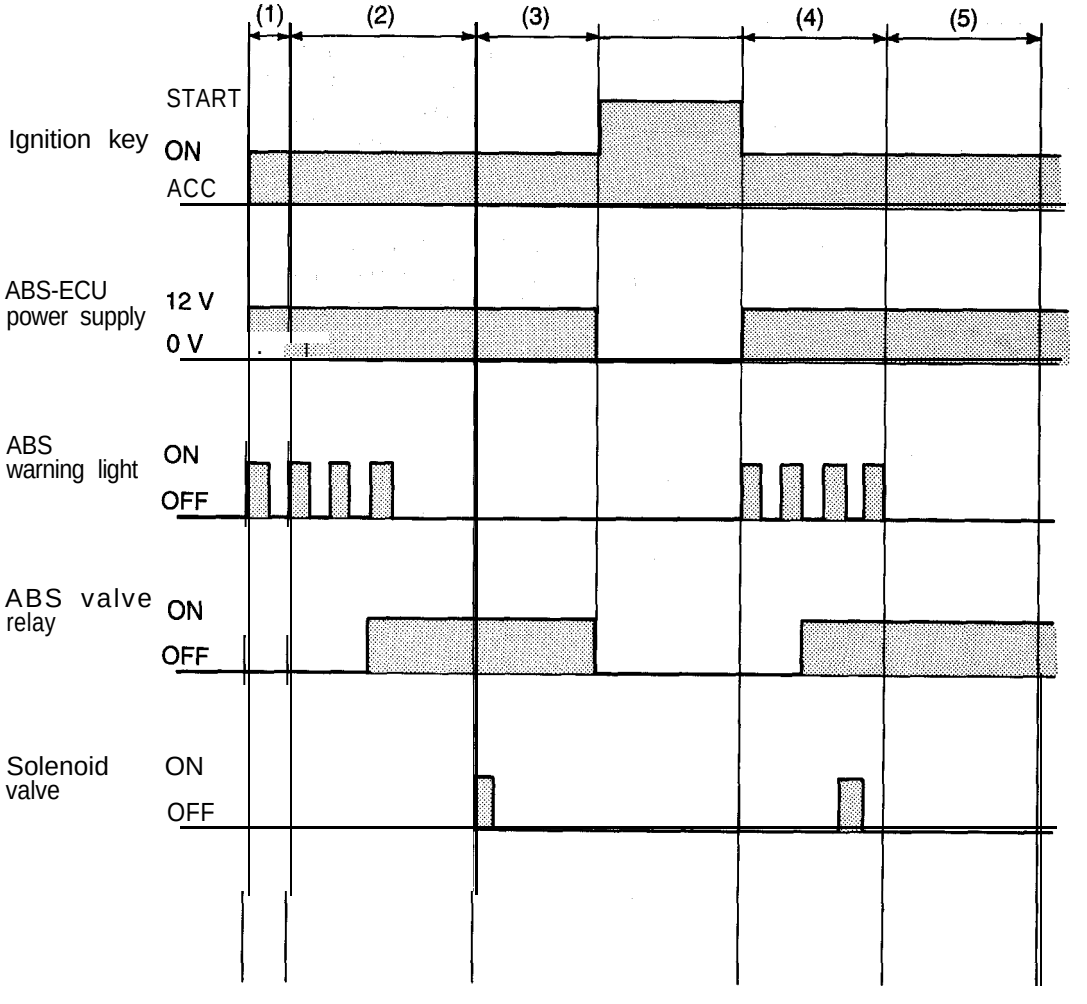
INITIAL CHECK FUNCTION

The ECU always performs an initial check on the ABS system with the on-board diagnostic function. If it detects an error, it illuminates the warning light, and disables the ABS system.

1. Initial Check Operation

(1) When the ignition key is placed in the ON position, the power is supplied to the ABS-ECU, and the ABS-ECU starts a diagnostic sequence. During the diagnostic period, the ABS valve relay stays in the "OFF" state and the warning light continues to light.
(2) Then, the ABS-ECU forces the ABS valve relay into the "ON" state and executes diagnostic test mode of the ABS valve relay to detect an ON or OFF failure.
(3) All the solenoid valves are caused to be ON and OFF to make sure that the valves are not sticking.
(4) If the engine starts and the ignition key is returned to the "ON" position, the ABS-ECU power supply is resumed, and initial checks in (1) through (3) are performed again.
(5) When the initial checks are satisfactorily completed, the ABS becomes ready for operation.

NOTE
An operation check for the motor relay and the motor is performed when the vehicle is put in motion after starting the engine. This check is performed only once whenever the ignition switch is turned "ON".



14X0243

FAIL-SAFE FUNCTION

Should a failure occur in the ABS system, the ABS-ECU isolates the system to retain the vehicle's ordinary braking function, thus assuring a high measure of safety.

- If the ABS-ECU determines that the system is defective as the result of diagnostic test mode, it causes the ABS warning light to light, drives the valve relay to interrupt control of the solenoid valves in the HU, and restores the ordinary braking mode.

DIAGNOSTIC FUNCTIONS

To facilitate inspection of the ABS system, the ABS-ECU offers the following facilities:

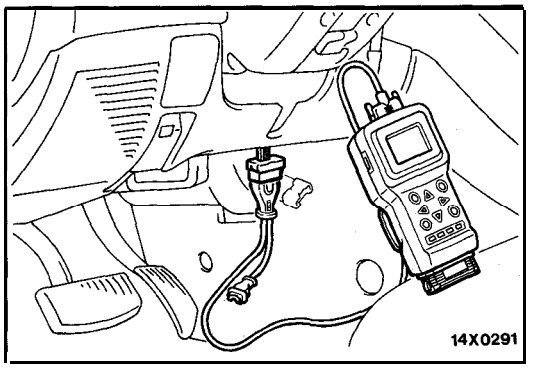
- Diagnostic trouble code output and erasure
- Actuator test

All of the items described above can be checked by the scan tool.

Scan Tool – ABS Interface

The scan tool function is entered by connecting the scan tool to the data link connector. At this time, the vehicle must be stopped, and the ignition should be OFF.

The ABS scan tool mode is entered when you select the ABS system on the scan tool. In this mode, diagnostic output, data list output and actuator test functions are available. During an actuator test, however, the ABS warning light illuminates and anti-lock control is inhibited to prevent ABS operation when a brake is temporarily inactivated during the actuator test.



Scan tool mode entry condition	① Wheel speeds of 0 km/h (0 mph), parked condition ② Check harness of scan tool connected to data link connector of vehicle ③ ABS system selected by control switch of scan tool (Specified serial data received)

NOTE

No communications with the ABS-ECU can be made by connecting the scan tool while the vehicle is in operation [wheel speeds not 0 km/h (0 mph)].

Diagnostic Trouble Codes

Conditions detected as a result of diagnosis are associated with a total of 14 codes including that for normal state, and the codes are stored in the volatile memory.
Even if the ignition key is placed in the "OFF" position, the contents of the memory are not cleared, as the memory remains powered by a backup power supply.

These codes are readable by connecting the scan tool.
When the scan tool is not used, they are also readable with a voltmeter which deflects in a pattern unique to each code.

1. Diagnostic items, diagnostic codes and detection condition

Code No. display on Scan tool	Inspection item	Diagnostic content	Detection conditions	
			A	B
11*1	Front right wheel speed sensor	Open circuit or short in + wire	x	x
12*1	Front left wheel speed sensor			
13*1	Rear right wheel speed sensor			
14*1	Rear left wheel speed sensor			
15*1	Wheel speed sensor system	Abnormal output signal		X
21	G sensor	Broke wire in G sensor or OFF malfunction		X
22*2	Stop light switch system	Open circuit or ON malfunction		X
41	Front left solenoid valve	No response to solenoid valve drive signal		X
42	Front right solenoid valve			
43	Rear solenoid valve	Current value in both valves is different when in same mode		X
51	Valve relay	Valve relay OFF failure	x	x
53*3	Motor relay or Motor	Motor relay OFF failure and motor drive failure		X
55	ABS-ECU	ABS-ECU internal failure (program maze, etc)	×	×
No fault code displayed	(The system is in order)			

Detection conditions
A: During system check immediately after staritng
B: During operation

NOTE

*1: The ABS-ECU can detect only an open circuit from the moment the ECU power supply is ON.
The ABS-ECU lights the ABS warning light when it detects an open circuit, but it does not immediately store the trouble code in memory and does not cause the system to shut down.
When an open circuit is detected, the trouble code is stored in memory and the system caused to shut down when the vehicle starts and the wheel speed reaches 6 km/h (4 mph) (the first acceleration after the IG has been placed in the ON state).
Troubles other than an open circuit cannot be detected until the wheel speed reaches 6 km/h (4 mph). When the ABS-ECU detects any of these troubles, it causes the system to shut down and simultaneously lights the ABS warning light.

The shut down responce time varies with the wheel speed as described below.

First start after engine start:
- When the wheel speed is less than 10 km/h (6 mph), the system shuts down 60 seconds later.
- When the wheel speed is 10 km/h (6 mph) or more, the system shuts down immediately.

Restart:
- When the wheel speed is less than 20 km/h (12 mph), the system shuts down 60 seconds later.
- When the wheel speed is 20 km/h (12 mph) or more, the system shuts down immediately.

When the ABS-ECU detects a wheel speed sensor error during ABS control, it causes the system to come down and simultaneously lights the ABS warning light after ABS control.

*2: The ABS-ECU takes more than 15 minutes from when it detects an error to when it determines that the fault has occurred.

*3: The ABS-ECU makes an initial check on the motor relay and motor when the wheel speed reaches 6 km/h (4 mph) for the first time after engine start. If anything wrong is detected, it causes the system to shut down and simultaneously lights the ABS warning light.

2. Diagnostic Trouble Code Indication Method

Diagnostic trouble codes are indicated as described below, depending on failure conditions in the system.

System failure condition	Display on scan tool	Display by voltmeter
No failure detected in the past	No diagnostic trouble code displayed.	ON/OFF at 0.5 sec. intervals (no-failure code)
Failure detected in the past	All codes associated with the failures that occurred in the past are displayed, beginning with the most recent one.	All codes associated with the failures that occurred in the past are displayed, beginning with the most recent one.

NOTE
Even if failures of a same code repeatedly occur, the code that is displayed is the one stored for the first time only,

3. Diagnostic Trouble Code Clearing Procedure

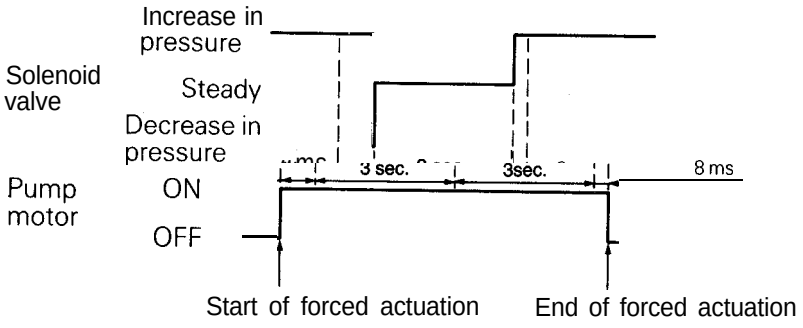
Clear the memory according to the message that appears on the scan tool. (For details, refer to the instruction manual for the scan tool.)

NOTE
(1) When the ABS-ECU system is out of order, the diagnostic trouble codes in the memory cannot be cleared by use of the scan tool.
(2) To check whether the memory has been cleared, the diagnostic trouble code reading procedure should be performed.
(3) Even after the memory has been cleared, an instruction from the scan tool can be accepted. To confirm a diagnosis code, the scan tool should be re-operated.

Actuator Test

The actuator can be force-driven using the scan tool for easy operation inspection,

NOTE
(1) If the ABS-ECU function has been cancelled, an actuator test cannot be performed.
(2) Actuator testing is only possible when the vehicle is stationary. If the vehicle speed during actuator testing exceeds 10 km/h (6 mph), forced actuation will be cancelled.
(3) The following item numbers are those to be entered on the scan tool to give an actuator test instruction.

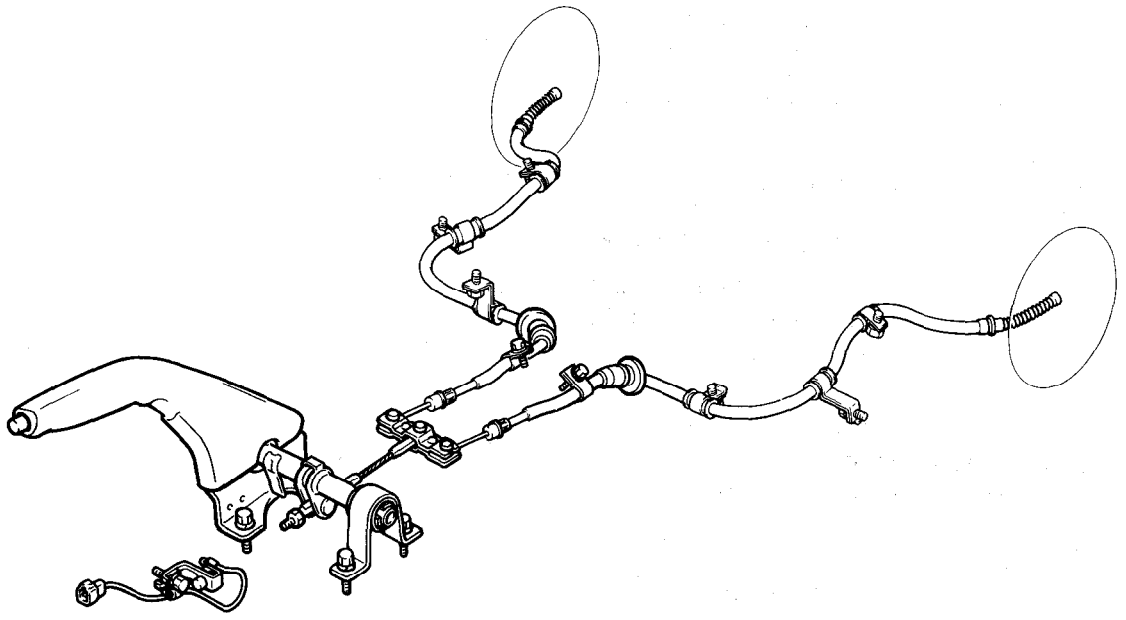
Item No.	Drive object	Drive pattern
04	F.R. solenoid valve and pump motor	
05	F.L. solenoid valve and pump motor	

PARKING BRAKES

N73ZO00AA

- The parking brake for all models is a mechanical control type acting on the rear wheels. The brake is either a drum type or a drum-in-disc type.
- The parking brake lever is offset torward the front passenger's seat side.

CONSTRUCTION DIAGRAM



14X0253

BODY

CONTENTS

N74ZA00AA

DOORS 7
- Door Lock.. 7
- Door Panel 7
- Window Glass Regulator 11

ELECTRIC SUNROOF 20
- Sunroof Control System 20
- Sunroof Control Unit 21

GENERAL DESCRIPTION 2
- Features ..... .

KEYLESS ENTRY SYSTEM 15
- Receiver 17
- Structure and Operation 16

MAIN BODY 3
- Body Color Charts 4
- Body Paneling ..... .

REDUCTION OF AERODYNAMIC NOISE 5
- Flush Surface 5
- Glass Catch ..... .

GENERAL DESCRIPTION

N74ZB00AA

The main body (monocoque body) is highly-rigid and excellent in noise and vibration reduction. It also reduces vehicle weight.

The keyless entry system which allows the doors to be locked and unlocked by remote control has also been adopted.

FEATURES

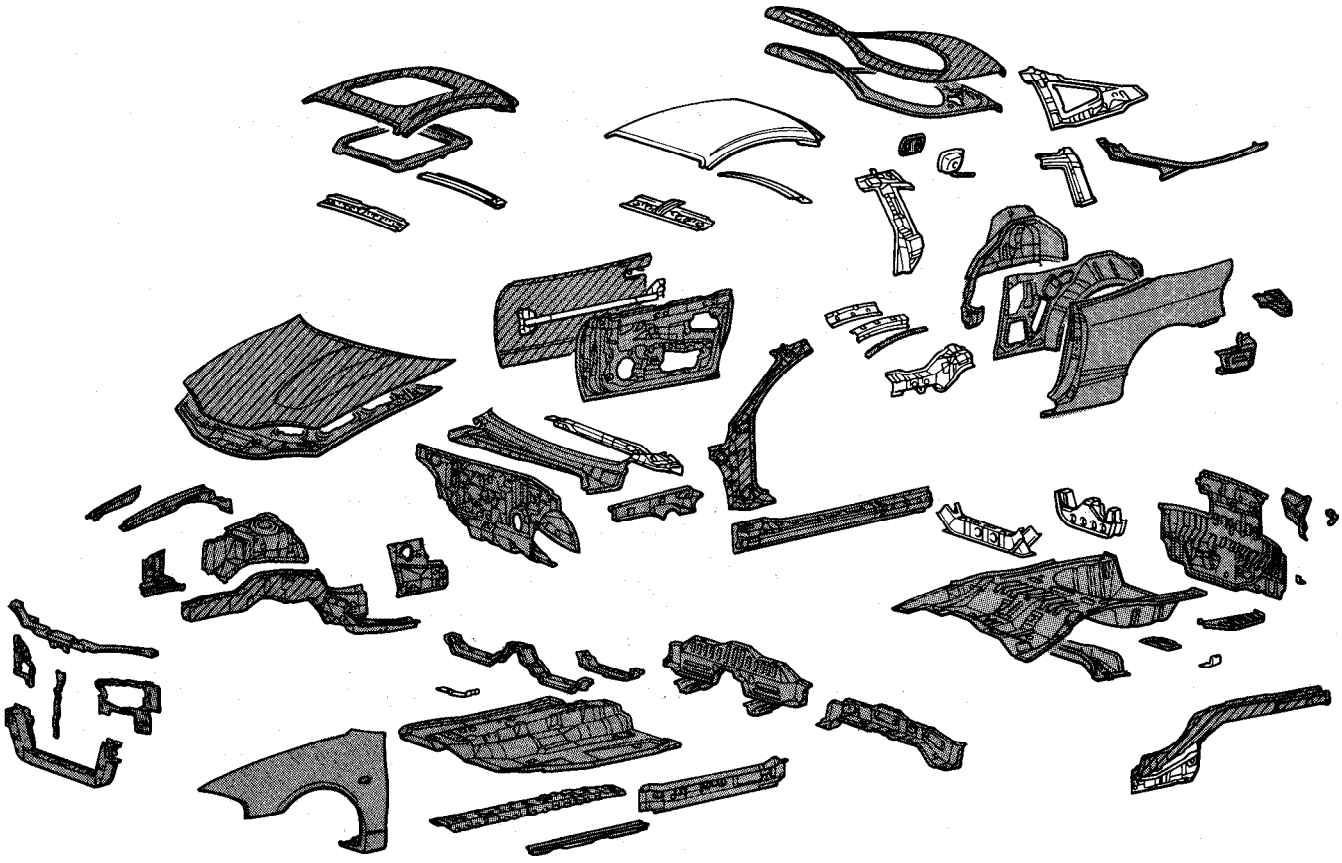
Light weight, added rigidity	1. Extensive use of high tension steel panels 2. Effective use of reinforcement to improve the rigidity of door outer panel
Corrosion control	1. Extensive use of anticorrosion steel panels 2. Application of rocker panel primer to the side sills
Reduction of vibrations, noises and aerodynamic noise	1. Tapering at each body corner 2. Glass area surfaces made flush with body paneling 3. Effective arrangement of sound absorbing and insulating materials
Improved controllability and safety	1. Side door beam to enhance occupant's safety in side collision 2. Central door lock system with key reminder system <Some models> 3. Radio wave remote control type keyless entry system (Option) 4. Power window switch with a one-touch-open mechanism
Improved merchantability and appearance	1. Flush surface body 2. Motor driven outer slide glass sunroof with tilt-up mechanism (Option)

MAIN BODY

N74ZC00AA

BODY PANELING

The body features a monocoque construction. Ample use of high-tensile steel panels and galvanized steel panels not only reduces the body weight but ensures good corrosion control.



: High-tensile steel panels
: Galvanized steel panels

31 x0305

BODY COLOR CHARTS

Color	Body color code		Color number
WHITE	w12		AC10812
SILVER	A52		AC11052
GRAY	A74		AC11074
BLACK	x13		AC10813
RED	R87		AC1 0987
COPPER RED	P01		AC11101
YELLOW	Y76		AC11076
GREEN	G36		AC11036
BLUE	B73		AC11073
WHITE	W12A74*	W12	AC10812
GRAY		A74	AC11074
SILVER	A52A74*	A52	AC11052
GRAY		A74	AC11074
BLACK	X13A74*	X13	AC10813
GRAY		A74	AC11074
RED	R87A74*	R87	AC1 0987
GRAY		A74	AC11074
COPPER RED	P01A74*	P01	AC11101
GRAY		A74	AC11074
YELLOW	Y76A74*	Y76	AC11076
GRAY		A74	AC1 1074
GREEN	G36A74*	G36	AC11036
GRAY		A74	AC11074
BLUE	B73A74*	B73	AC11073
GRAY		A74	AC11074

• Two-tone body color

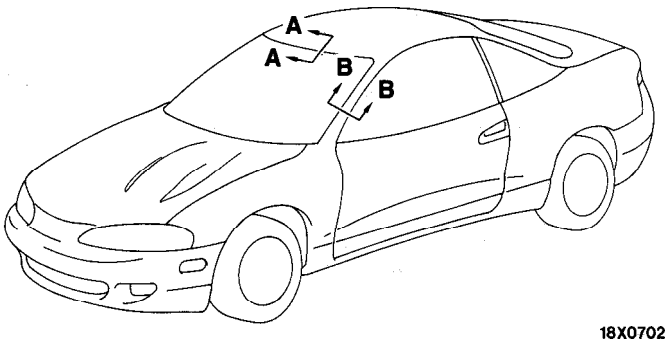
REDUCTION OF AERODYNAMIC NOISE

N74ZD00AA

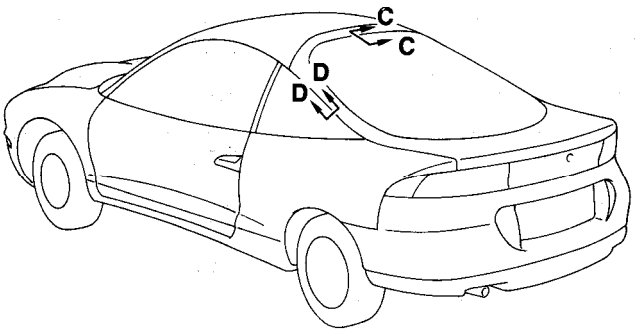
FLUSH SURFACE

The glass areas have been made flush with the body paneling for less aerodynamic noise and higher directional stability during high-speed operation.

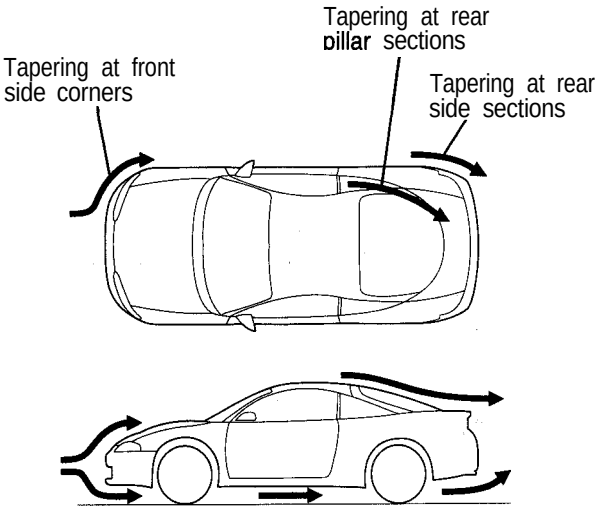
Additional body design features for these purposes include round-shaped body, tapering at each corner, beadless flat floor for smoother under-floor air flow, etc.



18X0702

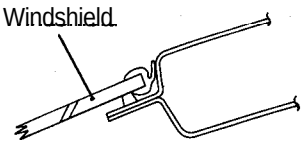


18X0703



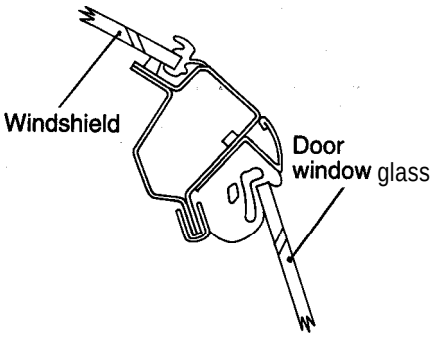
18X0648

Section A – A



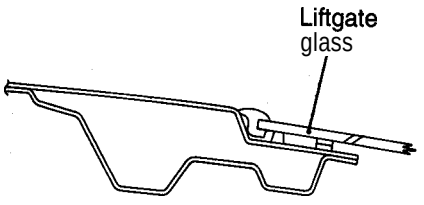
18X0633

Section B – B



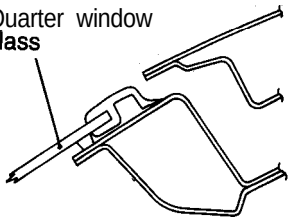
18X0634

Section C – C



18X0631

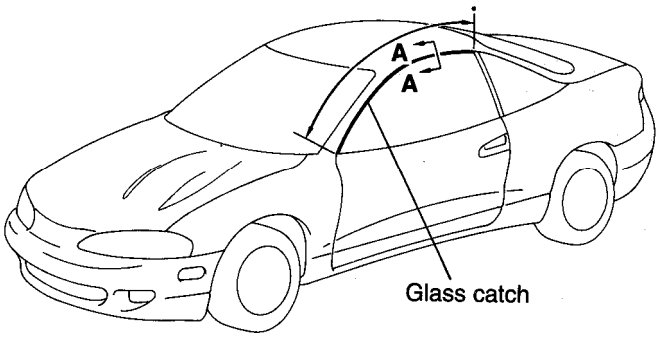
Section D – D



18X0632

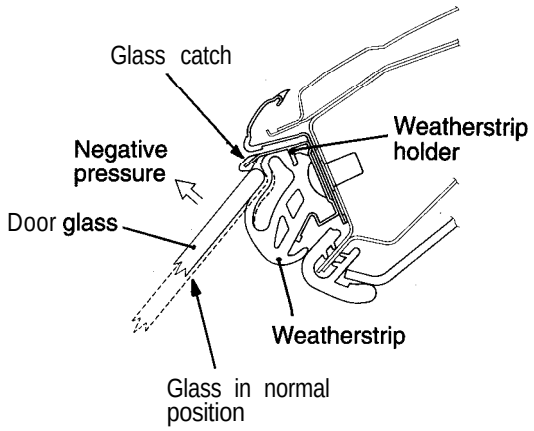
GLASS CATCH

Since sashless doors have been adopted, glass catches have been provided in the weatherstrip holders to prevent the door glasses from being drawn outward by the negative pressure during high-speed operation. This also improves sealing between the weatherstrip and door glass. This reduces noise generated by the air drawn out by negative pressure during high-speed operation.



18X0701

Section A – A



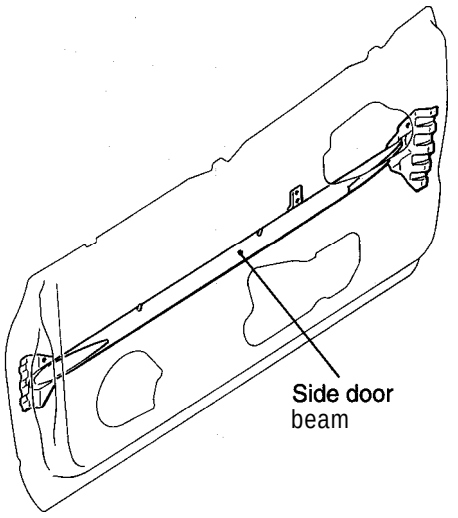
18X0400

DOORS

N74ZE00AA

DOOR PANEL

To ensure safety of the driver and passengers in a side collision, a reinforcement (side door beam) has been installed inside the door.



18X0630

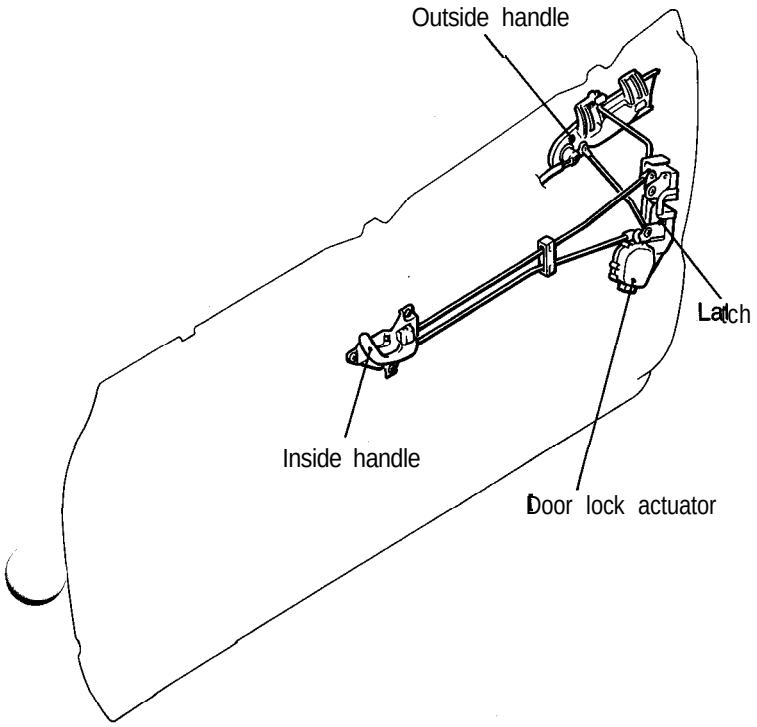
DOOR LOCK

N74ZE01AA

A key reminder equipped central door lock system has been adopted. This allows all the doors to be locked and unlocked by the key or door lock switch at either the driver's or front passenger's door. (Some models)

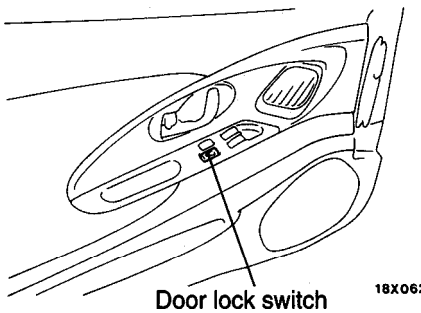
The central door lock system offers the following features.

- The driver's door only can be unlocked by operating the driver's door key once. All the doors can be unlocked by operating the key twice.
- All the doors can be locked by the driver's door inside lock knob.
- The keyless entry system has been adopted which allows operation of the central door lock system by remote control. (Option)
- Key reminder equipment (Refer to GROUP 7 ETACS.)



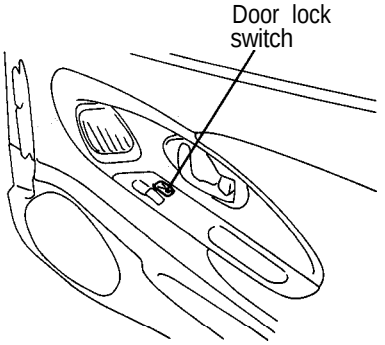
18X0635

<Driver's side>

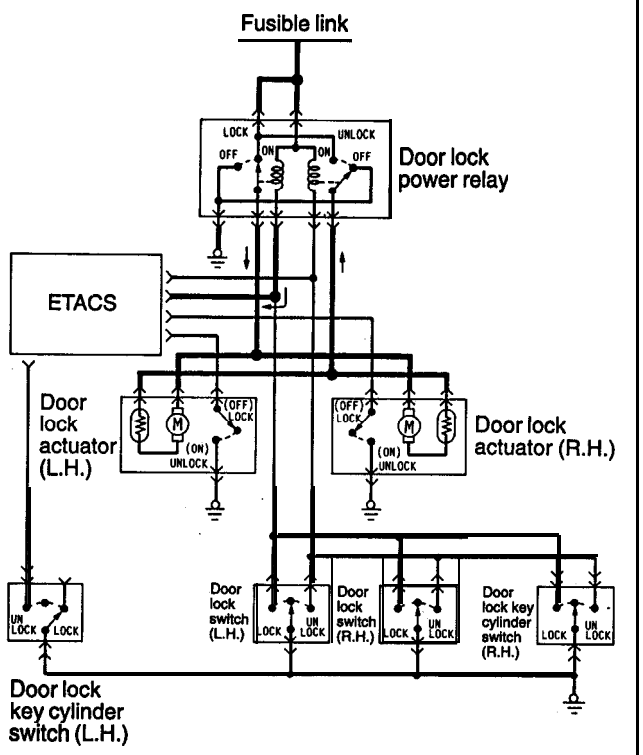


18X0628

<Passenger's side>



18X0627



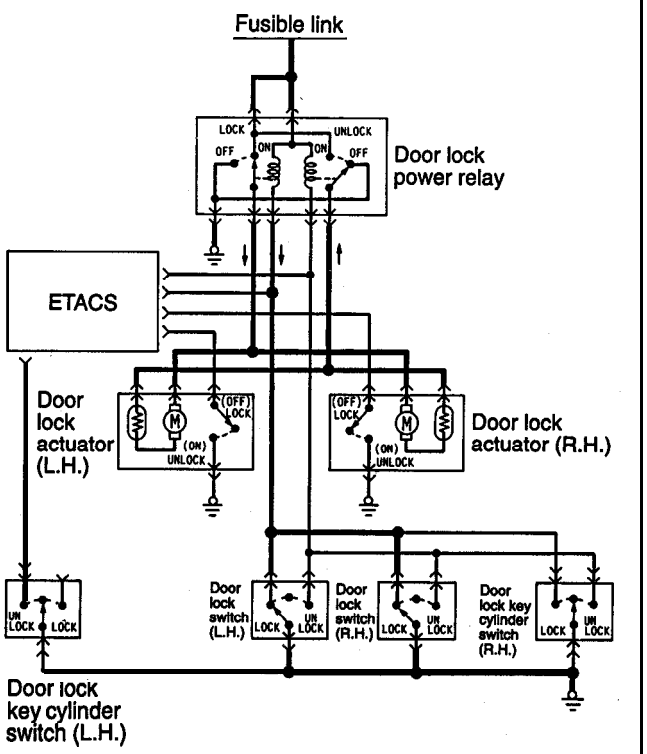
18X0636

CENTRAL DOOR LOCKING SYSTEM OPERATION

1. Door Locking Operation

(1) Door locking operation by Inside Lock Knob or Key

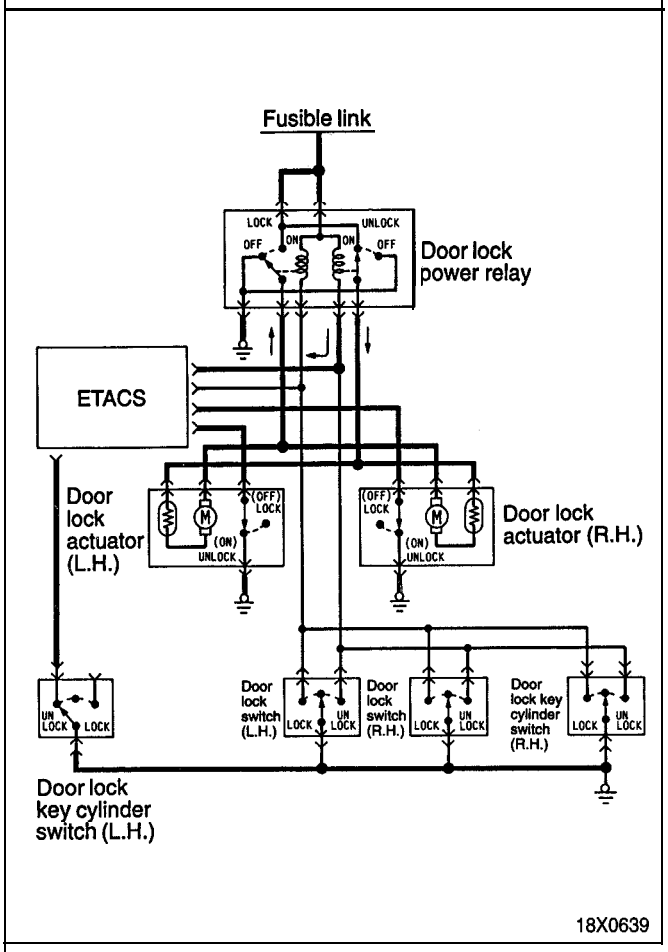
When the driver's lock knob or door key is placed in the lock position, the door lock actuator switch is forced to OFF by a mechanical link. The OFF signal from the actuator switch is input to the ETACS. In response to the signal, the ETACS delivers a lock output. Accordingly, the lock side coil of the door lock power relay is energized to operate the door lock actuators and lock the doors.



18X0637

(2) Door locking operation by door lock switch

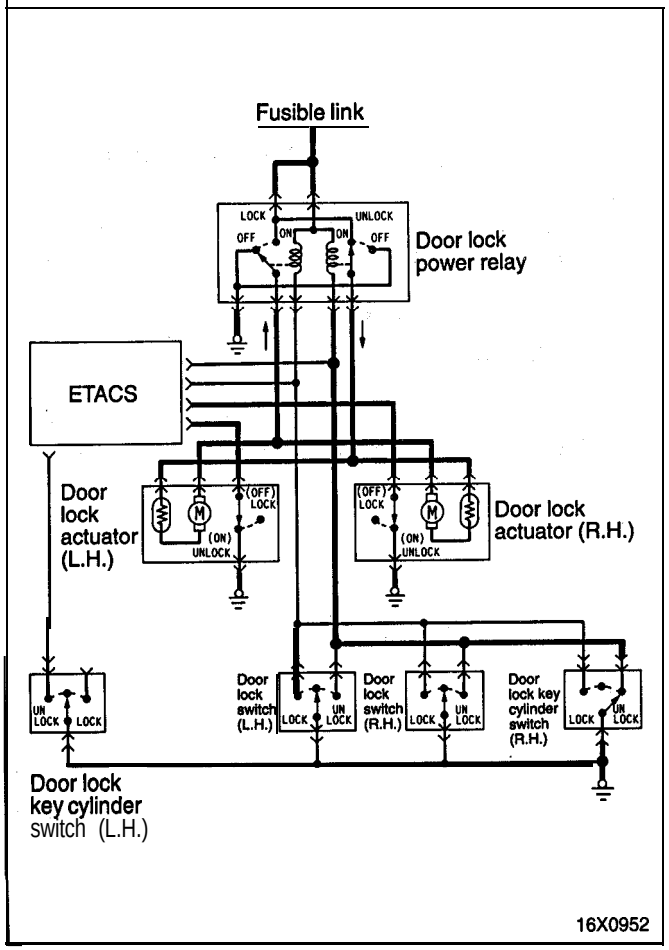
When the lock side of the door lock switch is turned ON, the lock side coil of the door lock power relay is energized to operate the door lock actuators and lock the doors.



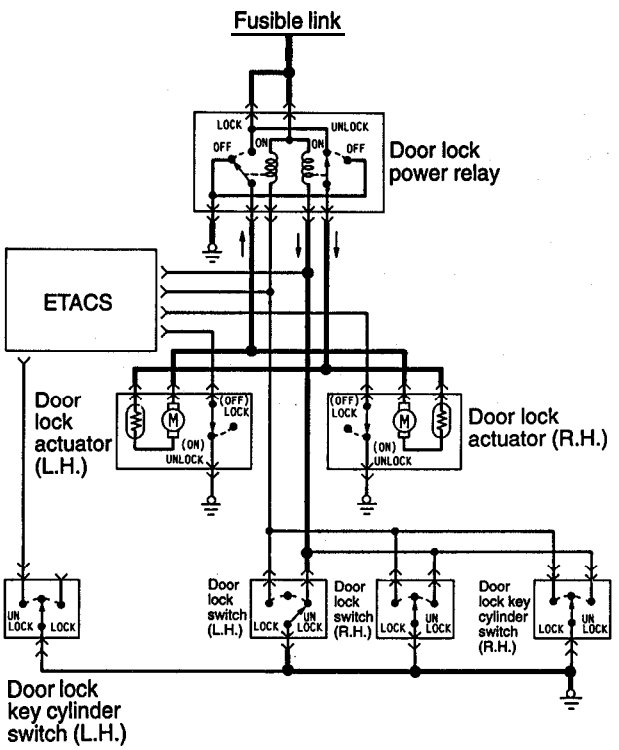
2. Door Unlocking Operation

(1) Door Unlocking Operation by Key

When the driver's door key is operated once toward the unlock side, the driver's door is unlocked by a mechanical link. At the time, the driver's door lock actuator switch signal to the ETACS changes to ON. In this state, when the driver's door key is operated once again toward the unlock side, the ON signal is input from the door lock key cylinder switch to the ETACS. In response to these signals the ETACS delivers an unlock output. Accordingly, the unlock side coil of the door lock power relay is energized to operate the front passenger's door actuator and unlock the front passenger's door.

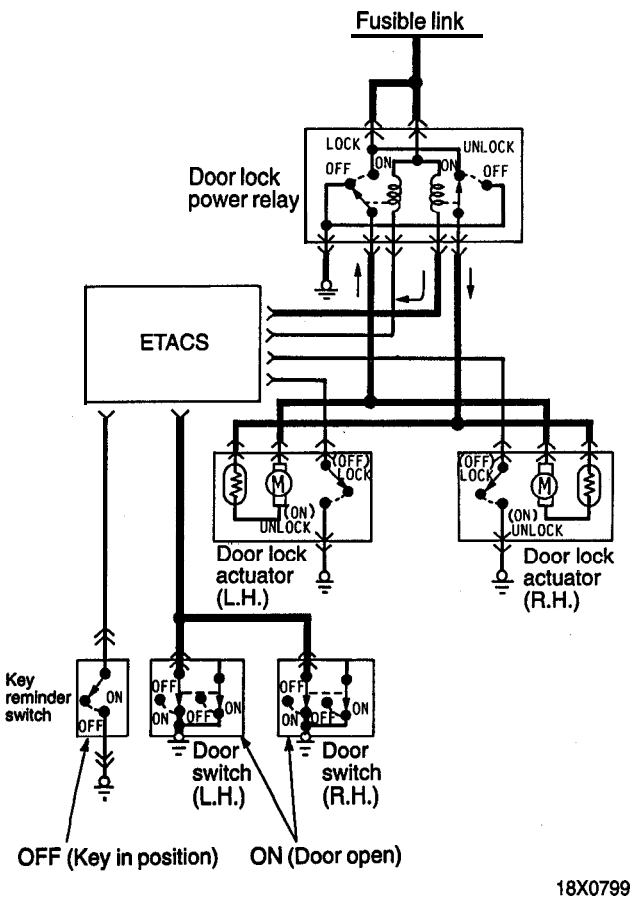


When the front passenger's door key is placed in the unlock position, the unlock side coil of the door lock power relay is energized to operate the door lock actuators and unlock all the doors.



(2) Door Unlocking Operation by Door Lock Switch

When the unlock side of the door lock switch is turned ON, the unlock side coil of the door lock power relay is energized to operate the door lock actuators and unlock the doors.



DOOR LOCKING PREVENTED WITH KEY IN IGNITION SWITCH

(1) When any of the doors is opened with the key inserted in the ignition switch (key reminder switch), the signals from the key reminder switch and door switch are input to the ETACS.

(2) In this state, when the driver's door inside lock knob is placed on the lock side (the OFF signal from the actuator switch input to the ETACS), an unlock output is supplied from the ETACS for 5 seconds.

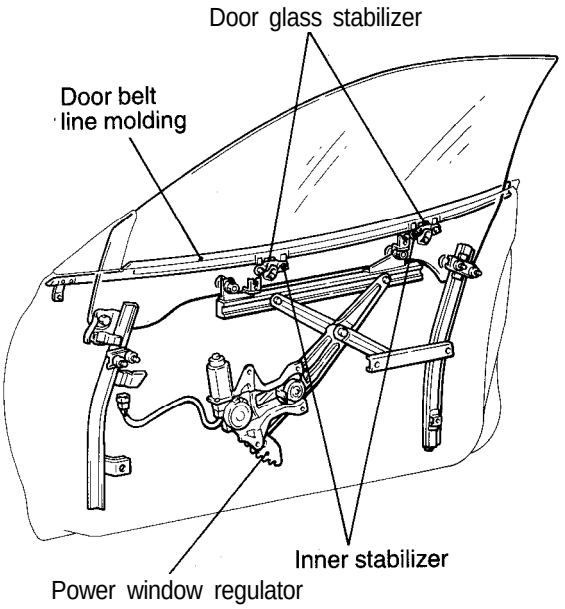
(3) This moves the door lock actuator to the unlock side. Therefore, the door cannot be locked unless the key is removed from the ignition switch (key reminder switch) or the door is closed.

WINDOW GLASS REGULATOR

N74ZE02AA

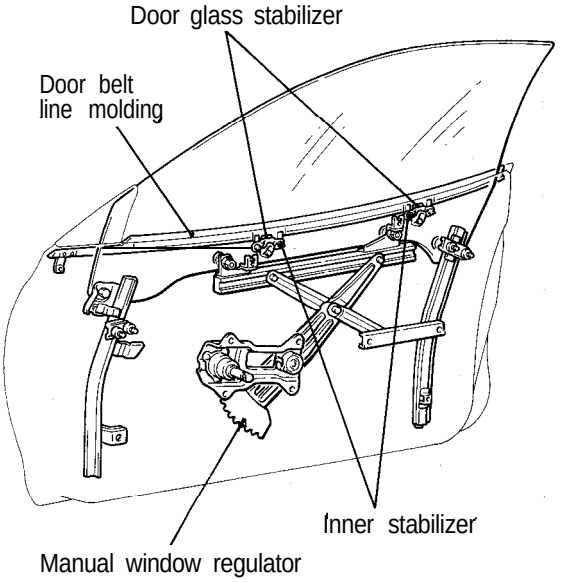
Since the sashless doors have been adopted, highly rigid X type window glass regulators have been adopted.
The door glass is supported by a whole length of hollow lip provided in the door belt line molding. The structure, compared with the localized support of the conventional outer stabilizers, places less load on the glass. Therefore, the outside of glass is less vulnerable to damage.
On power window equipped vehicles, the power window switch has been changed to lower the door glass when the knob is pressed in, and raise the door glass when the knob is pulled up.

<Vehicles with power window>

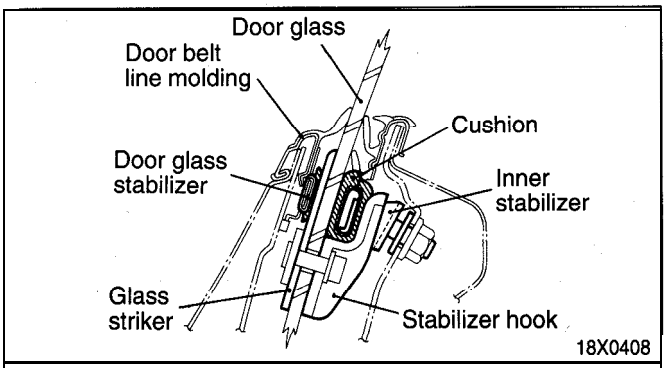


18X0707

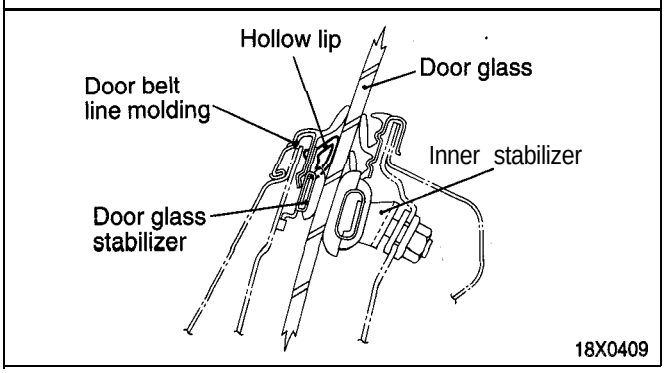
<Vehicles without power window>



18X0708



18X0408



18X0409

HOLDING OF DOOR GLASS

When fully raised, stabilizer hook on the door glass catches the inner stabilizer cushion to hold the door glass securely and draw it inward. In addition, from outside the door glass, the door glass stabilizer presses glass striker and the door glass inward.

WHEN DOOR GLASS BEGINS TO OPEN

The glass striker moves down with the door glass, but the hollow lip provided over the full length of the door belt line molding provides a proper pressure against the glass. Therefore, the outside of glass is less vulnerable to damage.

NOTE
The stabilizer hook also moves down with the glass.

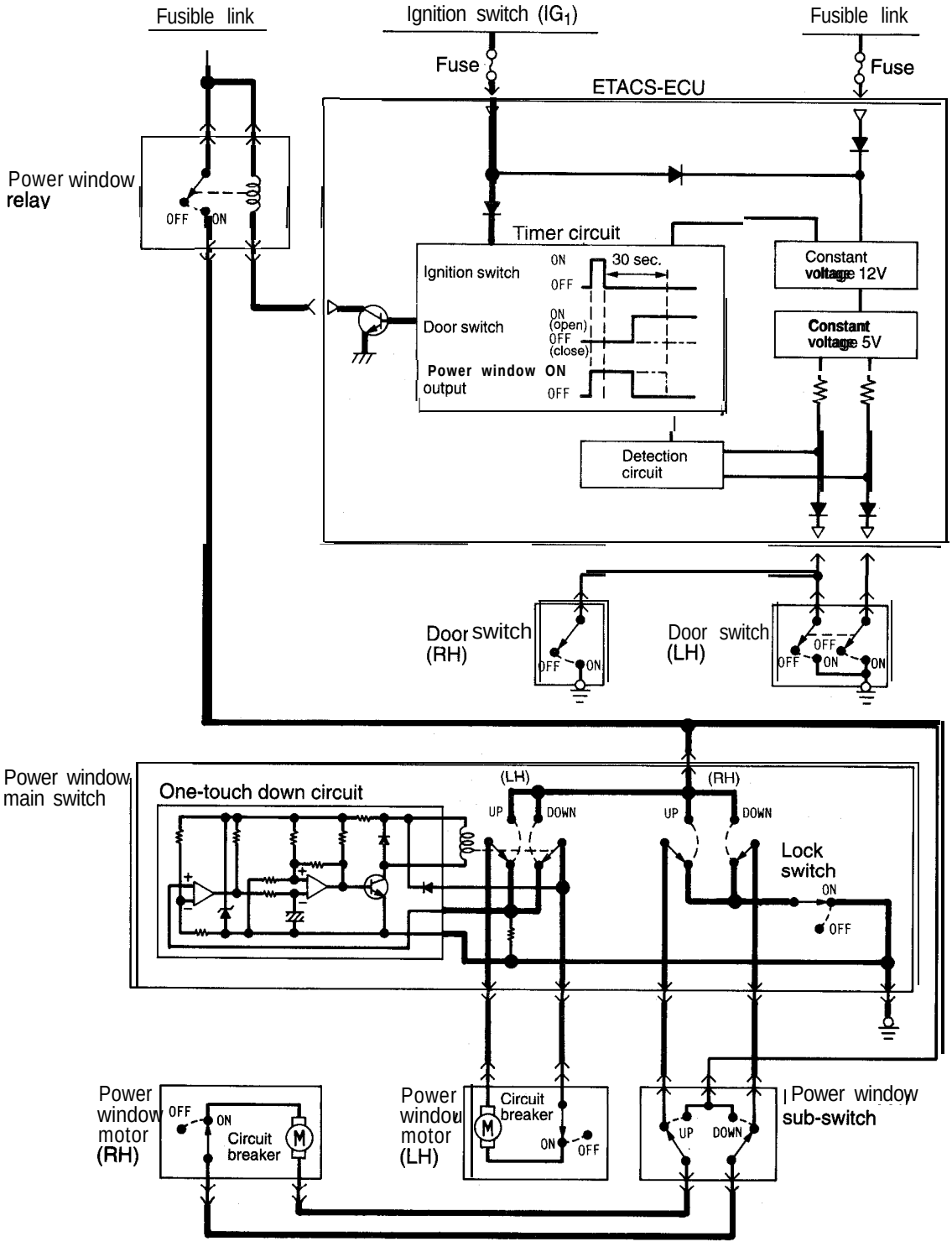
OPERATION OF POWER WINDOWS

1. Operation of Power Windows When Controlled by Main Switch

(1) When the ignition switch is placed at IG_1, current is supplied from the ETACS-ECU to the coil of the power window relay. This causes the power window relay to be ON.

(2) Current is supplied from the power window relay through the main switch to the power window motor to operate the power window.

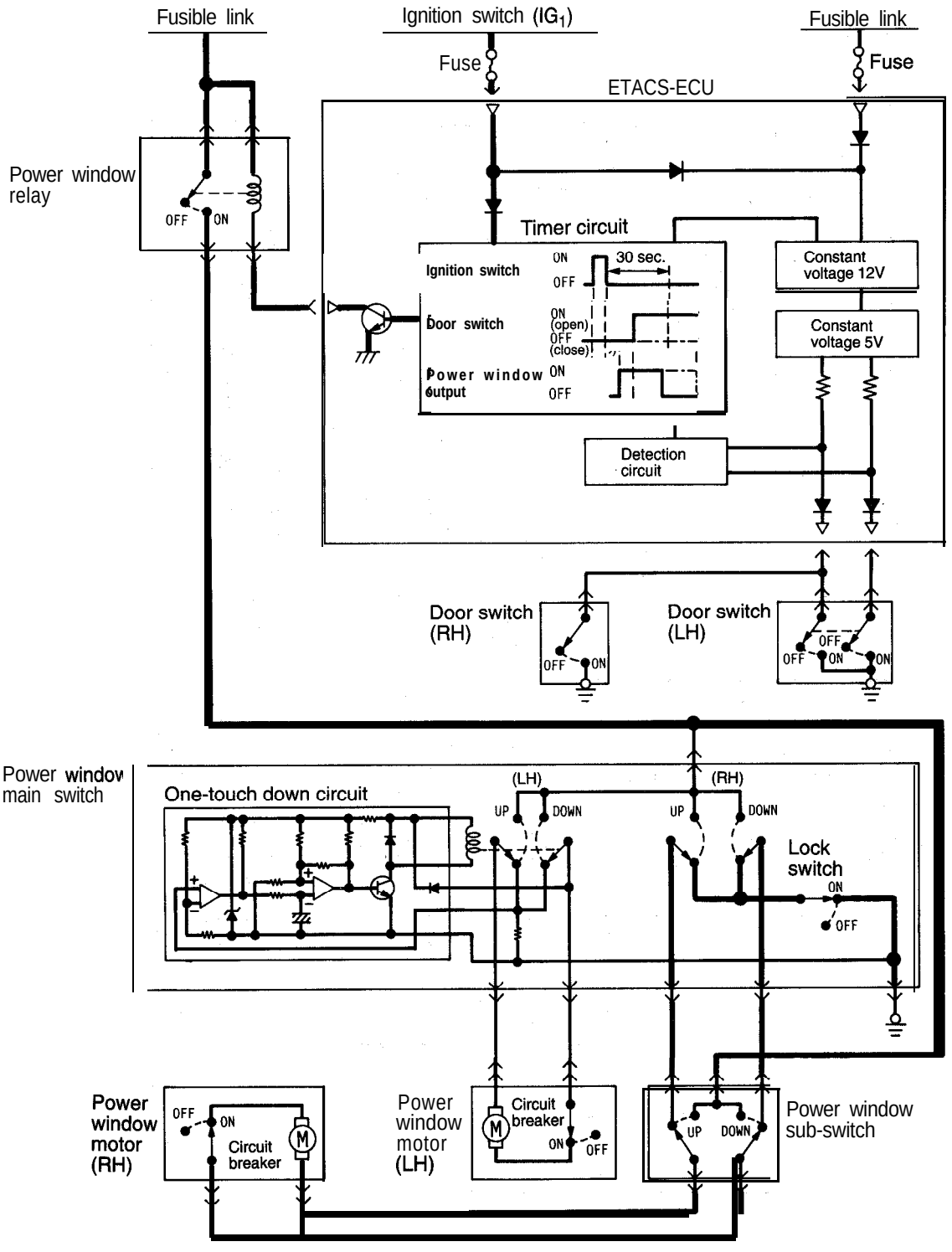
(3) Even after the ignition switch has been placed at OFF, the power window can be operated for a period of 30 seconds. During this period, however, the output is interrupted the moment the door is opened.



18X0640

2. Operation of Power Windows When Controlled by Sub Switches

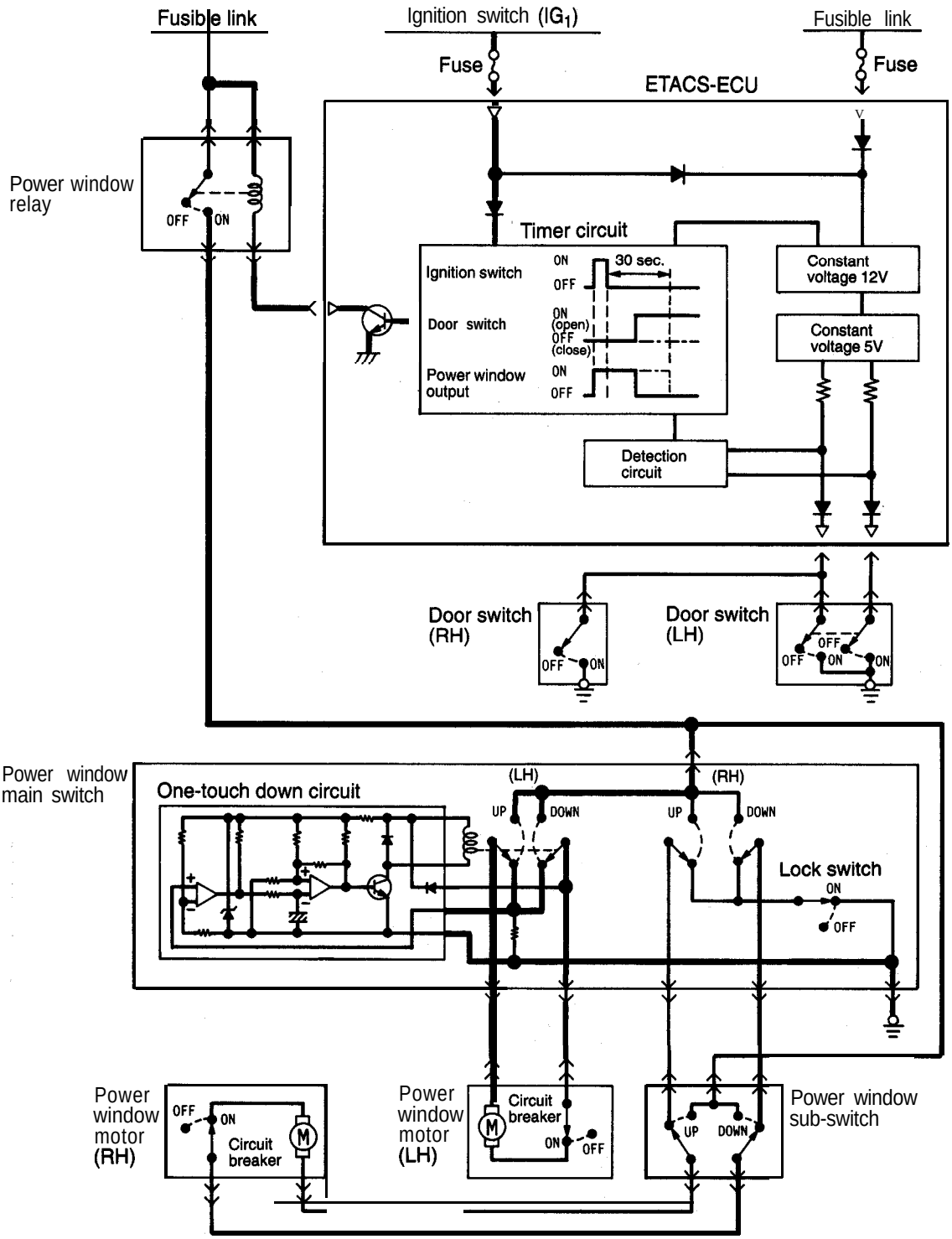
(1) When the ignition switch is placed at IG_1, current is supplied from the ETACS-ECU to the coil of the power window relay. This causes the power window relay to be ON.
(2) Current is supplied from the power window relay through the sub switch to the power window motor to operate the power window.
(3) Even after the ignition switch has been placed at OFF, the power window can be operated for a period of 30 seconds. During this period, however, the output is interrupted the moment the door is opened.



18X0641

3. Operation of LOCK Switch

When the lock switch of the power window main switch is placed at the lock position, the front passenger's side power window cannot be operated by the power window main switch or power window sub switch.



18X0642

KEYLESS ENTRY SYSTEM

N74ZG00AA

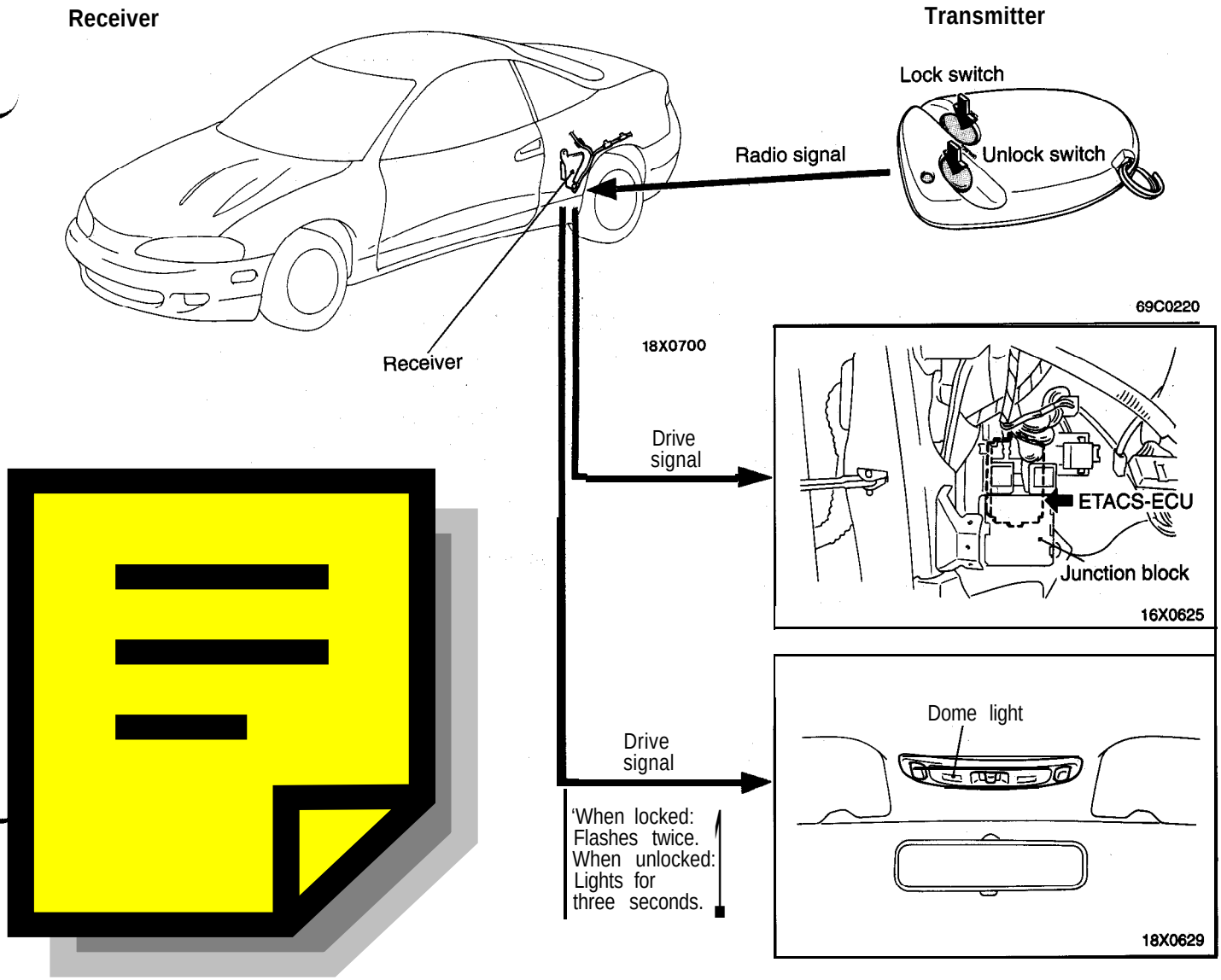
The radio wave remote control type keyless entry system has been adopted. The system is similar to the one introduced on the 1993 3000GT. It allows all the doors to be locked and unlocked by remote control. (Option)

The system consists of a transmitter and receiver added to the conventional central door lock mechanism. Even if the keyless entry system fails, the doors can be locked and unlocked by the key.

The system offers the following features.

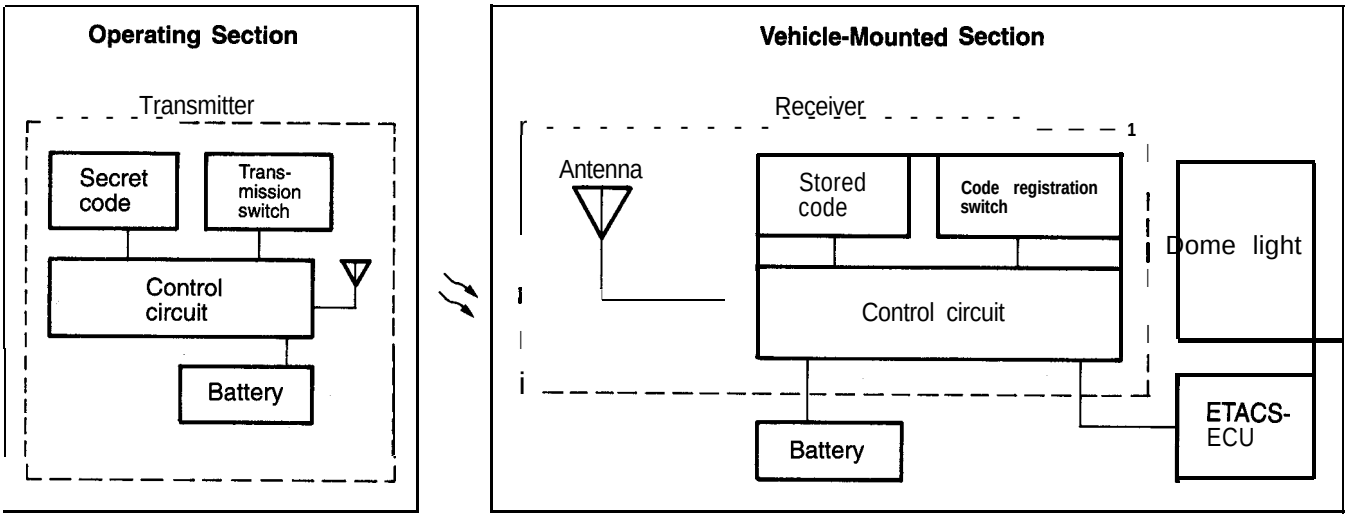
- Because of the radio wave remote control design, the operating range of the system is about 6 m (20 ft.) from the vehicle in all directions.
- The receiver has a built-in memorize/operation changeover switch (programming switch). Even if the transmitter is lost, the whole system need not be replaced. Just program a new transmitter to the receiver.
- The receiver can store two secret codes. Therefore, two transmitters can be used for a single vehicle.
- A timer lock function has been adopted so that even if the unlock switch of the transmitter is pressed by mistake, all the doors will be re-locked unless any of the doors is opened within a period of 30 seconds after the unlock switch has been pressed.
- For confirmation of system operation at night, a confirming function flickers the dome light twice after the doors have been locked, and keeps the dome light lit for three seconds after the doors have been unlocked. (The dome light switch, however, must be in the "DOOR" position.)

NOTE
The foot light also simultaneously flashes or lights with the dome light.

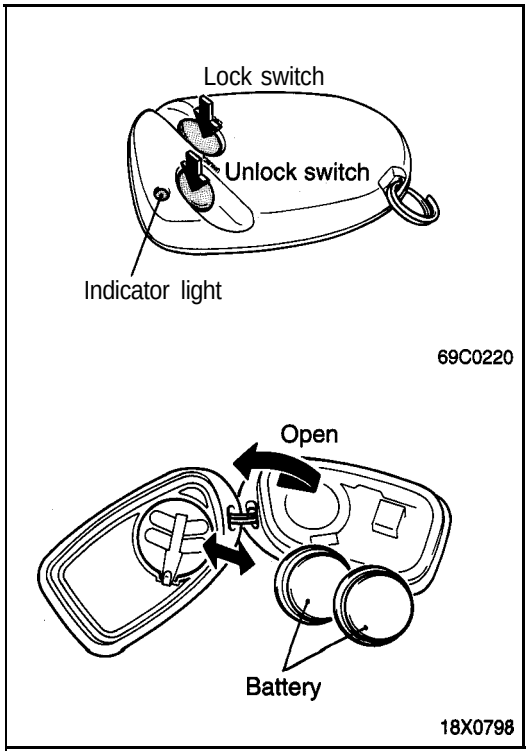


Part name	Function
Transmitter	Sends its secret code by the radio wave signals.
Receiver	Switched over between the operation and memorizing modes by the code registration switch. In the operation mode, the receiver compares the signal received from the transmitter by the built-in antenna with the code stored in the receiver and outputs the drive signal to the ETACS-ECU and dome light only when the signal coincides with the code. In the registration (programming) mode, the receiver stores the signals from the transmitter in the EEPROM in the receiver as a new code.

Outline of the System



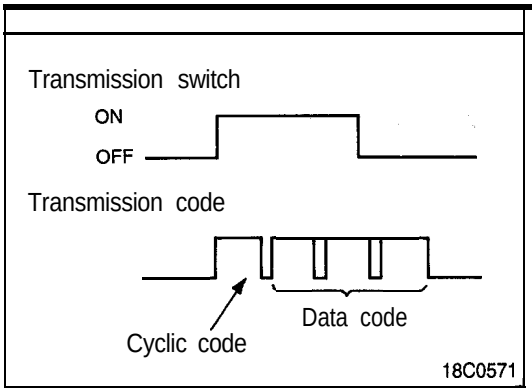
18X0643



STRUCTURE AND OPERATION

TRANSMITTER

The transmitter is a key holder type independent of the master ignition key. The transmission switch comprises two switches which independently perform the lock and unlock functions. When the transmission switch is operated, the secret code unique to the transmitter is transmitted in radio form.
The transmitter has an indicator light which lights when the transmission switch is placed in the ON state. The light makes it possible to confirm switch operation and battery discharge. The battery comprises two lithium cells (CR2016) and offers a life expectancy of about two years at a rate of use of 10 times/day.



Transmission Code

The illustration at left shows a code transmitted from the transmitter. When the switch is operated once, three data codes following the cyclic code are sent. One data code comprises a total of 51 bits, of which 21 bits are used to constitute a secret code for identification of the user, and the remaining 25 bits are used for system identification, etc. The secret code for user identification is a combination of **"0s"** and **"1s"**. More than a million combinations are available.

RECEIVER

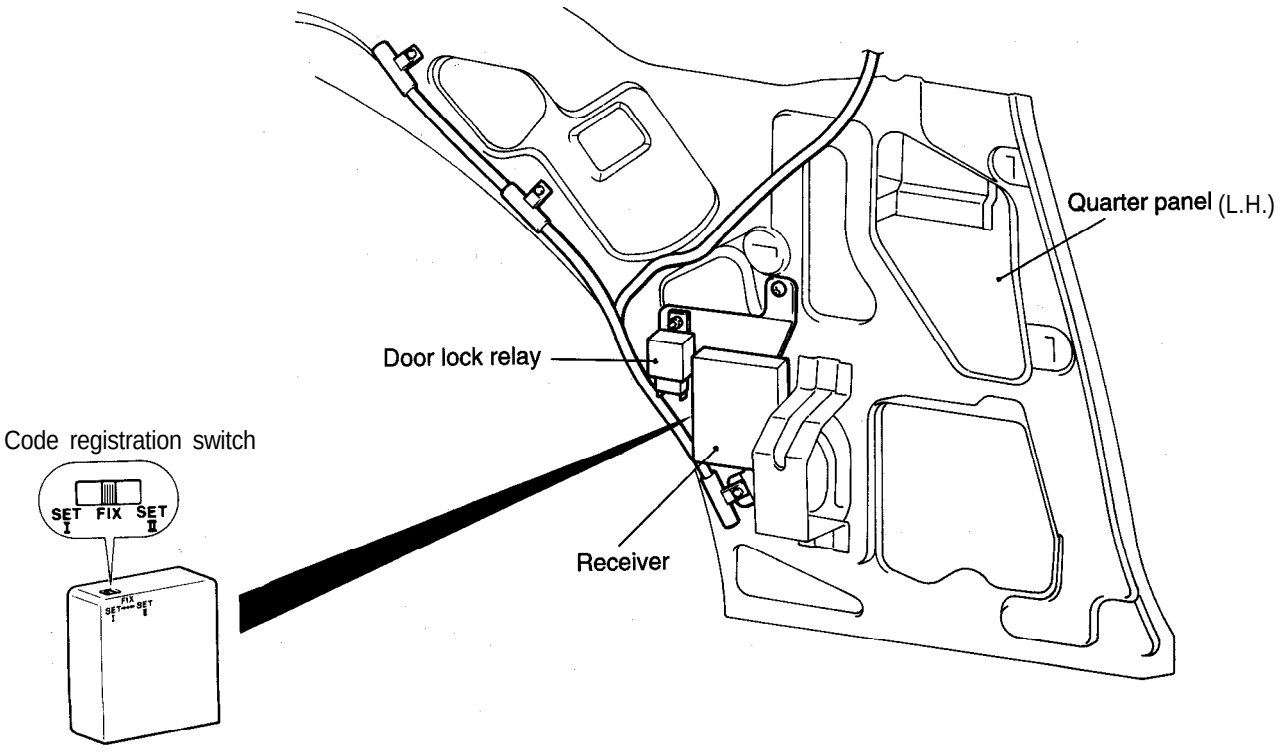
The receiver is mounted at the driver's side rear quarter panel. The receiver has a code registration switch by which the receiver is switched between the system operation mode and code registration mode.

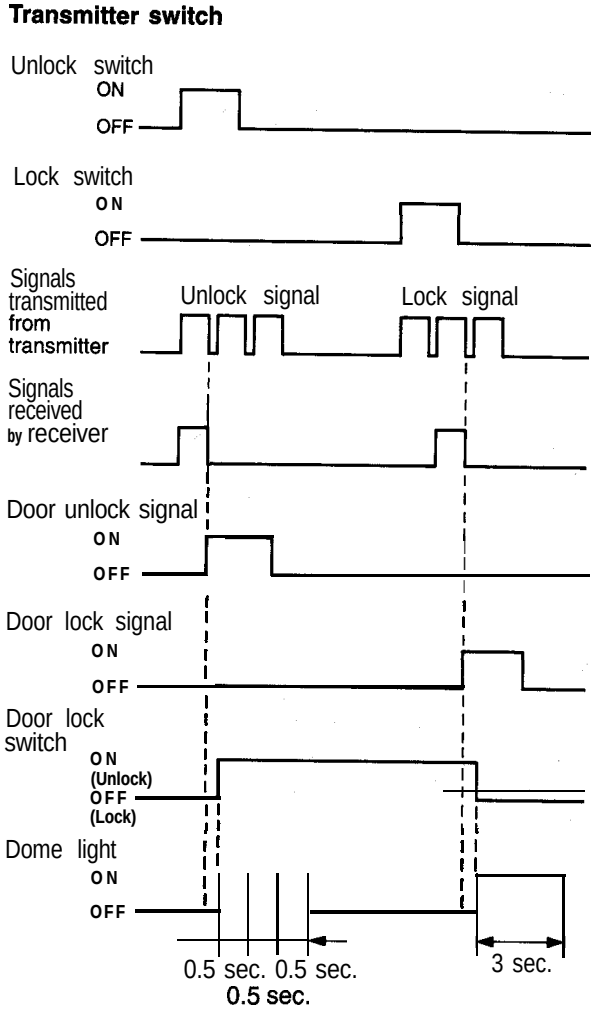
Normal keyless entry system operations are performed in the system operation mode. In the system operation mode, the signals transmitted from the transmitter are compared with the code stored in the EEPROM in the receiver. Only when the results are in agreement, a signal is output to the ETACS-ECU to lock or unlock the doors and cause the dome light to flash (when the doors are locked) or steadily light (when the doors are unlocked). (The dome light switch, however, must be in the "DOOR" position.)

When the transmitter or receiver is replaced, note that the secret code unique to the transmitter and the code stored in the EEPROM in the receiver will be out of agreement. To allow operation of the system, the code sent from the transmitter must coincide with the code stored in the receiver. For this purpose, place the receiver in the registration mode and write (transmit) the secret code assigned to the transmitter in the EEPROM in the receiver as a new code.

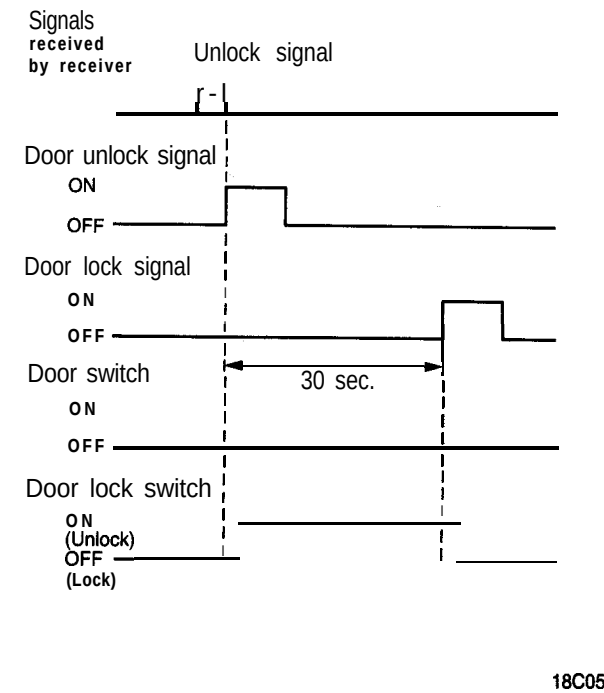
The EEPROM can store two codes. Since the user has only one transmitter at first, the EEPROM stores two identical codes at shipment. When the user wants to use one more transmitter, a maximum of two transmitters can be used by repeating the registration operation to the EEPROM.

(EEPROM: Electrical Erasable & Programmable ROM which allows data to be electrically erased and rewritten)





18C0573



18C057

OPERATION IN SYSTEM OPERATION MODE

When the transmission switch is pressed once, three identical codes are transmitted from the transmitter. The secret code is decrypted by the comparator circuit in the receiver which compares the code with the code stored in the receiver. When the transmitted code coincides with the stored code, the receiver sends a door unlock signal or door lock signal to the ETACS-ECU.

In response to the signal, the doors are locked or unlocked. When the door lock switch in the door lock actuator is caused to be ON (unlock) or OFF (lock), the receiver causes the dome light to flash or steadily light (operation confirmation function).

NOTE

The receiver determines that the codes are in agreement when any of the three codes transmitted from the transmitter coincides with the code stored in the receiver.

TIMER LOCK FUNCTION

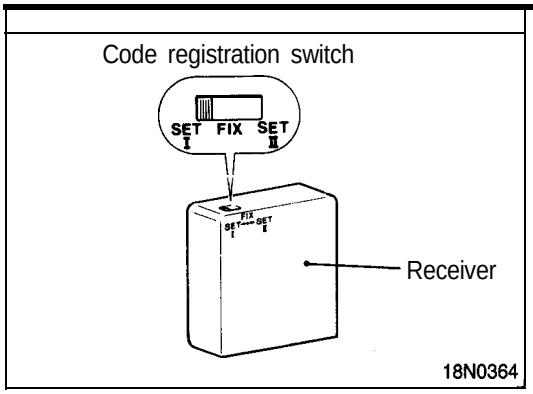
If none of the doors is opened in less than 30 seconds after the doors have been unlocked by the keyless entry system, the receiver will automatically output a door lock signal to the ETACS-ECU to re-lock the doors.

This function prevents accidental unlocking of the doors that may be caused by an unintentional operation of the transmitter.

Operation Inhibit Conditions

In the following cases, operation of the system is inhibited.

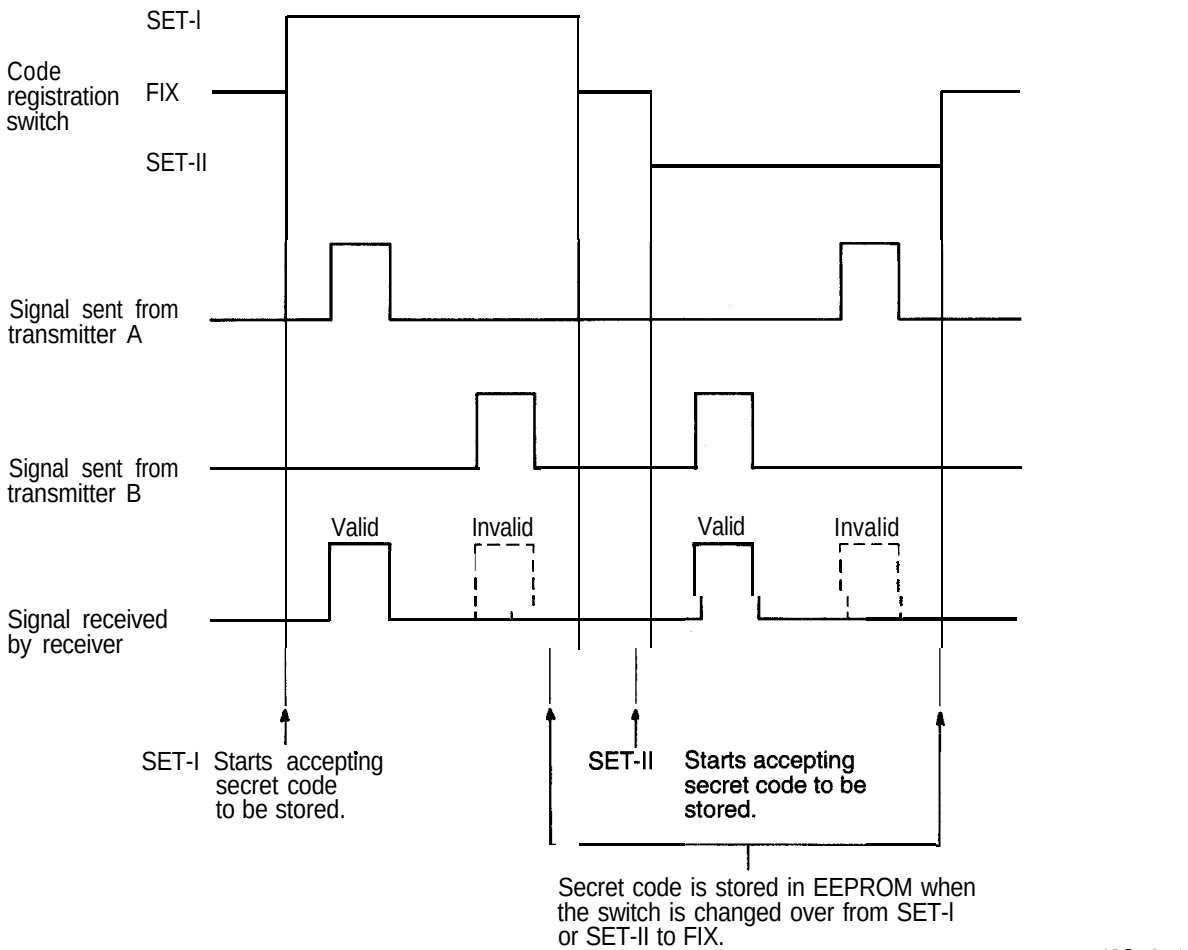
- When a code different from the one stored in the receiver is received 30 consecutive times in a minute, operation of the system is inhibited for 10 minutes.
- When the ignition key is in the ignition switch (detected by the key reminder switch)
- When any of the doors is not fully closed (door switch: ON)



OPERATION IN CODE REGISTRATION MODE (PROGRAMMING)

When the code registration switch is in the SETI or SETII position, the receiver enters the registration mode where it stores the first received secret code in the EEPROM.
Two different secret codes can be stored with the switch in the SETI and SETII positions. Therefore, the user can use two transmitters.

Timing Chart



ELECTRIC SUNROOF

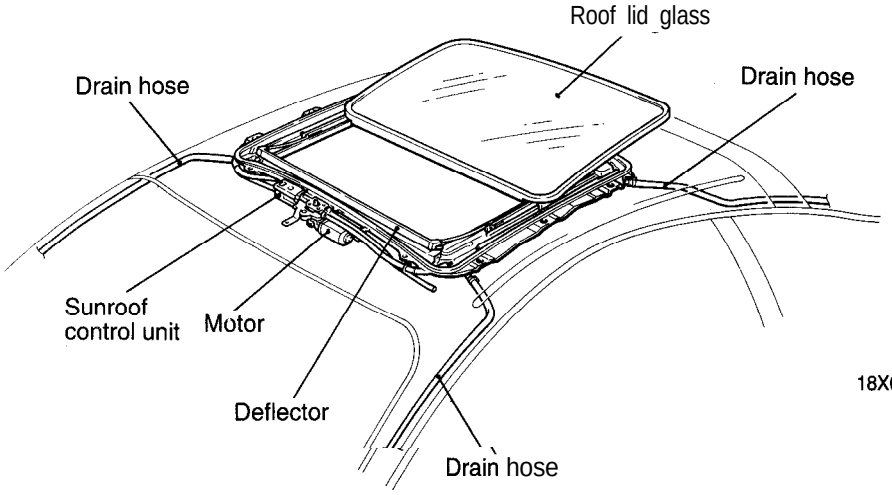
N74ZF00AA

SUNROOF CONTROL SYSTEM

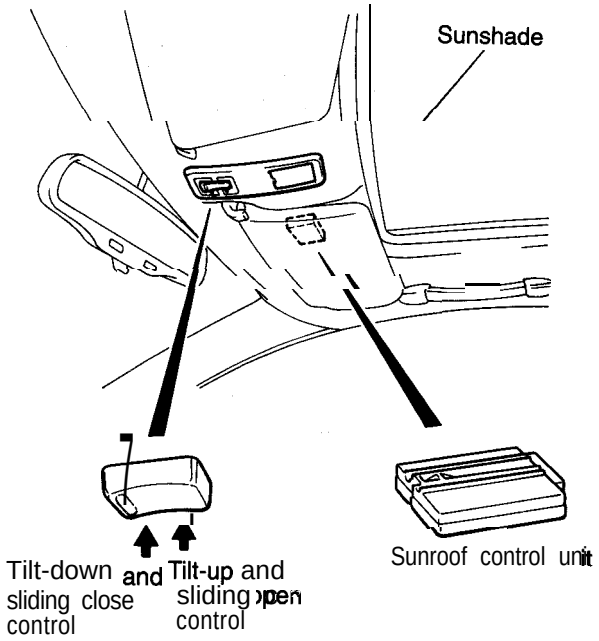
The motor driven outer slide glass sunroof tilt-up mechanism is an option for all models. This glass sunroof provides a well-lighted, open environment even with the roof lid glass in the fully closed state. The sun roof provides the following features.

- To slide open or close the sunroof or tilt it up or down, you don't have to continue to press the switch like the conventional one. The sunroof operates at the touch of the switch.
- If motion of the roof lid glass is interrupted during a tilt-up operation, the tilt up operation does not stop until the roof lid glass reaches the fully tilted up state.
- If an obstruction interferes with the sliding open motion, the roof lid glass immediately stops.
- If an obstruction interferes with the sliding close or tilt down motion, the roof lid glass will automatically reverse.
- Even after the ignition switch has been placed at OFF, the sunroof can be operated for 30 seconds. When a door is opened during the period, the sunroof can be operated for another 30 seconds from that time.

Components



18X0706



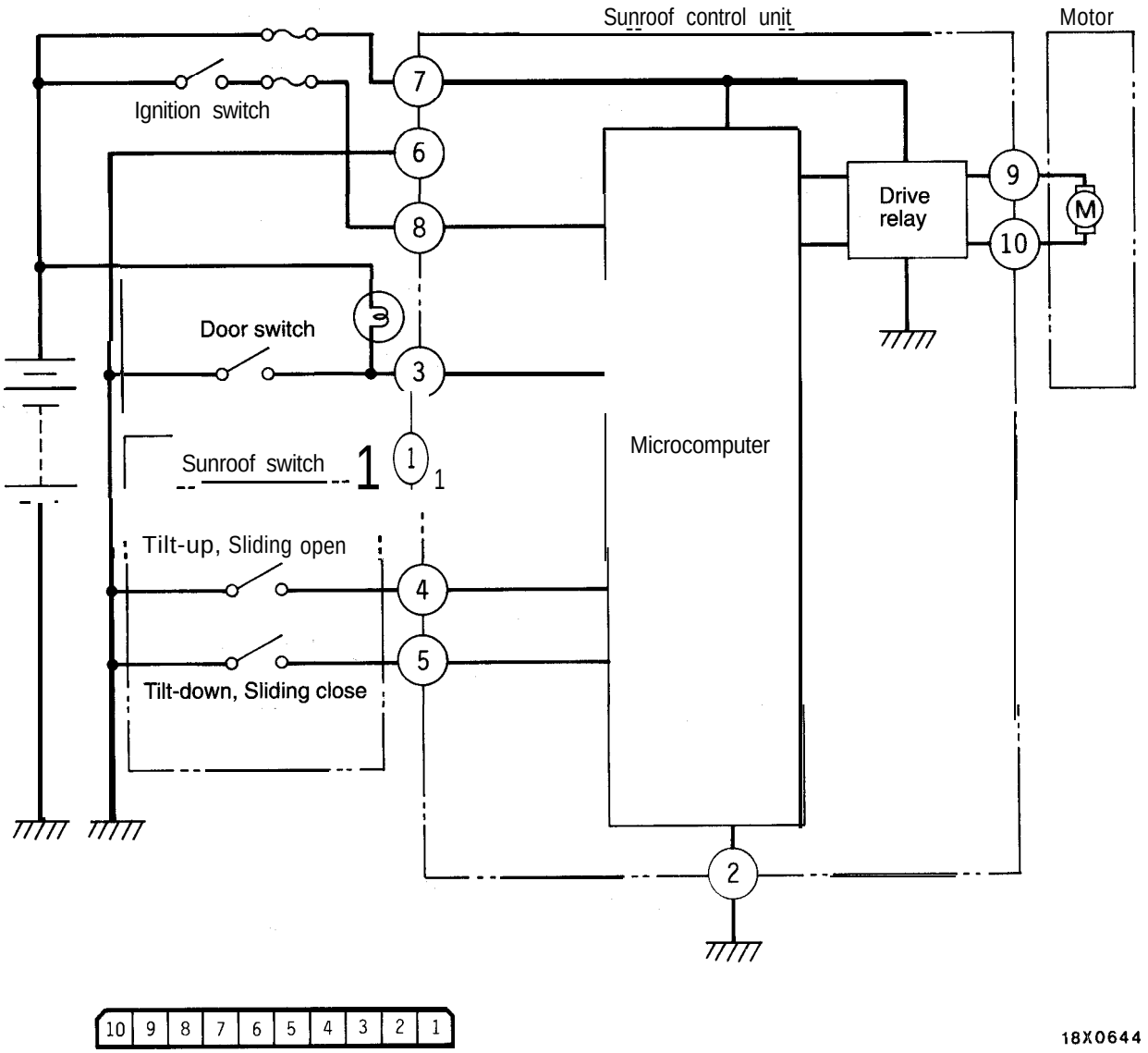
18X0705

SUNROOF CONTROL UNIT

The microcomputer in the sunroof control unit controls several functions with two different signals (tilt up and sliding open, tilt down and sliding close) from various points: the sunroof switches, the door switch.

The sunroof motor drive circuits, incorporated in the sunroof control unit, operate under control of the microcomputer.

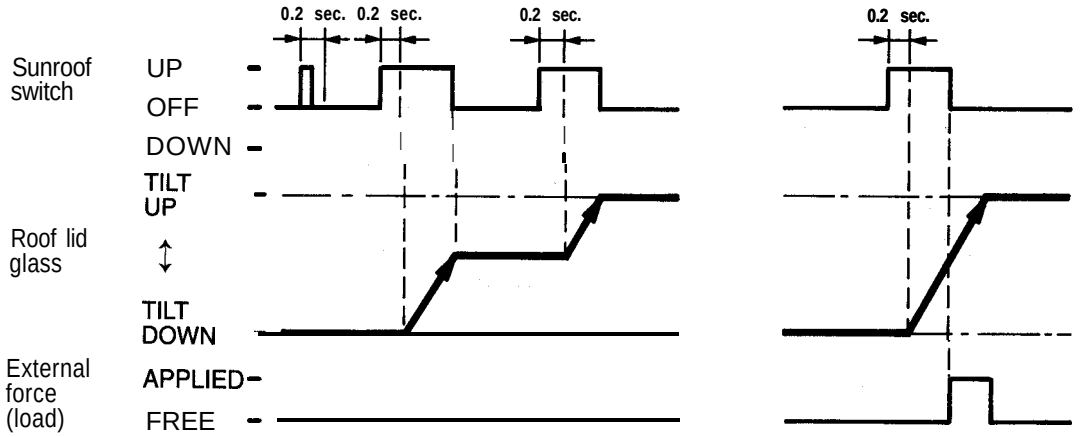
System diagram



TILT UP OPERATION

(1) When the tilt up switch is pressed for more than 0.2 seconds, the motor activates.

(2) If motion of the roof lid glass is interrupted during a tilt up operation, the-motor does not stop until the roof lid glass reaches the fully tilted up state.



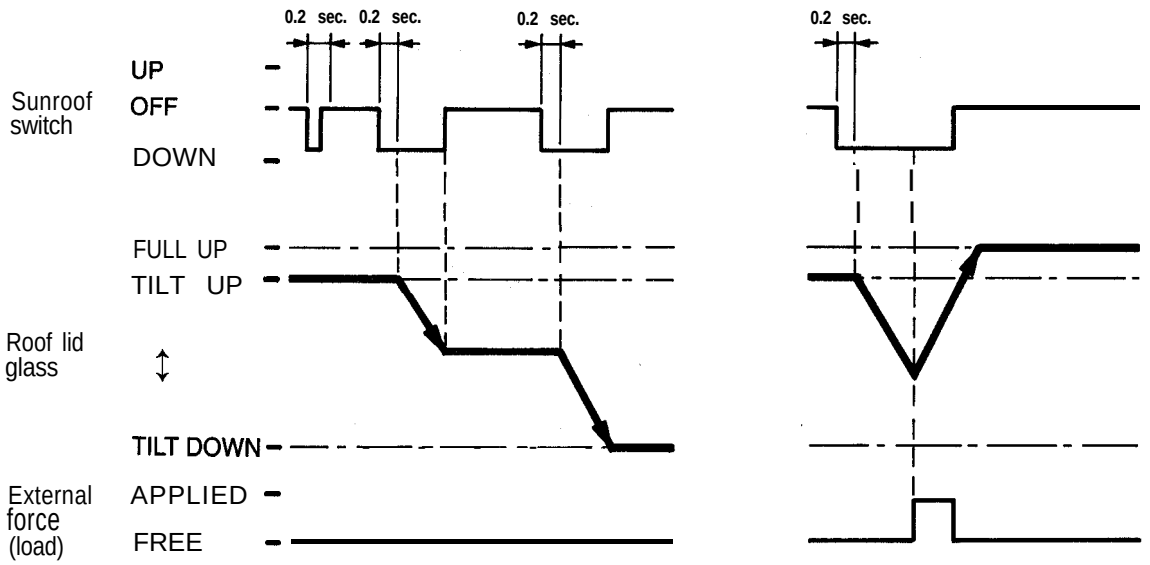
18X0645

TILT DOWN OPERATION

(1) When the tilt-down switch is pressed for more than 0.2 seconds, the motor activates.

(2) If motion of the roof lid glass is interrupted during a tilt-down operation, the motor reverses and stops after the roof lid is returned to its full up position.

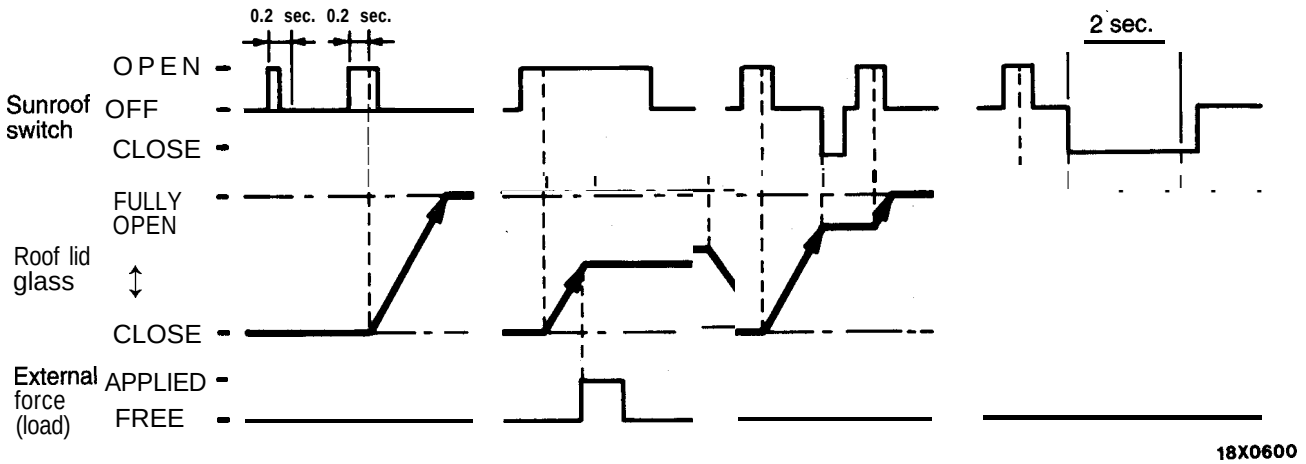
NOTE
Full up position: Where the roof lid glass begins to slide open



18X0646

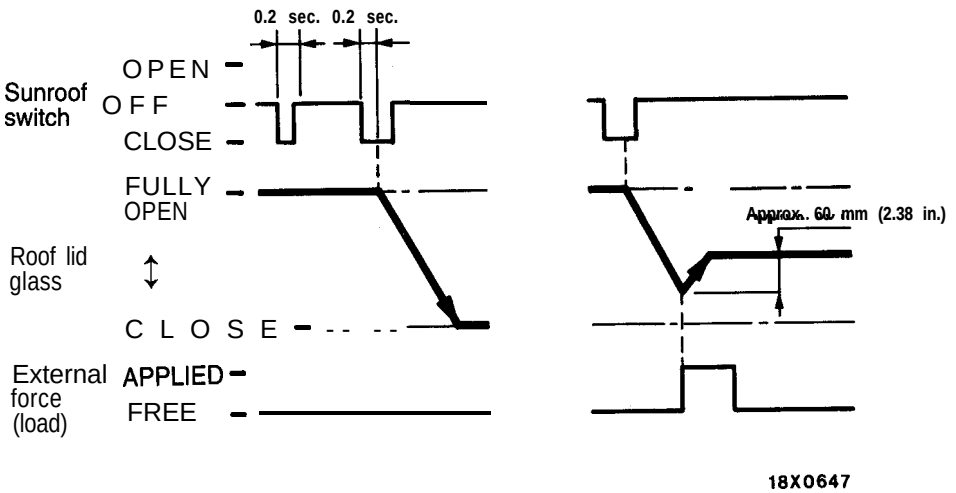
SLIDING OPEN OPERATION (AFTER TILT-UP)

(1) When the sliding open switch is pressed for more than 0.2 seconds, the motor activates.
(2) If movement of the roof lid glass is blocked during the sliding open operation, the motor will stop immediately.
(3) The motor can be stopped by pressing the sliding close switch even while the roof lid is sliding open.
(4) If the sliding close switch is kept pressed further, the motor turns in the opposite direction (to the lid closing direction).



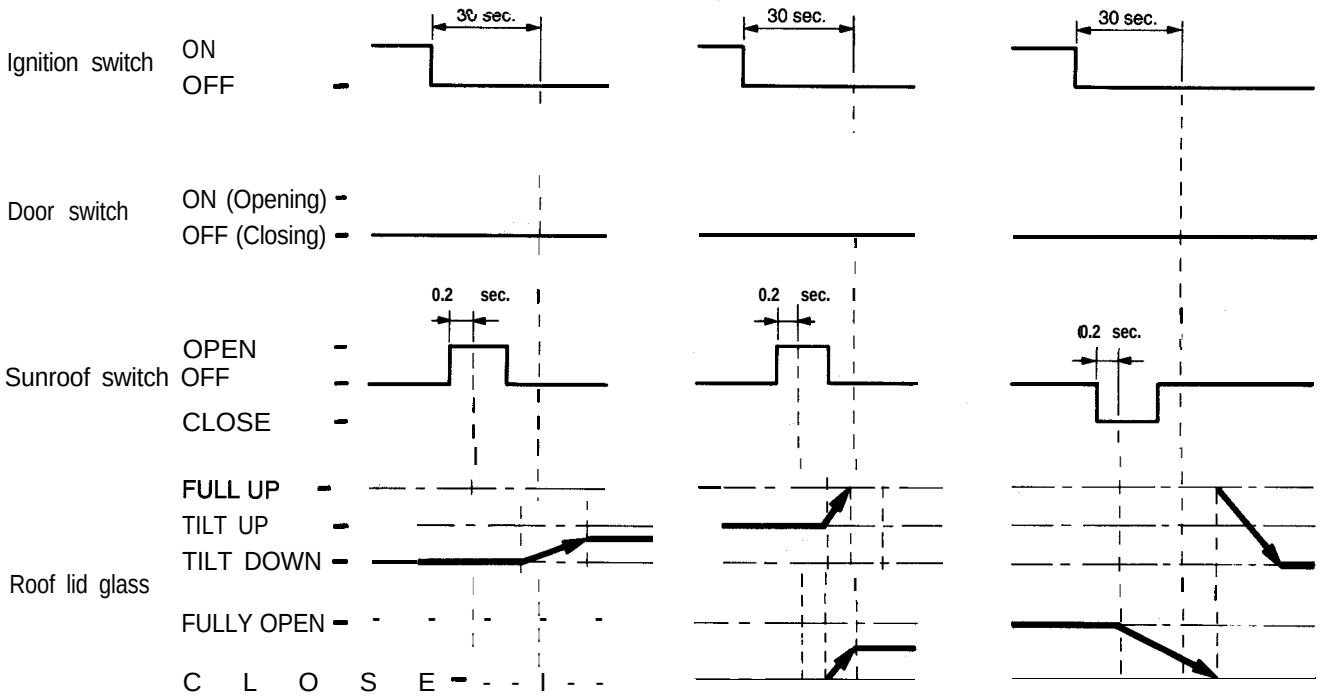
SLIDING CLOSE OPERATION

(1) When the sliding close switch is pressed for more than 0.2 seconds, the motor activates.
(2) If movement of the roof lid glass is blocked during the sliding close operation, the motor will rotate in the reverse direction by approx. 60 mm (2 3/8 in,) in terms of the roof lid glass movement distance before it stops.



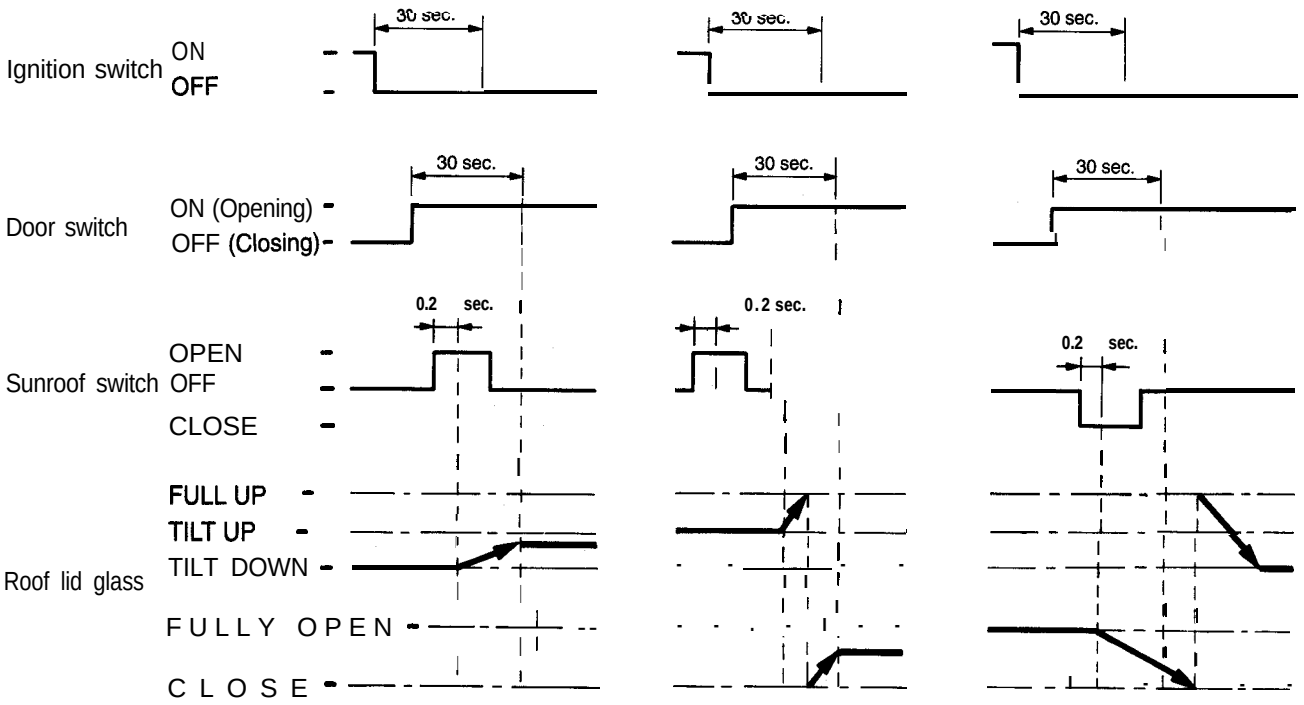
KEY OFF OPERATION

(1) The sunroof can be operated for 30 seconds after the ignition switch has been set to OFF. In the slide close mode only, however, the motor can continue until the sunroof reaches the fully closed position.



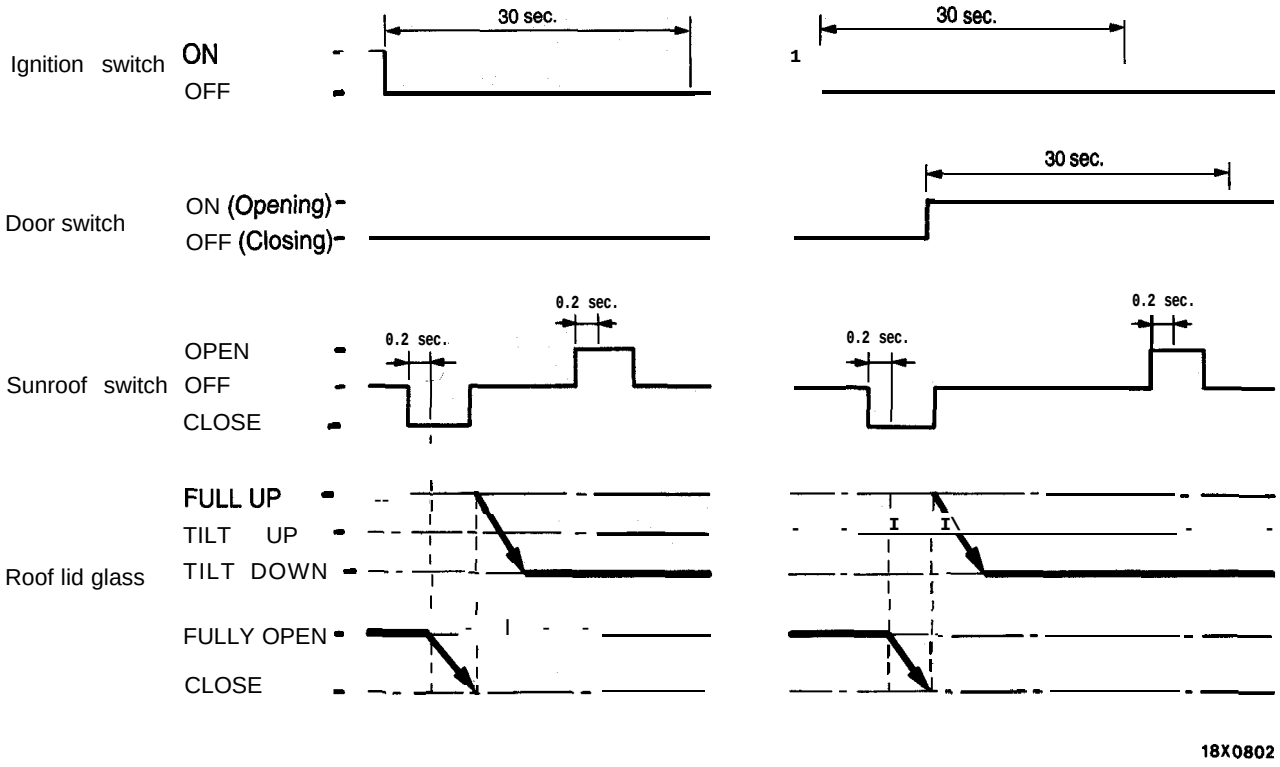
18X0803

(2) If any of the doors is opened in 30 seconds after the ignition switch has been placed at OFF, the sunroof can be operated for another 30 seconds. In the slide close mode only, however, the motor can continue until the sunroof reaches its fully closed position.



18X0804

(3) Once the sunroof reaches its fully closed position in less than 30 seconds after the ignition switch has been placed at OFF, the sunroof can no longer be operated.



EXTERIOR

CONTENTS

N?SUOQM

DOOR MIRRORS **3**

GENERAL DESCRIPTION **2**

Features 2

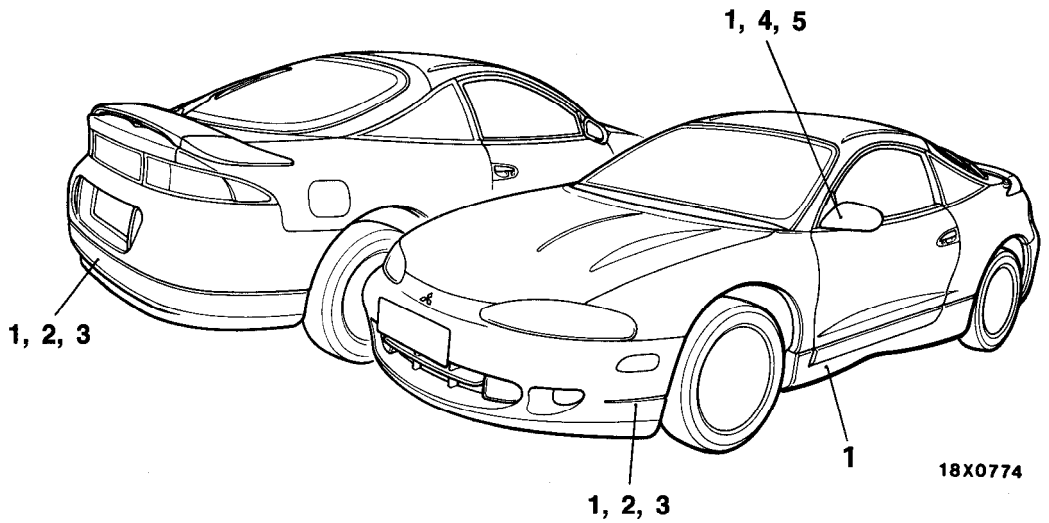
GENERAL DESCRIPTION

N75ZB00AA

All models are equipped with large front and rear resin bumpers to enhance styling.

FEATURES

Improvement of appearance	1. The bumpers, door mirrors, and side protection mouldings (some models) color coordinated with the vehicle body. 2. Large resin bumpers wrapped round the corners up to the wheel arches.
Enhancement of aerodynamic characteristic	3. Rounded bumper corners
Improvement of facility for easy operation	4. Use of heated door mirrors (some models) 5. Adoption of electric remote-controlled door mirrors (some models)
Resources recycling oriented measures	Material identification marks stamped on plastic parts and maximum use of recyclable parts.

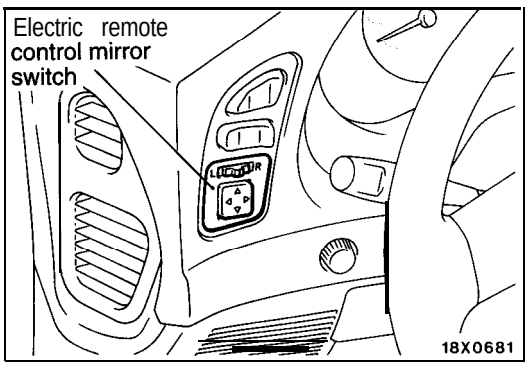


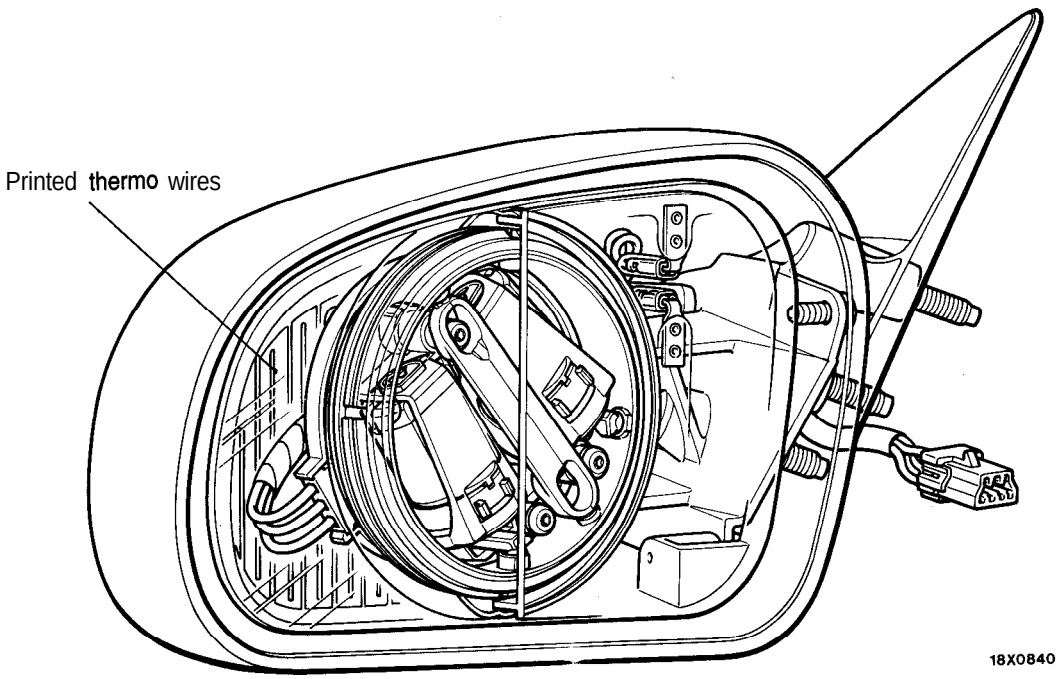
DOOR MIRRORS

N75ZC00AA

The large-size Talbot mirrors are attached on the front doors that smoothly blend into the body styling. They also contribute to the reduced aerodynamic drag, and offer the following features:

- The mirrors can be either manually remote-controlled or electric remote-controlled depending on the model.
- Heated door mirrors are available on some models (mirror defogger). This function is performed together with the rear window defogger function by operating the rear window defogger switch. The mirror defoggers are controlled by the same timer that controls the rear window defogger.





INTERIOR

CONTENTS

N762AOOAA

INSIDE REAR VIEW MIRROR WITH READING LAMP 10

INSTRUMENT PANEL AND FLOOR CONSOLE BOX 3

LUGGAGE COMPARTMENT FLOOR 10

SEAT 4

- Construction and Operation 5
- Front seat 4
- Power seat 7
- Rear seat ..... .

SEAT BELTS 8

SUMMARY OF INTERIOR PARTS 2

- Features 2

SUPPLEMENTAL RESTRAINT SYSTEM (SRS) 11

- Air Bag Module 17
- Clock Spring 28
- Construction and Operation 16
- SRS Connector 26
- SRS Diagnostic Unit 22
- SRS Sehematic 12
- SRS Warning Light 30
- Warning/Caution Labels 13

SUMMARY OF INTERIOR PARTS

N76ZB00AA

The interior parts are designed to create a sense of high quality while attaching great importance to the vehicle's function, comfort and safety. Also, they reflect our attitude getting active in protection of global environment and recycling of resources.

FEATURES

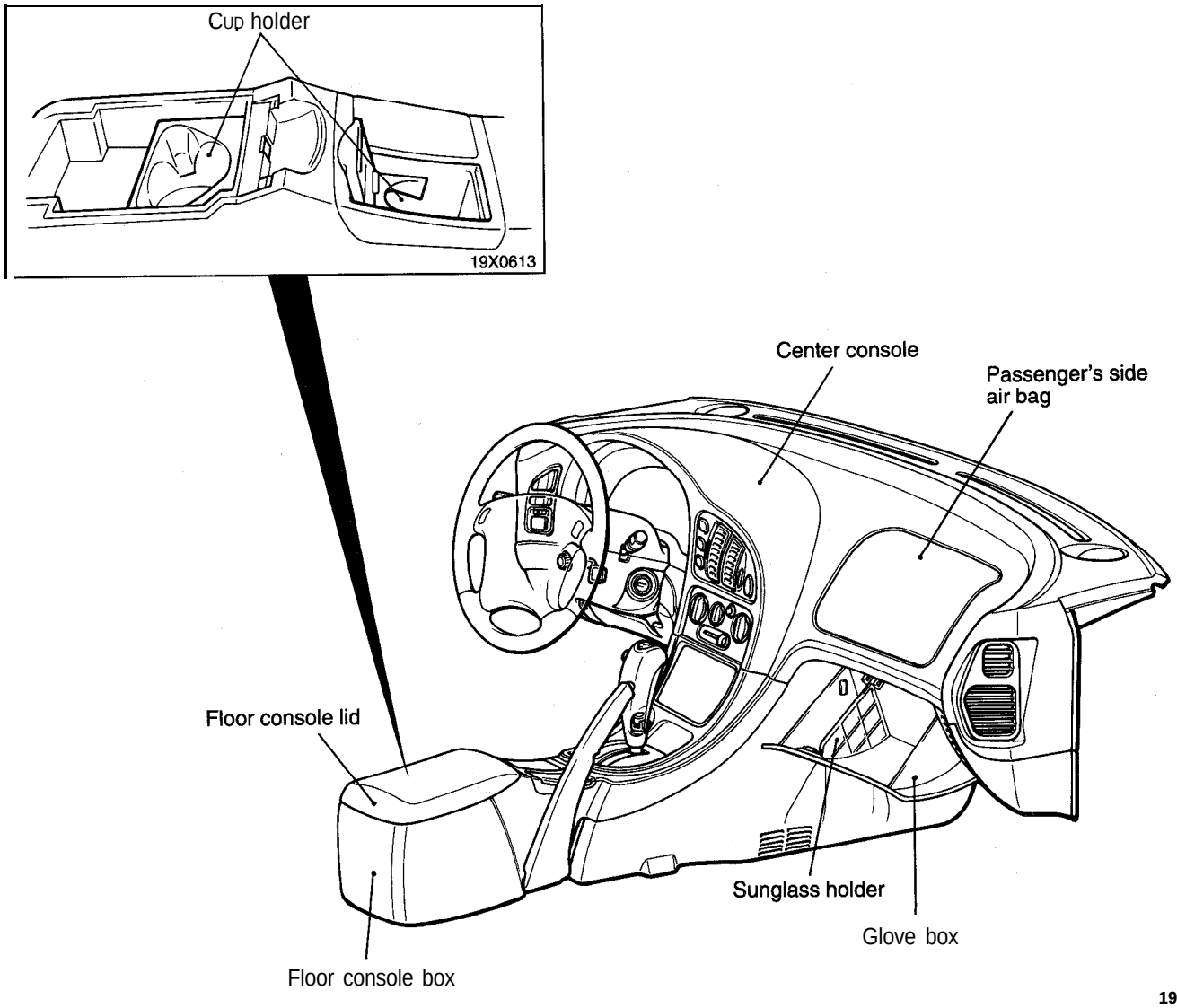
Improved quality feeling	1. Fully trimmed cabin 2. Flowing, integral type instrument panel 3. Integral head lining
Greater ease of handling	1. Large glove box 2. Cup holders
Convenient accommodation space for small articles	Ample accommodation space in instrument panel, floor console, door, luggage compartment, etc.
Greater safety	1. Instrument panel padding 2. Three-point seat belt with ELR (driver's side)/Three-point seat belt with ELR and ALR (passenger's side and rear seat) 3. Flame-retardant material for upholstery covering and padding (urethane pad.) 4. Installation of air bag module for front seat passenger
Provision for optimum driving position	1. One-touch pushbutton type adjustable shoulder anchor 2. Seat cushion using high-elasticity urethane pad to allow long driving with little fatigue 3. Dual height control mechanism 4. Power seat (3-way adjustment)
Considerations for protection of global environment and recycling of resources.	1. Stamping of material names on plastic parts 2. Use of CFC-free sheet urethane 3. Use of recyclable material for sound insulating pads

INSTRUMENT PANEL AND FLOOR CONSOLE BOX

N762COOAA

The flowing instrument panel provides the feeling of a cockpit. It has the following characteristics.

- The instrument panel surface has been covered with a soft pad to enhance the safety and the sense of quality.
- The center console has been tilted toward the driver's seat to provide the driver with improved control and visibility of the console.
- A large glove box with a sunglass holder has been adopted.
- To offer more convenience, the floor console has been provided with two cup holders which can be stored inside the console.
- On some models, the floor console lid has been covered with a soft pad to serve as an armrest.
- An air bag module has been installed in the upper part of the instrument panel on the front passenger's side.
- The resin parts have been stamped with their material names to facilitate recycling.



SEAT

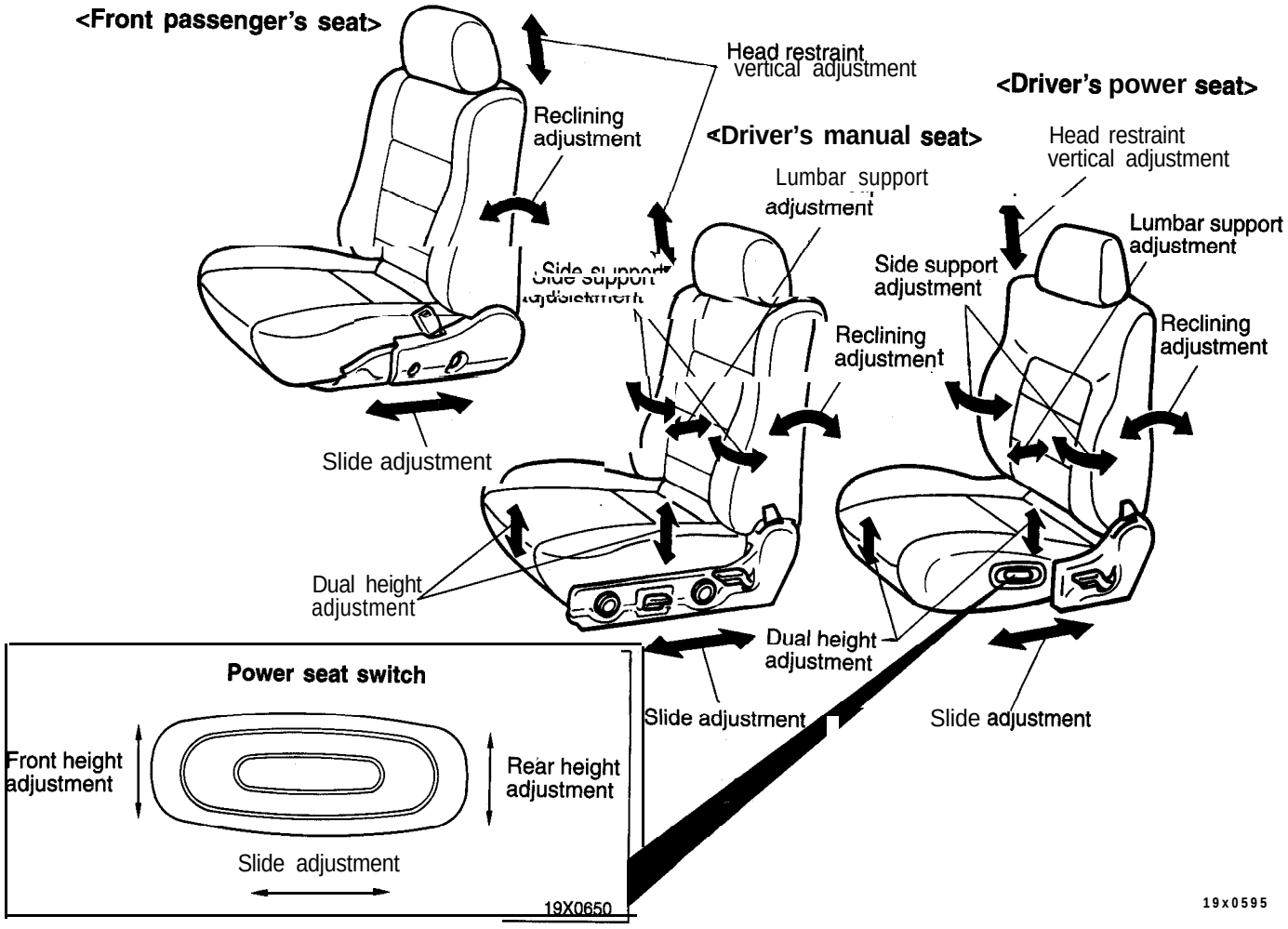
N76ZD6IIAA

FRONT SEAT

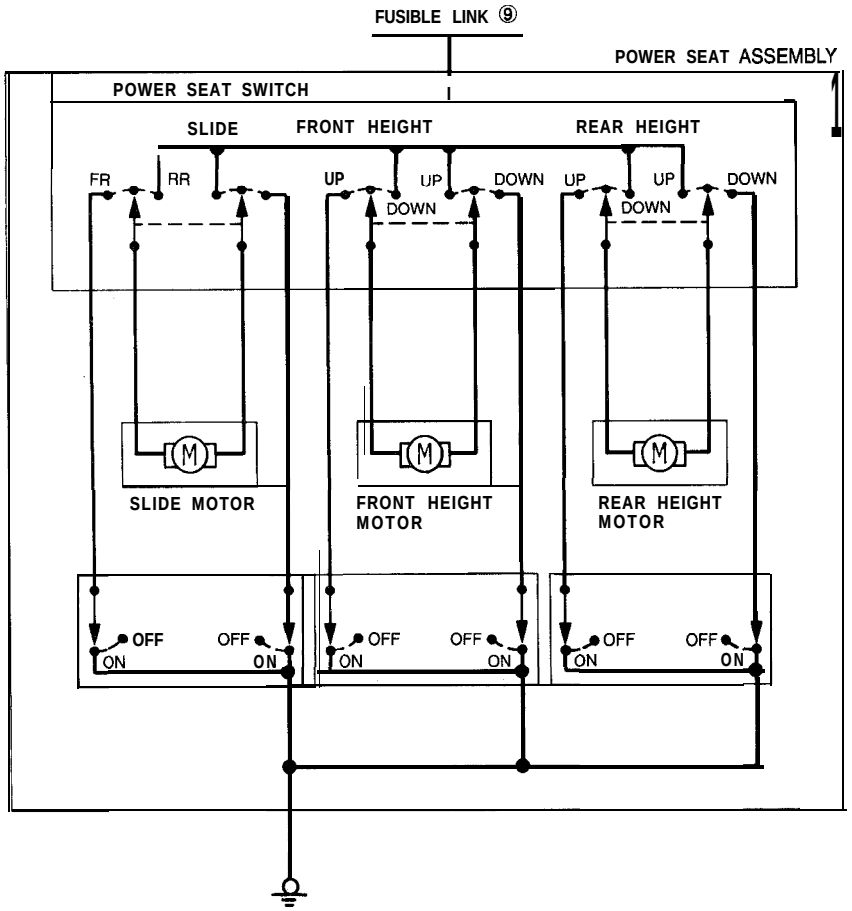
The front seats are designed around the body's center of gravity. The driver's seat has been equipped with various adjustment mechanisms (7-way adjustments at maximum) to best fit the driver's physical features and riding posture. On some models, optional power seats with three-way adjustment mechanisms, namely, power-driven dual height adjustment mechanisms and slide adjustment mechanism are available. In addition, use of Freon in urethane pad manufacturing process has been suspended in an effort to protect the global environment.

Items		Driver's seat		Front passenger's seat
		Manual seat	Power seat	Manual seat
Dual height adjustment	Front height adjustment	X	X (power)	
	Rear height adjustment	X	X (power)	
Slide adjustment		X	X (power)	X
Reclining adjustment		X (with memory)	X (with memory)	X (with walk-in mechanism)
Lumbar support adjustment		X*	X	
Side support adjustment		X*	X	
Head restraint vertical adjustment		X	X	X

NOTE: * indicates the item available on some models.



Power Seat Circuit

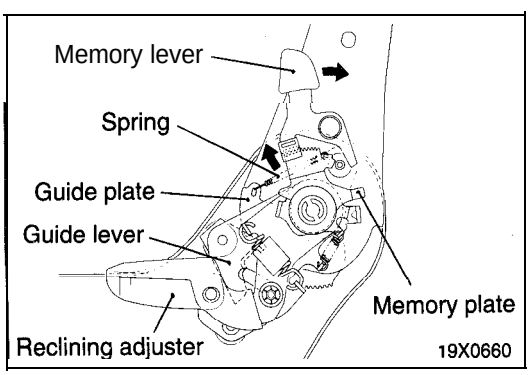


19X0617

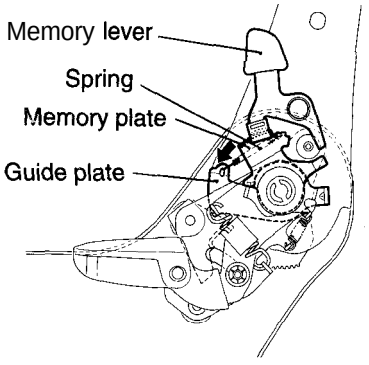
CONSTRUCTION AND OPERATION

RECLINING ADJUSTMENT MECHANISM WITH MEMORY

If the seatback is raised after being inclined to the front, it can be returned to the original angle set in memory by previously setting the seatback angle in memory.
Furthermore, even after it is reclined at any angle, if the seatback is raised after being inclined to the front, it can be returned to the original angle set in memory.

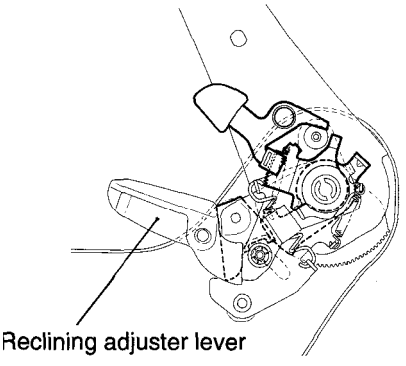


The reclining memory mechanism consists of a memory lever, memory plate, guide plate, guide lever and spring.
(1) Set the seatback to the position to be memorized, and push the memory lever.



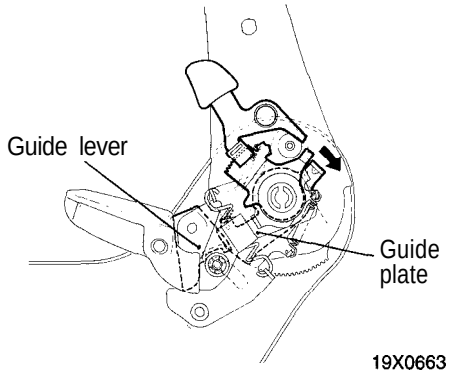
19X0661

(2) When the memory lever is pushed, it releases the meshing of the memory plate and memory lever, and the memory plate is rotated by the spring force and contacts the guide plate.
When the memory lever is released, the lever engages with the memory plate, completing the memorizing operation.



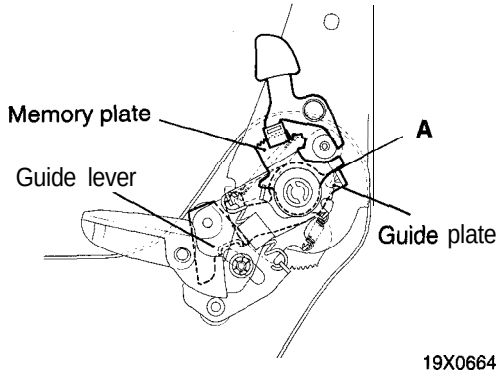
19X0662

(3) Pull the reclining adjuster lever and fold the seatback forward.



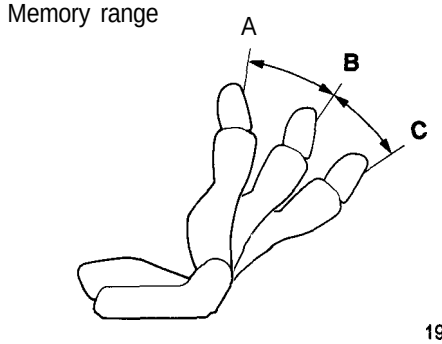
19X0663

(4) Raise the seatback.
As the guide lever is now held by the guide plate, the reclining gear cannot be locked.



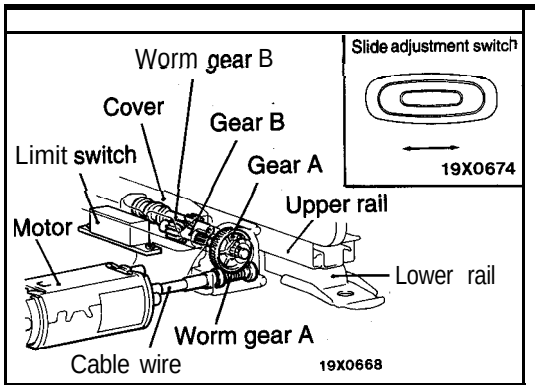
19X0664

(5) Raise the seatback further
Then the memory plate contacts the position A of the guide plate and the guide plate starts to rotate.
When the memorized position is reached, the guide plate releases the guide lever and the reclining gear is locked to hold the seatback in position.



19X0659

(6) The memory range is between A and B in the illustration.
If the memory lever is operated at a position between B and C, position B is memorized.



POWER SEAT

N76ZD01AA

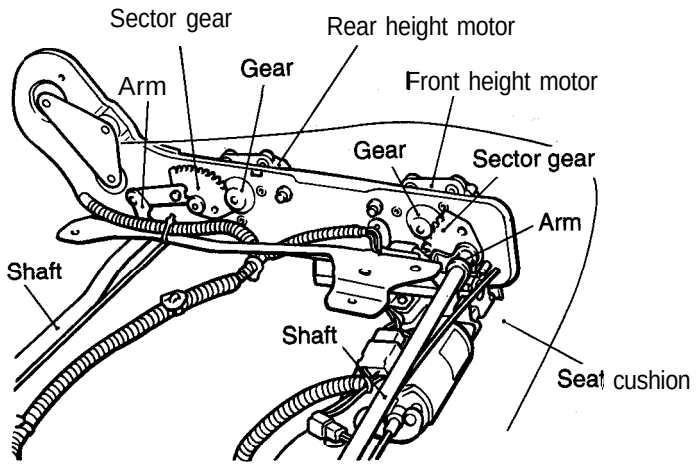
Slide Adjustment Structure

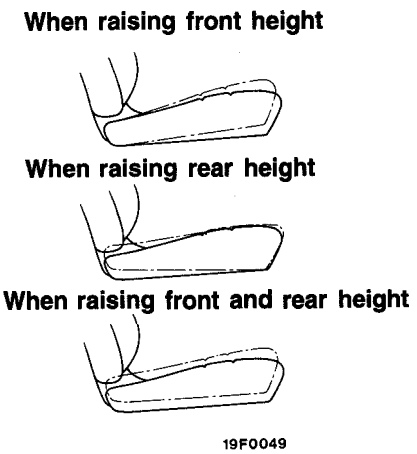
The motor, limit switch and gears are mounted on the plate fixed to the lower rails.
When the slide adjustment switch is operated, the motor starts and rotates worm gear A in the gear box via the cable wire. This rotating torque is transmitted through gears A and B to worm gear B. The worm gear B moves the upper rails and therefore the seat mounted on the upper rails.
When the seat slides to the forward or backward limit, the cover mounted to the upper rail pushes the limit switch and turns the motor off. This stops the seat slide operation.

Front Height and Rear Height Adjusting Structure

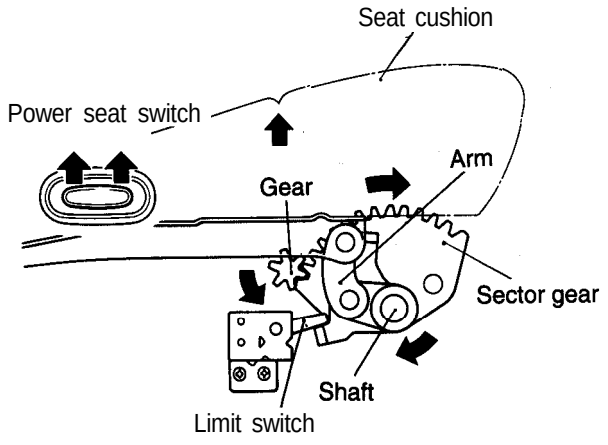
The front and rear portions of the seat cushion can be raised and lowered independently. If the front height and rear height switch is pushed to the up side, motor revolutions will be transferred to gear to sector gear. Since the sector gear, shaft and arm are fixed, the seat cushion rises continuously (stepless) along with the revolution of the sector gear.

As the seat cushion continues to rise, the claw on the shaft turns the limit switch from ON to OFF, cutting off power to the motor and stopping it.
In addition, if the front height and rear height switch is pushed to the down side, operation is reversed with the motor revolving in the opposite direction and lowering the seat cushion.

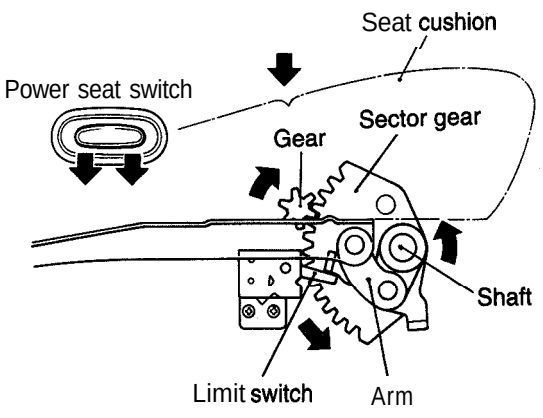




<Raising>



<Lowering>

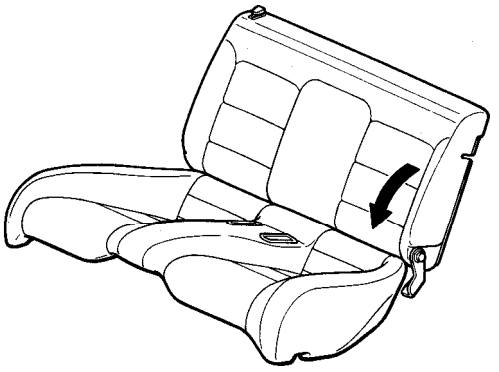


REAR SEAT

N76ZD02AA

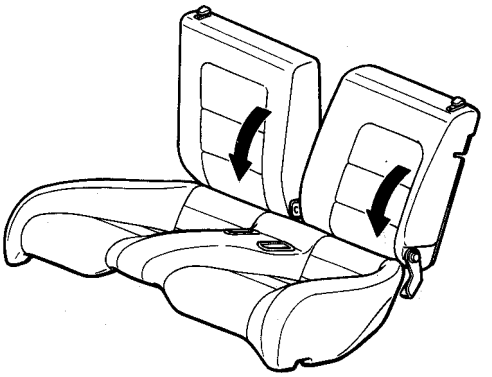
The rear seat comes in two types, bench type and split type. Both types can be tilted forward, to extend the luggage compartment as an additional cargo loading space.

<Bench Type>



19X0646

<Split Type>



19x0647

SEAT BELTS

N76ZD10AA

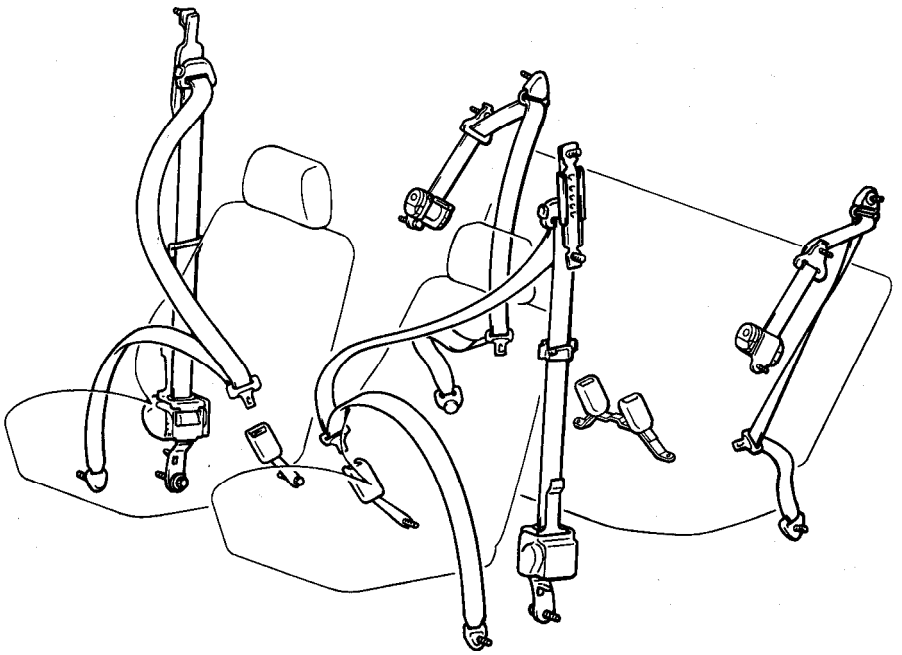
The seat belts have the following mechanisms.

FRONT SEAT BELTS

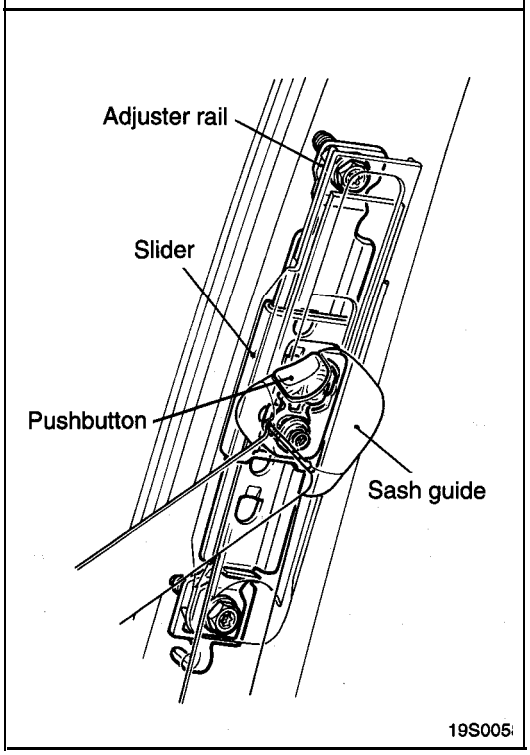
- 3-point seat belt with ELR (Driver's side)
- 3-point seat belt with ELR and ALR (Passenger's side)
- Seat-mounted buckle
- One-touch push button type adjustable shoulder anchor

REAR SEAT BELTS

- 3-point seat belt with ELR and ALR



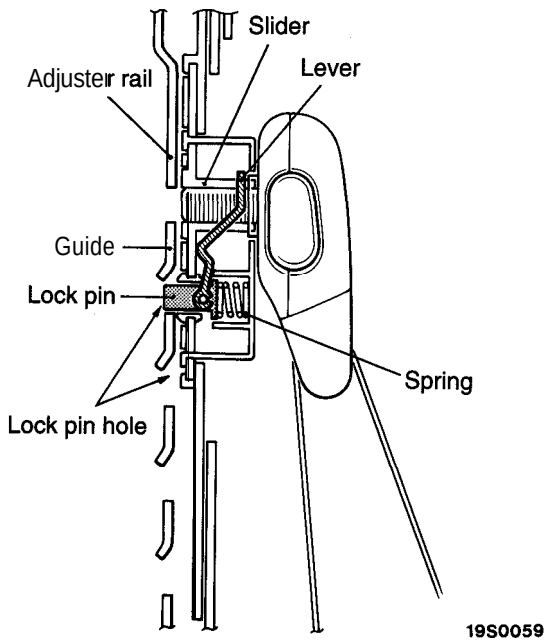
19X0651



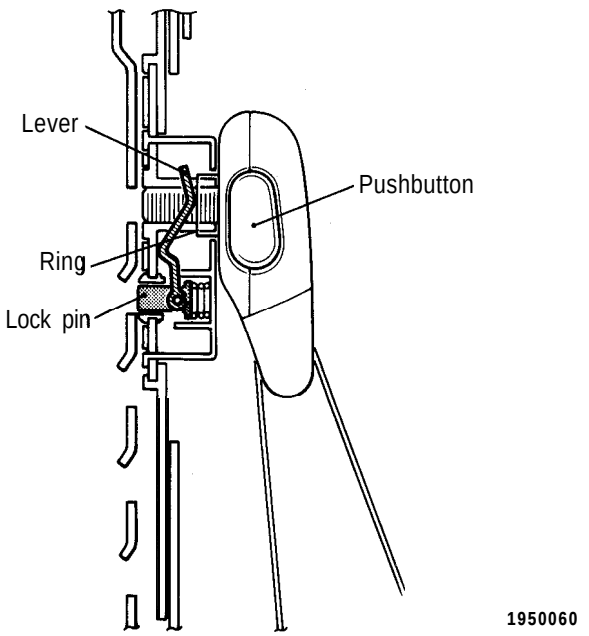
ONE-TOUCH PUSHBUTTON TYPE ADJUSTABLE SHOULDER BELT ANCHOR

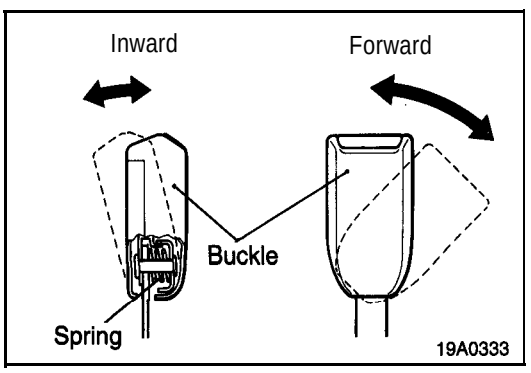
The mechanism allows adjustment of shoulder belt anchor height in five stages depending with the physique of the front seat occupant. It consists of an adjuster rail, a slider and a pushbutton provided on the seat belt sash guide.
The adjuster rail is secured to the center pillar and provided with five holes in which the lock pin of the slider may fit.
The slider is so assembled to the adjuster rail that it may move up and down along the rail. The lock pin is provided in the slider to secure the slider in place.
The lock pin is always kept pressed to the rail by spring. Depressing the pushbutton against on the seat belt sash guide will push the ring out of the sash guide. Then, the lever inside the slider is pushed to lift the lock pin until the pin is disengaged from the adjuster rail, making the slider movable up and down.
Each lock pin hole of the adjuster rail is provided with a guide in the upward direction only so that the upward movement of the seat belt anchor can be made without depressing the pushbutton, improving the operability.

Locked (Pushbutton released)



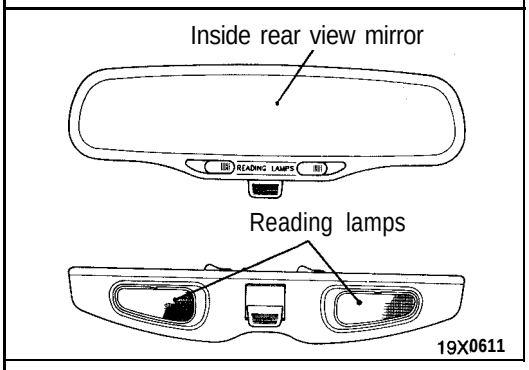
Unlocked (Pushbutton depressed)





CONSTRUCTION AND OPERATION OF THE BUCKLE

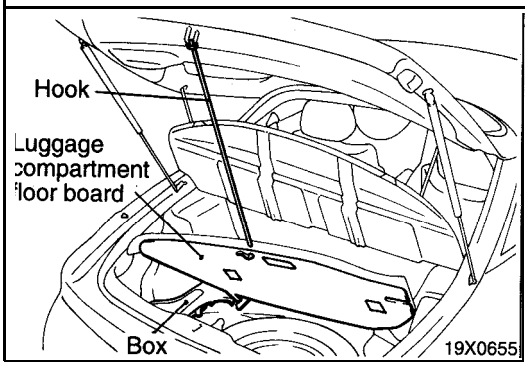
There is a spring installed in the portion connecting the buckle to the arm, allowing the buckle to tilt forward and inward so that the belts can be tight enough around the body.



INSIDE REAR VIEW MIRROR WITH READING LAMP

N76ZJOOAA

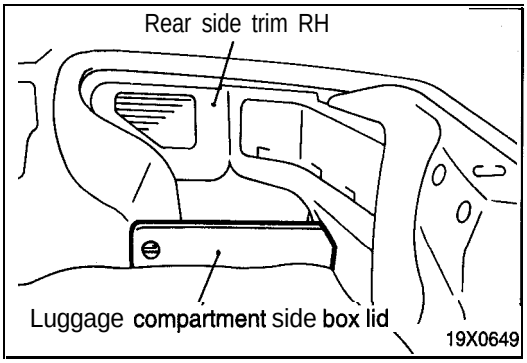
Vehicles with power sunroof have been provided with an inside rear view mirror with reading lamps.



LUGGAGE COMPARTMENT FLOOR

N76ZHOIAA

For greater convenience in loading and unloading the spare wheel or other articles, the luggage compartment floor board is hinged at the front, and its rear end can be held raised with a hook. A box on the left side under the luggage compartment floor board may be used to hold small articles. A luggage compartment side box is located in the R.H. side of the rear side trim. In addition, a cargo net has been provided inside the luggage compartment to prevent cargo from shifting during vehicle operation, as well as to offer more convenience to the user.



SUPPLEMENTAL RESTRAINT SYSTEM (SRS)

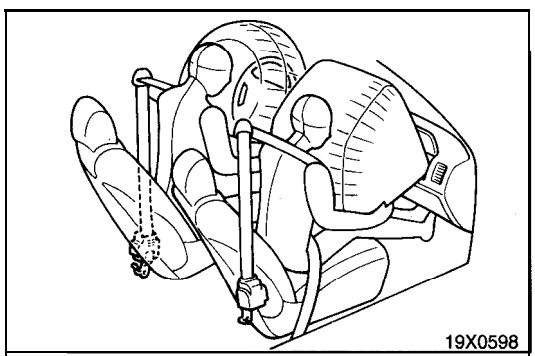
N76ZIOOAA

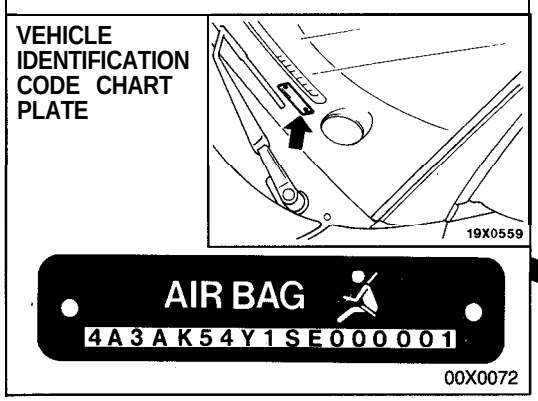
The Supplemental Restraint System (SRS) is designed to supplement the front seat belts to help reduce the risk or severlty of injury to the front seat occupants by activating and deploying two air bags during certain frontal collisions.

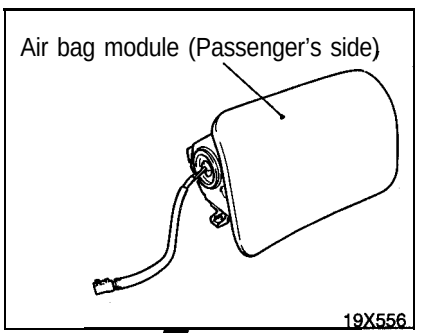
The SRS consists of: left front and right front impact sensors (located on the right and left front shield plate); air bag modules for the driver (located in the center of the steering wheel) and for the front seat passenger (located above the glove box). Each module contains a folded air bag and an inflator unit. The SRS also contains: an SRS Diagnostic Unit (SDU) with safing impact sensor (located under the floor console assembly); and SRS warning light to indicate the operational status of the SRS (located on the instrument panel); clock spring (mounted behind the steering wheel); and wiring.

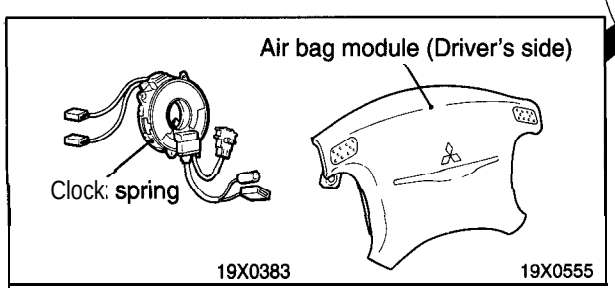
The SRS is designed so that the air bags will deploy when the safing sensor, plus either or both of the left front and right front impact sensors simultaneously activate while the ignition switch is in the ON position. These sensors are designed to activated in frontal or near-frontal impacts of moderate to server force.

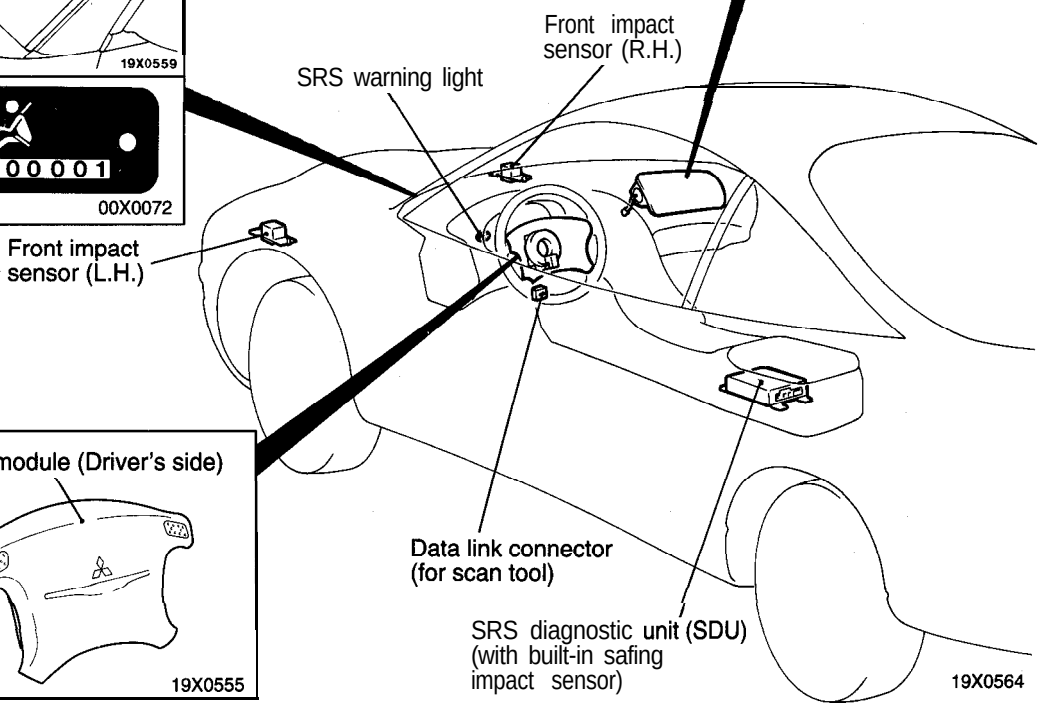
Only authorized service personnel should work on or around SRS components. Those personnel should read this manual carefully before starting such work. Extreme care must be used when servicing the SRS to avoid injury to service personnel (by inadvertent deployment of the air bags) or vehicle occupant (by rendering the SRS inoperative).



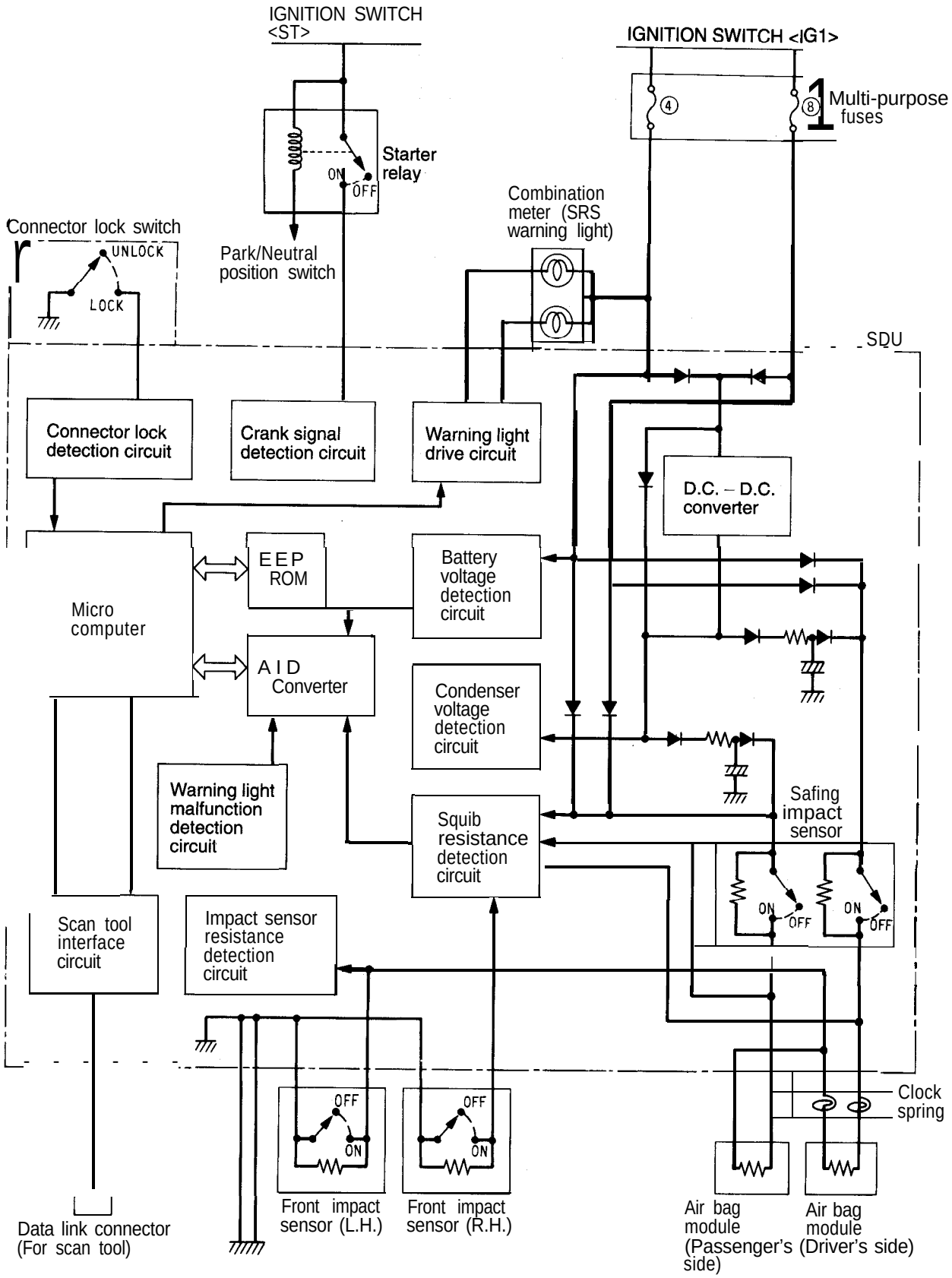








SRS SCHEMATIC

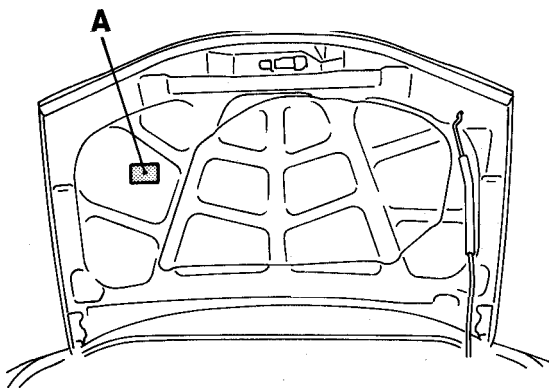


19X0588

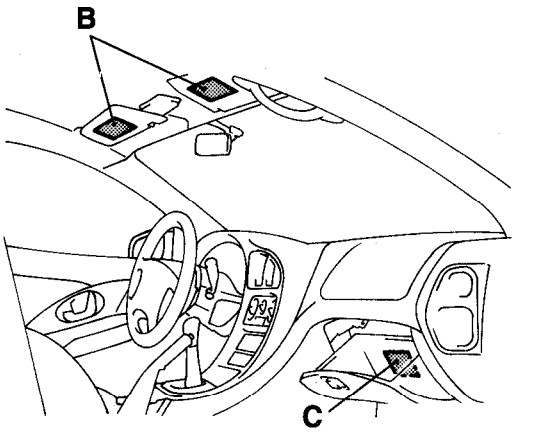
WARNING/CAUTION LABELS

A number of caution labels relating to the SRS are found in the vehicle, as shown in the following illustration. Follow label instructions when servicing SRS.

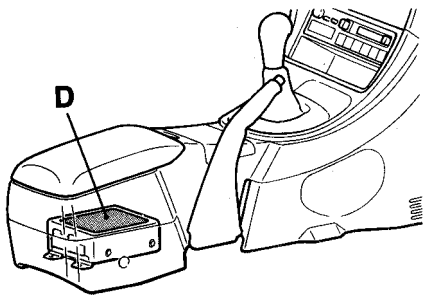
If labels are dirty or damaged, replace them with new ones.



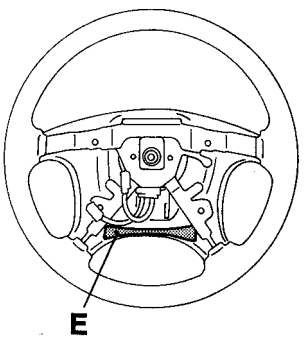
19X0547



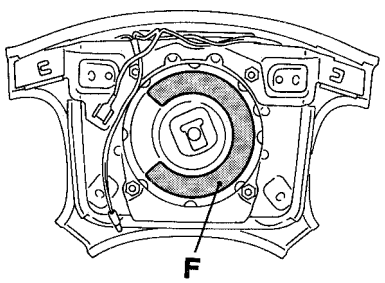
19X0573



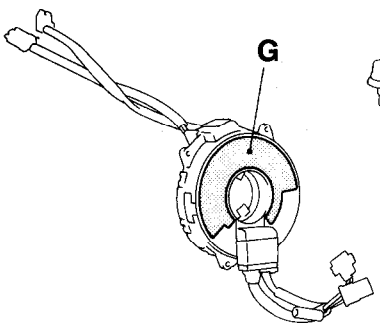
19X0562



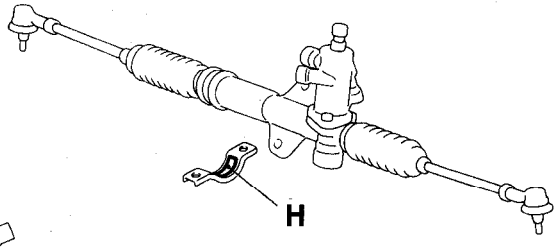
19X0549



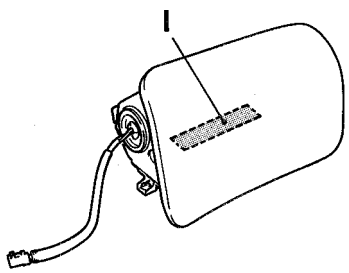
19X0552



19X0015



13X0187



19x0557

A. WARNING
This vehicle has an air bag system.
Refer to service manual before servicing or disassembling underhood components. Read "SRS" section of manual for important instructions.
Improper service procedures can result in the air bag firing or becoming inoperative, possibly leading to injury.

B. CAUTION
This vehicle has air bags for front occupants as a supplemental restraint system (SRS).
You must always wear your seatbelt, even with an air bag:
Air bags are not designed to inflate in rollovers or in rear, side or low-speed frontal crashed.
Air bags inflate powerfully and in a moment. If you're too close to an inflating air bag, it could seriously injure you. Seatbelts help keep you in position for air bag inflation in a crash. An inflating air bag can seriously injure small children. A child in a rear-facing child restraint can be badly injured by an inflating air bag, so never use a rear-facing child restraint in the front seat of this vehicle: a rear-facing child restraint should be used only in the rear seat. Use a forward-facing child restraint with the front passenger seat as far back as possible, or in the rear seat.
Before driving read label inside the glove box; if the "SRS" light comes on while you are driving, or does not come on when you first start the vehicles, see your dealer for service.

C Driver's air bag information
This vehicle has an air bag which will supplement the seatbelt in certain frontal collisions. The air bag is not a substitute for the seatbelt in any type of collision. The driver, and all other occupants, should wear seatbelts at all times.
WARNING!
If the "SRS" warning light does not illuminate For several seconds when ignition key is turned to "ON" or the engine is started, or if the warning light stays on while driving, take the vehicle to your nearest authorized dealer immediately. Also if the vehicle's front end is damaged or if the air bag has deployed.
Take the vehicle for service immediately.
The air bag system must be inspected by an authorized dealer ten years after the vehicle manufacture date shown on the certification label located on the left front door-latch post or door frame.

Read the "SRS" section of your owner's manual before driving, for important information, about operation, and service of the air bag system. When you are going to discard your gas generator or vehicle, please see your MITSUBISHI dealer.

D. CAUTION: SRS diagnostic unit
This unit cannot be repaired.
If defective, remove and replace entire unit per service manual instructions.
Do not disassemble or tamper.
See service manual for handling and storage instructions.
Do not drop: keep dry.
Failure to follow instructions could render air bag inoperative and result in driver injury.

E. CAUTION: SRS
Before replacing steering wheel, read service manual, center front wheels and align SRS clock spring neutral marks.
Failure to do so may render SRS system inoperative, risking serious driver injury.

F. DANGER POISON
Keep out of the reach of children.
Contains sodium azide and potassium nitrate contents are poisonous and extremely flammable. Contact with acid, water, or heavy metals may produce harmful and irritating gases or explosive compounds. Do not dismantle, incinerate, bring into contact with electricity or store at temperatures exceeding 93°C (200°F).
FIRST AID: If contents are swallowed induce vomiting. For eye contact flush eye with water for 15 minutes. If gases from acid or water contact are inhaled, seek fresh air. In every case, get prompt medical attention.
For additional information, see material safety data sheet (MSDS) for this product.

G. CAUTION: SRS clock spring
This is not a repairable part. Do not disassemble or tamper.
If defective, remove and replace entire unit per service manual instructions.
Before replacement, read service manual, center front wheels and align neutral marks.
Failure to follow instructions may render SRS system inoperative, risking serious driver injury

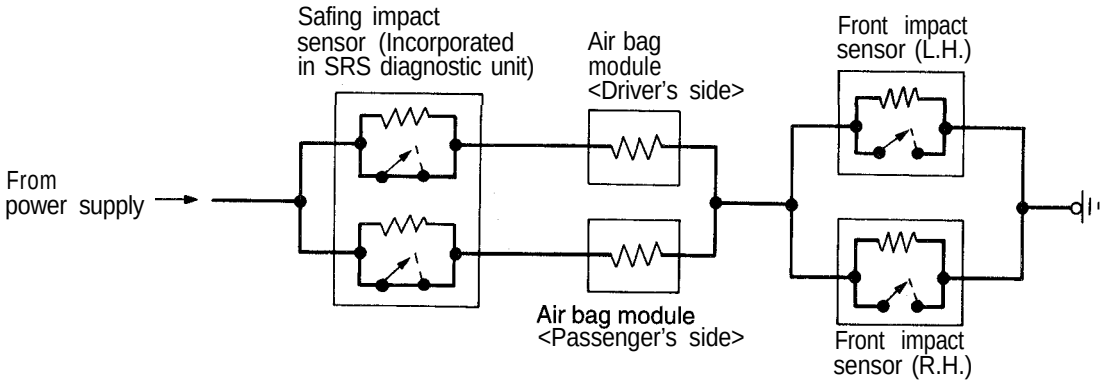
H. CAUTION: SRS
Before removal of steering gear box, read service manual, center front wheels and remove ignition key.
Failure to do so may damage SRS clock spring and render SRS system inoperative, risking serious driver injury.

I. WARNING: SRS
This air bag module cannot be repaired. Do not disassemble or tamper.
Do not perform diagnosis. Do not touch with electrical test equipment or probes.
Refer to service manual for further instructions, and for special hadling.
Storage and disposal procedures. Tampering or mishandling can result in injury.
DANGER POISON
Keep out of the reach of children.
Contains sodium azide and potassium nitrate contents are poisonous and extremely flammable. Contact with acid, water or heavy metals may produce harmful and irritating gases or explosive compounds. Do not dismantle. Incinerate, bring into contact with electricity or store at temperatures exceeding 93°C (200°F).
FIRST AID:
If contents are swallowed induce vomiting. For eye contact flush eye with water for 15 minutes. If cases from acid or water contact are inhaled, seek fresh air. In every case, get prompt medical attention.

CONSTRUCTION AND OPERATION

IMPACT SENSORS

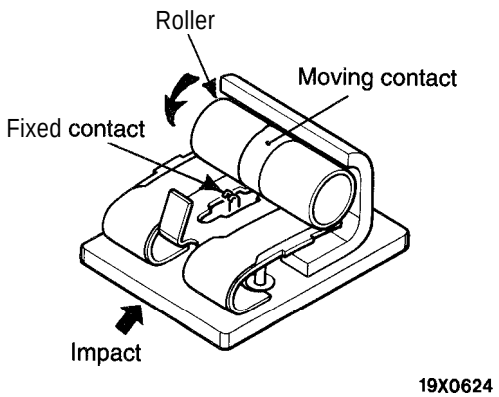
There are 2 different types of sensors used; 2 front impact sensors and safing impact sensor. One front impact sensor is provided in each of the right and left shield plate, and one safing impact sensor is built in the SRS diagnosis unit. The right and left front impact sensors are connected in parallel. The front impact sensors are connected in series with the safing impact sensor.



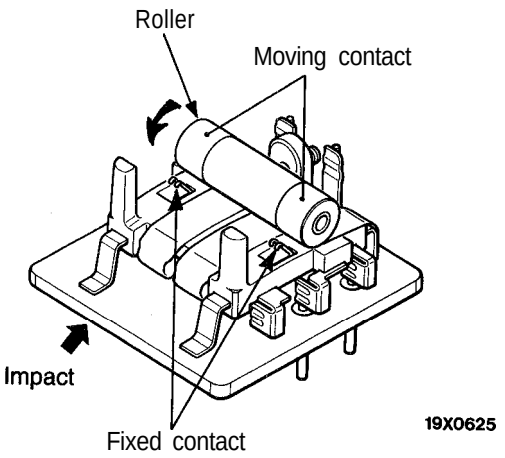
If a front-end collision causes either of the front impact sensors and the safing impact sensor to be simultaneously "ON", the air bag will deploy. They are constructed as shown below and contain a G sensor each.
The front and safing impact sensors are essentially identical in construction.
The G sensor consists of a moving contact which is a roll spring wound around a roller, a fixed contact positioned in its moving direction, consisting of a base, a metallic case, etc. If an impact greater than preset is applied in the direction of the arrow shown in the illustration, the inertial force causes the roller to rotate and move, so that contacts are brought into the ON stage. To maintain a high measure of G sensor reliability, the contacts have been gold plated and the metallic case charged with an inactive gas.
Each impact sensor contains a resistor connected in parallel with the contacts for detection of a fault in the wiring. The SRS diagnosis unit always supplies a very small amount of current to the sensor circuit to monitor a change in the circuit resistance.

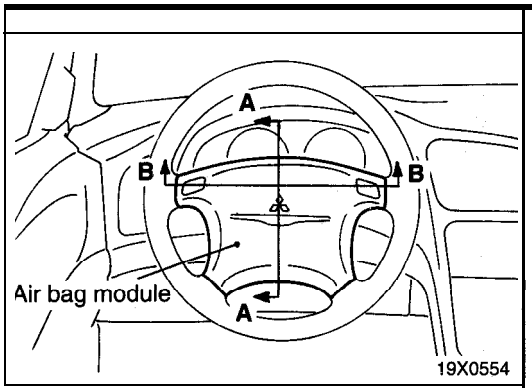
Caution
Make sure that the impact sensors are never disassembled.

Front impact sensor



Safing impact sensor



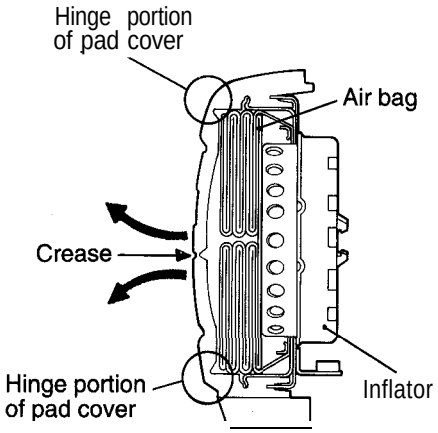


AIR BAG MODULE

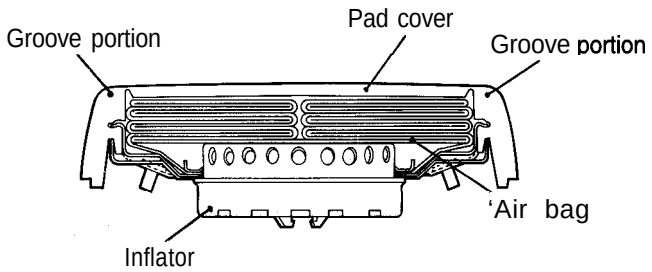
<Driver's side>

The air bag module is an assembly part comprising of an air bag, pad cover, inflator, and parts for securing them. It is provided at the center of the steering wheel.

Caution
Make sure that the air bag is never disassembled.



Section A – A



Section B – B

⬅: Pad cover deploying direction

13R0694

13R0695

Air bag

The air bag is made of a nylon cloth with a rubber coating inside. It is accommodated in the pad at the center of the steering wheel together with the inflator.
The air bag is inflated by the nitrogen gas from the inflator. The load of the driver pressed against the air bag by the impact causes the nitrogen gas to escape through the two exhaust holes made on the rear, and the deflation helps lessen the impact.

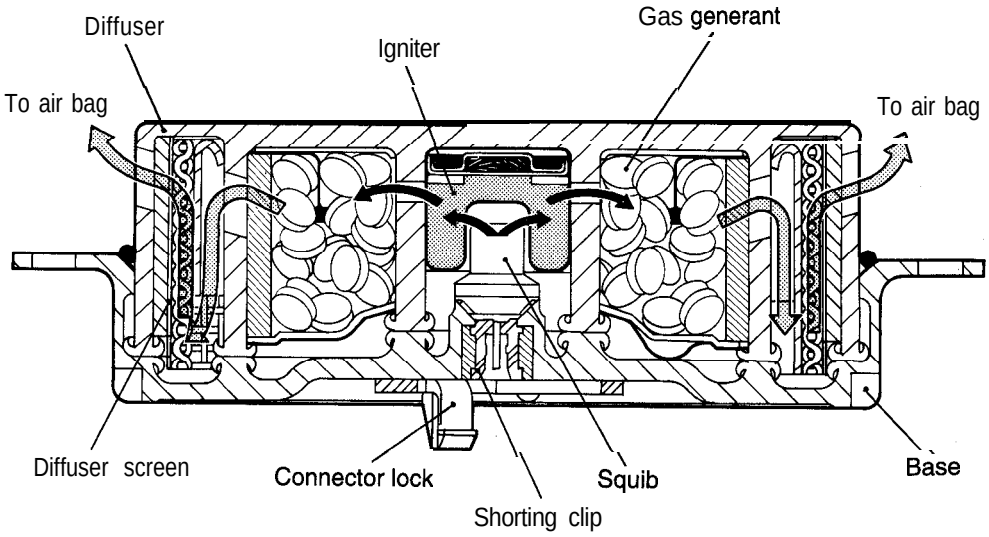
Pad cover

The pad cover is made from urethane. When the air bag deploys, the crease is broken, allowing the air bag to move out and deploy with the hinge portions as its fulcrums. The pad cover has a net, etc. insert-molded except for the crease to prevent the air bag from being broken as it deploys, and also to prevent broken pieces from scattering around.

Inflator

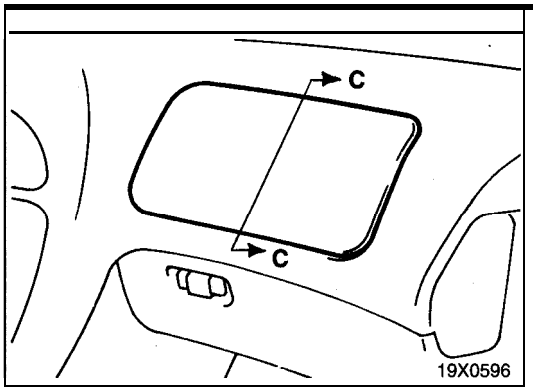
The inflator consists of a squib, igniter, gas generants, diffuser screen, etc. contained in an aluminum container. It is mounted in the air bag module housing.

The bottom of the inflator is provided with an electrical connection to which an ignition current is supplied. If current is supplied to the squib, a small amount of explosive in the squib is burnt causing the igniter to burn, and the resultant heat burns the gas generants. Combustion of the generants rapidly produces nitrogen gas which is forced through the diffuser screen into the air bag. The diffuser screen serves as a filter to remove cinders and also helps cool down the gas temperature and reduce the gas generation noise. A shorting pin is provided in the connector portion of the squib. Whenever the air bag module is removed, the shorting pin makes a short circuit across the terminals to prevent flow of current caused by static electricity to the squib.



⇦: Nitrogen gas
⬅: Flame

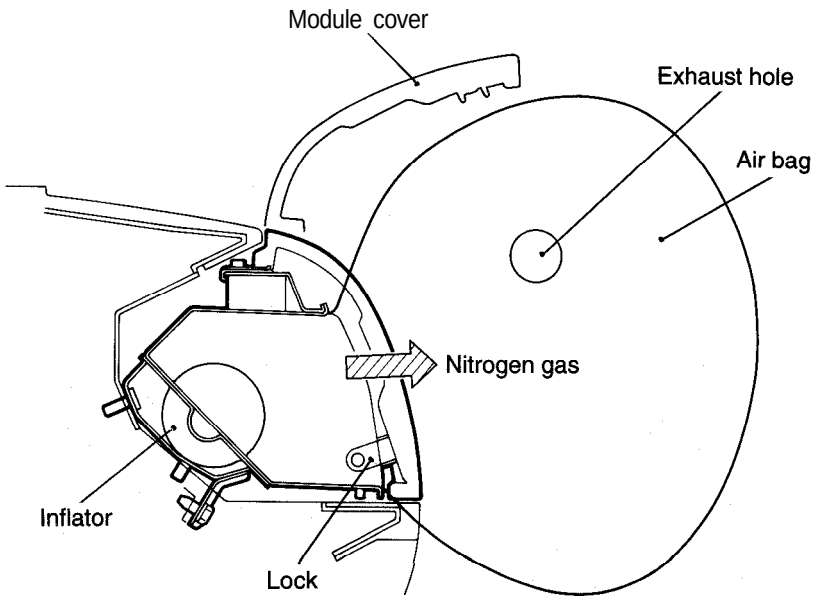
19N0233



<Passenger's side>

The air bag module consists of an air bag, module cover, inflator, and parts for securing them. It is provided above the glove box.

Caution
Make sure that the air bag is never disassembled.



19L0419

Air bag

The air bag, made of nylon cloth lined with rubber coating, is housed together with the inflator, under the module cover provided above the glove box. The air bag is inflated with nitrogen gas generated by the inflator. Then, as the front passenger hits the air bag, the gas is discharged from the two exhaust holes, one on each side, deflating the air bag to reduce the impact on the passenger.

Module cover

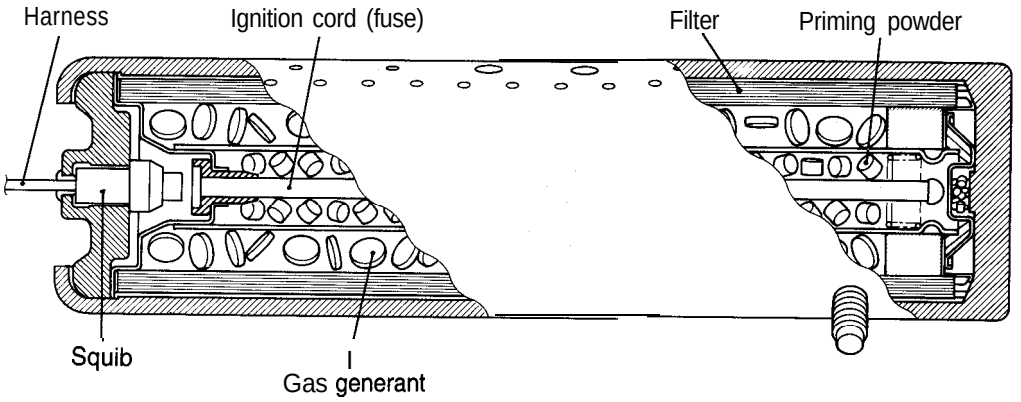
The module cover has aluminum sheet and urethane formed into a unit. It is normally closed by hard rubber type locks on both the sides.
When the air bag is deployed, the hard rubber type lock is broken, allowing the module cover to turn on the hinge provided at the upper part, open upward and let the air bag out to be inflated.

Inflator

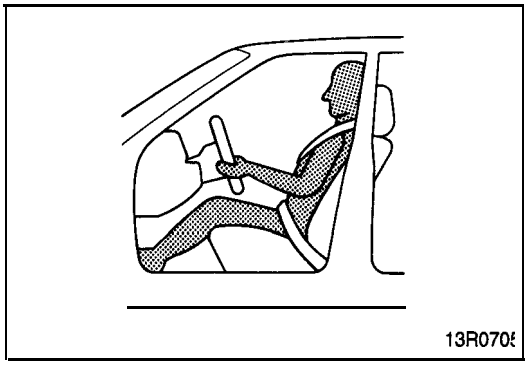
The inflator has a squib, ignition cord (fuse), priming powder, gas generator, filter, etc. put in an aluminum container and is installed inside the air bag module. On one side of the inflator is the harness through which an ignition current flows. When the current flowing through the harness reaches the squib, a small quantity of powder is burned to ignite the ignition cord. The cord burns the priming powder and the generated heat causes the gas generator to burn. Combusion of the gas generator produces nitorogen gas quickly, which is sent to the inside of the air bag through the filter.

The filter eliminates cinders, lowers the gas temperature and reduce the gas generator noise.

The inflator has a shorting clip provided at the connector of the squib harness in the same manner as the driver's side inflator.



19L0418



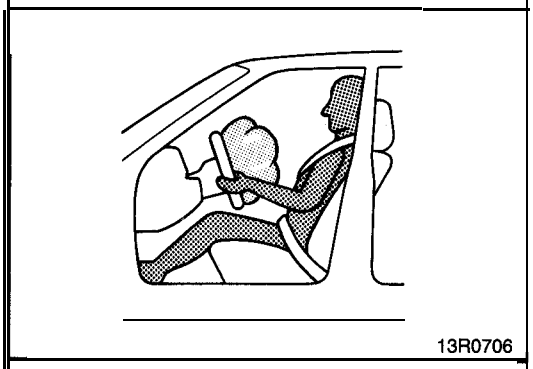
13R070

Air bag deployment [in case of 50 km/h (30 mph) frontal impact]

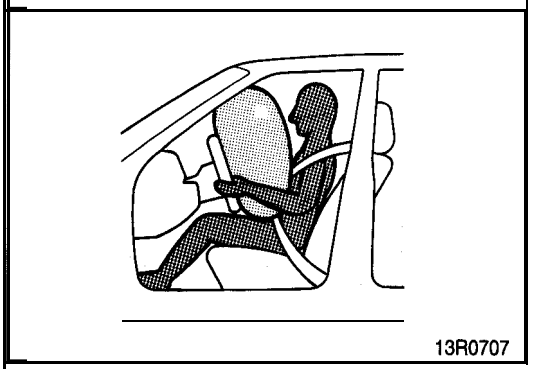
(1) OPERATION FOR APPROXIMATELY 15 MILLISECONDS AFTER THE COLLISION

If a strong impact produced by a collision is detected by either of the front impact sensors and the safing impact sensor in approximately 10 milliseconds after the collision, the SRS diagnostic unit will supply an ignition signal to the squib.

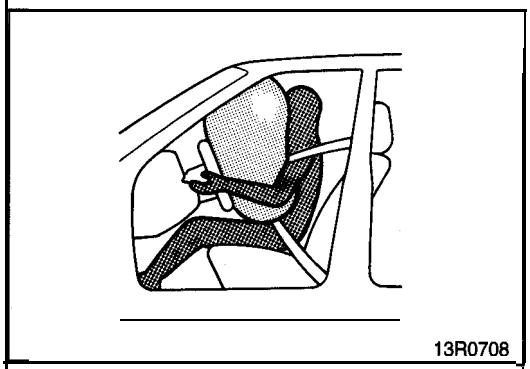
In approximately 3 milliseconds after the ignition signal has been supplied to the squib, gas generation will begin.


13R0706

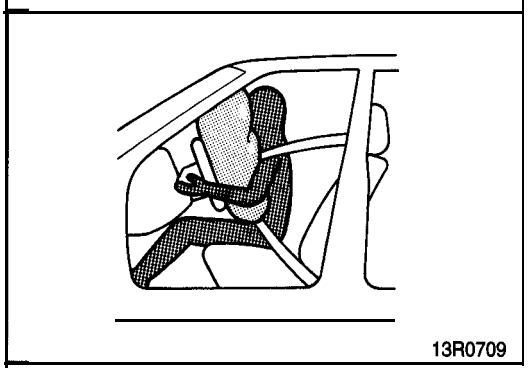
(2) In approximately 20 milliseconds after the collision, the air bag folded in the pad cover will begin to inflate, the pad cover will break at its crease, and the air bag will expand outward.


13R0707

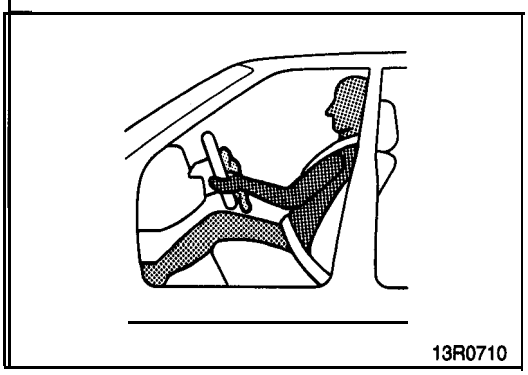
(3) In approximately 35 milliseconds after the collision, the inflated air bag will touch the chest of the driver.


13R0708

(4) In approximately 40 milliseconds after the collision, the air bag will be fully inflated.


13R0709

(5) In approximately 55 milliseconds after the collision, the pressure of the driver against the air bag causes the gas to escape through the two exhaust holes on the rear of the module, and the deflation helps lessen the impact imposed on the driver.

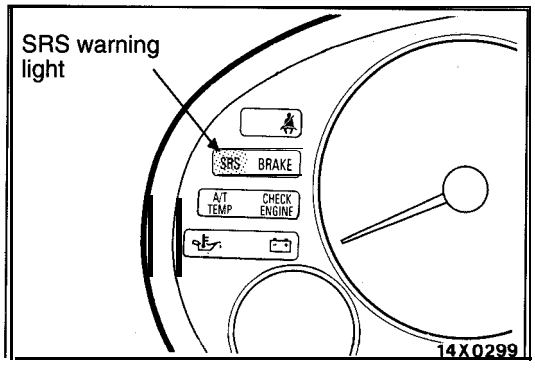

13R0710

(6) In approximately 105 milliseconds after the collision, the air bag that has absorbed the impact will rapidly deflate, providing visibility for the driver.

SRS DIAGNOSTIC UNIT

The SRS diagnostic unit monitors the impact sensors, squib, wiring harness, condensers, battery voltage etc. If it detects a problem, it illuminates the "SRS" warning light to alert the driver. It also stores in memory what the problem is, and the duration of the problem (the duration during which the warning light stayed ON).
The condensers provided in the diagnostic unit accumulate electric energy during the period the ignition switch is ON. This supplies squib ignition current, even if the power cable from the battery is broken by the collision, to inflate the air bag as soon as the front impact sensor and safing impact sensor are simultaneously switched ON.

Caution
Make sure that the SRS diagnostic unit is never disassembled.



1. Monitoring function

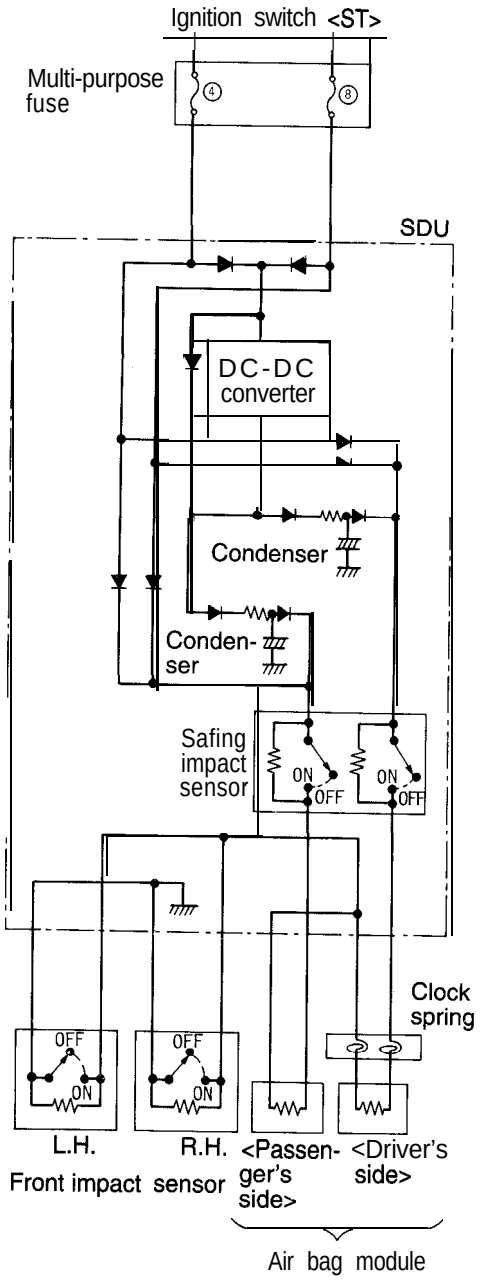
The SRS diagnostic unit monitors the wiring harness and SRS components shown in the following table to check whether they satisfy the specified values. When the ignition key is in "ON" or "START" position, the SRS warning light should illuminate for about 7 seconds and then turn off.
This indicates that the SRS system is in operational order. If the SRS warning light does any of the following, immediate inspection is needed.
(1) The SRS warning light does not illuminate as described above.
(2) The SRS warning light stays on for more than 7 seconds.
(3) The SRS warning light illuminates while driving.

The fault data is stored in terms of a diagnostic code in the non-volatile memory (EEPROM)*. The duration of the fault is also stored in terms of the ON duration of the warning light.

Component	Main Monitoring Point	Diagnostic Code No.
Front impact sensor	Short circuit	11
	Open-circuit once	12
	Open-circuit twice	13
Air bag module (Driver's side)	Short circuit	21
	Open circuit	22
Air bag module (Passenger's side)	Short circuit	24
	Open circuit	25
Condenser	Terminal voltage high	31
	Terminal voltage low	32
Cranking detection circuit	Cranking signal detection time	33"

Component	Main Monitoring Point	Diagnostic Code No.
Double lock connector	Unlock or lock switch open-circuited	34**
Battery	IG1 voltage low (Multi-purpose fuse No. 4 is blown)	41**
	IG1 voltage low (Multi-purpose fuse No. 8 is blown)	42**
SRS warning light	External circuit open-circuited or short-circuited	43**
	Drive circuit defective	44
SRS diagnostic unit	EEPROM defective	45
	A/D converter defective	

NOTE
* EEPROM = Electrically Erasable Programmable ROM
A ROM to which data can be stored and be electrically written and from which data can be electrically erased.
**: Equipped. with the automatic diagnosis code erasure function. (Refer to P.6-25)



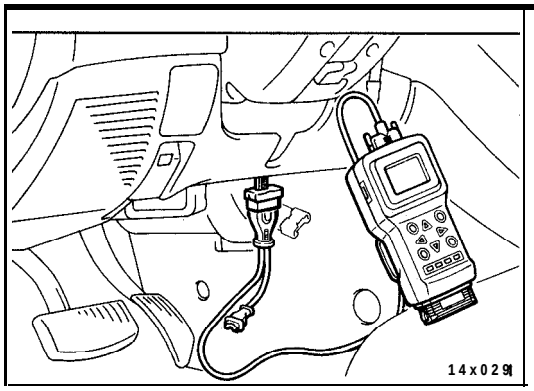
2. Supplying squib ignition energy

The energy for ignition of the squib is supplied by two circuits; the battery of the vehicle and the condensers.
Even if the power voltage to the SRS diagnostic unit is lost. the ignition capability is-retained by the condensers for more than 0.5 seconds.

(1) The two independent battery power supplies (from fuses 4 and 8) are connected via diodes in the diagnostic unit. If the voltage is larger than 9V between the connector terminal of the unit and the ground, the squib can be ignited.
(2) The IG1 voltage is boosted to about 25V by the DC-DC converter to provide more in reserve than the low limit voltage mentioned above in charging the condensers that supply the ignition energy.

Caution

1. **When the SRS is to be repaired or parts to be replaced, make sure that the negative (–) cable of the battery is disconnected beforehand for insulation.**
   After the negative (–) cable of the battery has been disconnected, wait for more than 60 seconds before making any service attempt.
   The condensers in the SRS diagnostic unit retain for a given period the voltage necessary for inflating the air bag even after removal of the battery voltage.If a service attempt is made during the period, accidental inflation could cause serious personal injury.
2. **Do not measure the resistance across the terminals of the SRS diagnostic unit. Do not directly touch the test probe to any of the terminals.**
   Even if an attempt is made to measure the resistance, no correct value can be obtained because of the effects of internal circuits. In addition, there is a danger of damage to the gold plated portion of the terminals.



3. Diagnostic function

Fault diagnosis continues to be performed during the period the ignition switch is ON except during cranking. If a fault is detected, the SRS warning light is lit.
The microcomputer determines a diagnostic code on the basis of the results of measurements by various measuring circuits and stores it in "EEPROM".
The fault duration (the period the warning light has been ON) is integrated in increments of a minute and stored in the EEPROM together with the diagnostic code. The stored data can be read and erased by a scan tool. The number of times the memory has been erased by a scan tool is stored in the "EEPROM" to provide reference information on the past service history. The data can be read by a scan tool in the same way as the fault durations.

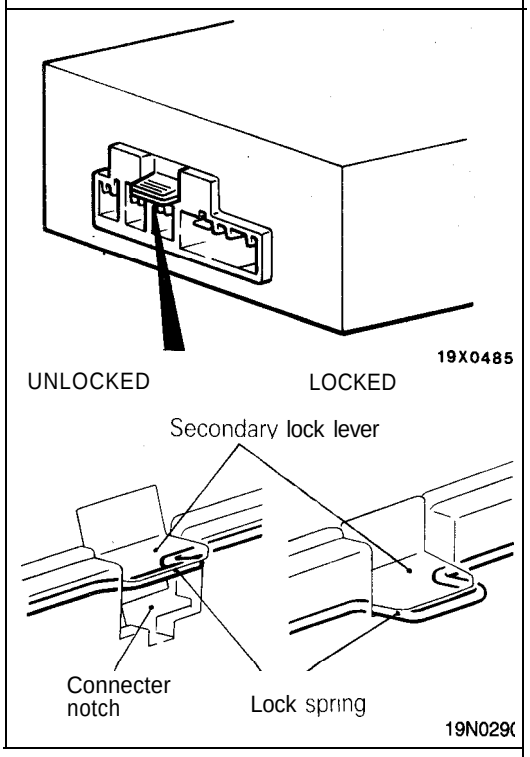
Data to be stored	Description
Faults	All faults stored in diagnostic codes
Fault duration	The period the warning light is ON is integrated in minutes. (Maximum stored period: 9999 minutes ≒ 7 days)
Number of times memory can be erased	The number of times the diagnostic codes and fault durations have been erased by a scan tool is integrated. (Maximum number of times to be stored: 250)

NOTE
Once a fault is detected, the SRS warning light continues to light, even if normal operation of the system is restored, until the diagnostic code is erased.

4. Automatic diagnostic code erasure function

The automatic diagnostic code erasure function operates according to the indicated diagnostic code No. (Refer to P.6-22). Once the malfunction location that causes a diagnostic code to be displayed returns to the normal condition, if the malfunction reoccurs continuously at 5-second intervals, the appropriate malfunction code can be erased. At this time, if all other diagnostic codes have been erased, the SRS warning light will switch off and the intermittent durations of the malfunction will also be erased automatically. In this case, the erasure is not included in the number of times erased.

NOTE
If the A/D converter inside the SRS diagnostic unit is malfunctioning, diagnostic codes No. 41, 42 and 43 will not be erased by the automatic diagnostic code erasure function. Furthermore, during cranking, none of the codes will be erased by this function.

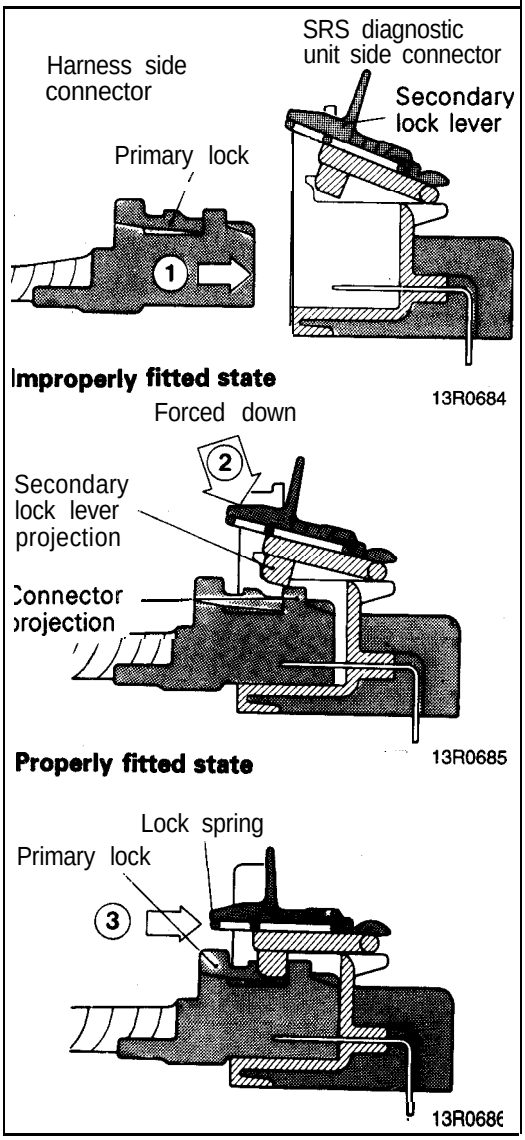


SRS CONNECTOR

The connector of the SRS diagnostic unit has a double lock mechanism, fit verification mechanism and connector shorting mechanism.

DOUBLE LOCK MECHANISM

The mechanism is composed of two mechanisms: each connector of the SRS diagnostic unit is locked to the connector of the harness, then these connectors (of the four harnesses) are locked with the secondary lock lever mounted on the connector of the SRS diagnostic unit side.
The secondary lock lever locking is done as the lock spring fits in the notch of the connector. The operating principle is described below.



When Connectors are to be Fitted

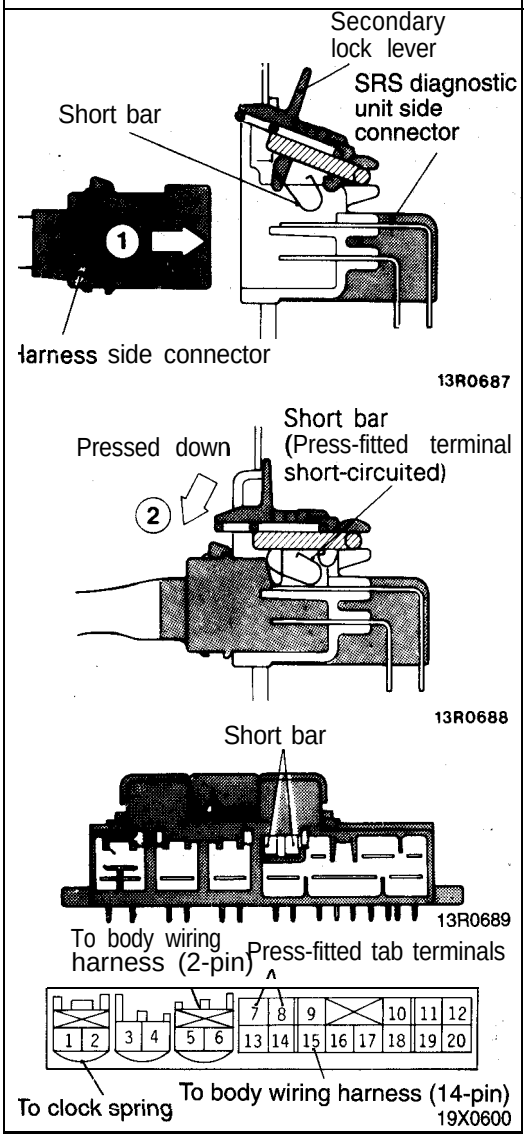
(1) The SRS diagnostic unit and harness side connectors are fitted. (Primary lock)
(2) The secondary lock lever mounted to the SRS diagnostic unit side connector is pressed down by finger until a click is heard indicating that the connectors have been locked. (Secondary lock)
If the harness and SRS diagnostic unit connectors do not properly fit, the secondary lock lever side projection and the harness side connector projection interfere with each other, making it impossible to lock the connectors.

When Connectors are Unlocked

(1) Press in the lock spring with a flat tip (–) screwdriver to disengage the lock spring from the notch area of the connector, and release the lock (secondary lock) of the secondary lock lever.

Caution
Forced removal of the connector without releasing the secondary lock lever will result in a damaged lock lever.

(2) Press the primary lock of each of the harness side connectors and remove the harness side connector.

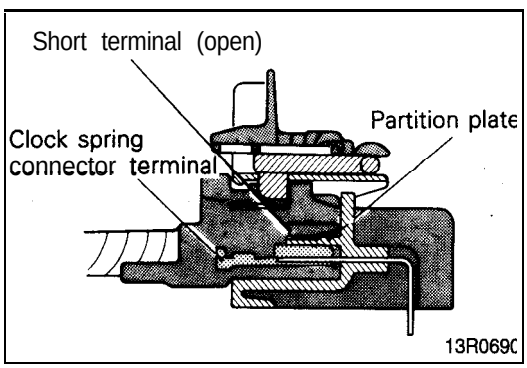


FIT VERIFICATION MECHANISM

The mechanism is used to electrically check the engagement of the connector between the SRS diagnostic unit and the body wiring harness. The operating principle is described below.

(1) Securely connect the SRS diagnostic unit and harness side connectors and press the secondary lock lever down to lock the connectors.

(2) At this time, the short bar provided on the rear surface of the secondary lock lever produces a short circuit across terminals No. 7 and 8 of the SRS diagnostic unit. The SRS diagnostic unit supplies monitoring current to the circuit to electrically verify that the connectors have been locked.

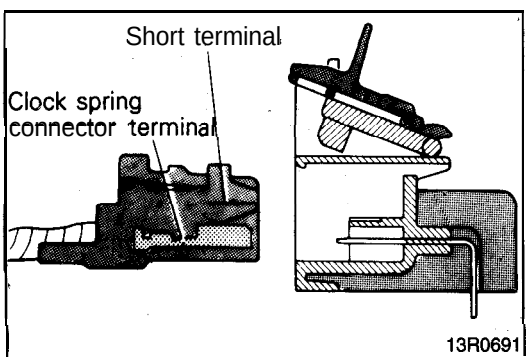


CONNECTOR SHORTING MECHANISM

The mechanism is designed for prevention of accidental explosion of the inflator when the clock spring connector (for the squib circuit) is removed from the SRS diagnostic unit. The operating principle is described below.

When Connectors are Fitted

When the SRS diagnostic unit and clock spring connector are coupled, the circuit between the short terminals and clock spring connector terminals are kept in the OFF state by the partition plate provided in the connector of the SRS diagnostic unit.



When Connectors are Disconnected

When the clock spring connectors are disconnected from the SRS diagnostic unit, the partition plate between the short terminals and clock spring connector terminals is removed. As a result, a short circuit is formed between the two poles of the clock spring connector terminals to prevent generation of a potential difference (current) between the squib terminals.

CLOCK SPRING

The clock spring is provided between the steering wheel (air bag module) and column switch body (steering column).

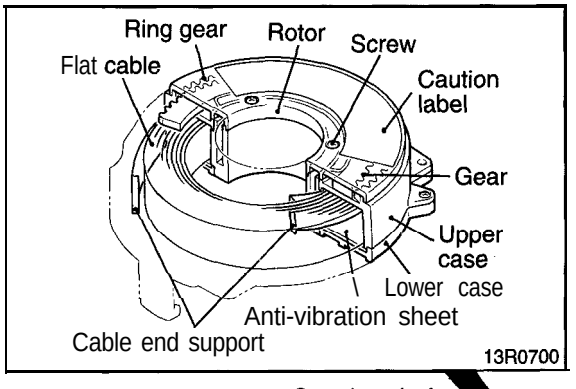
The clock spring provides harness connections between the air bag module and SRS diagnostic unit, between the horn switch and dashboard wiring harness, and between the remote control switch and dashboard wiring harness.

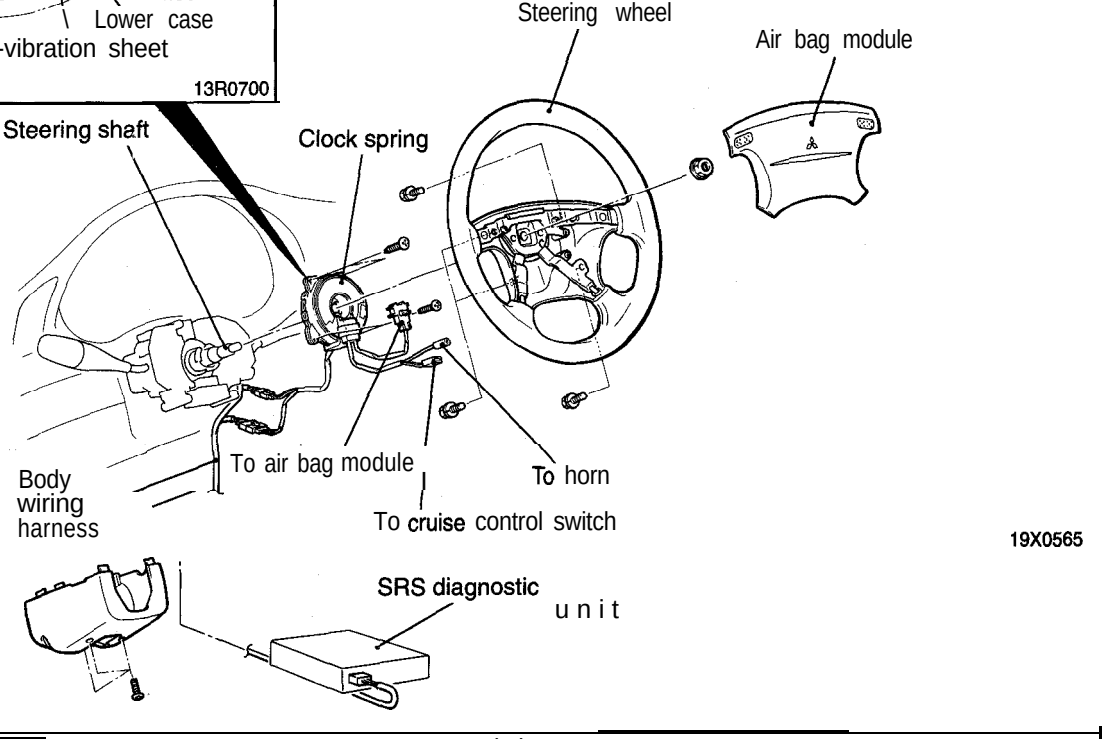
The clock spring consists of a neutral position indication mechanism, flat cable, upper case, lower case, rotor, etc.

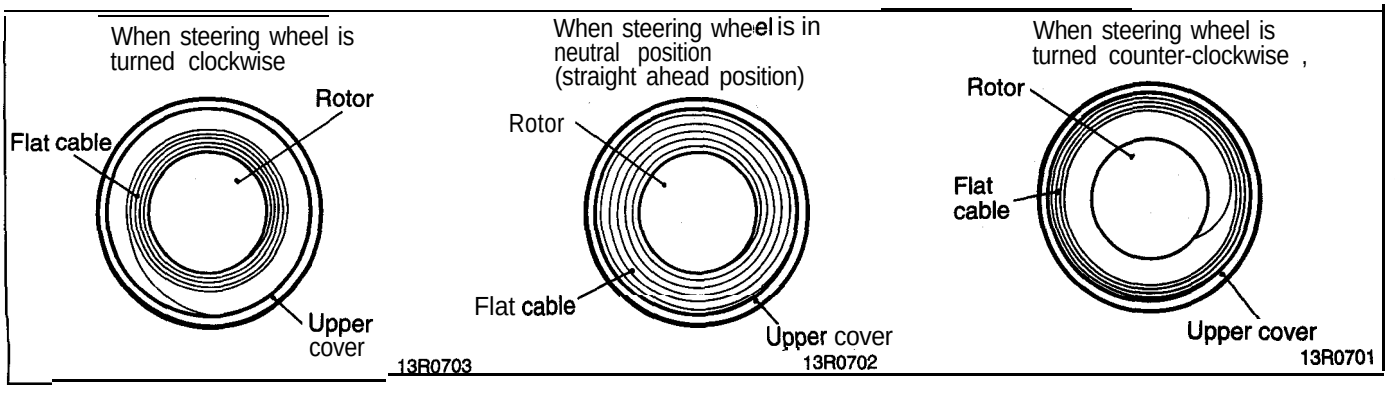
The flat cable is loosely wound like a coil, and is held in the upper and lower cases with one of its ends mounted to the rotor and the other end mounted to the upper case. The upper and lower cases are mounted to the steering column. The rotor is coupled with. the steering shaft. Rotation of the steering wheel (steering shaft) causes the rotor to rotate. Accordingly, the flat cable is wound round the rotor or loosened, and operates with the rotor as the steering wheel is turned.

Caution

Make sure that the clock spring is never disassembled.







NEUTRAL POSITION INDICATION MECHANISM

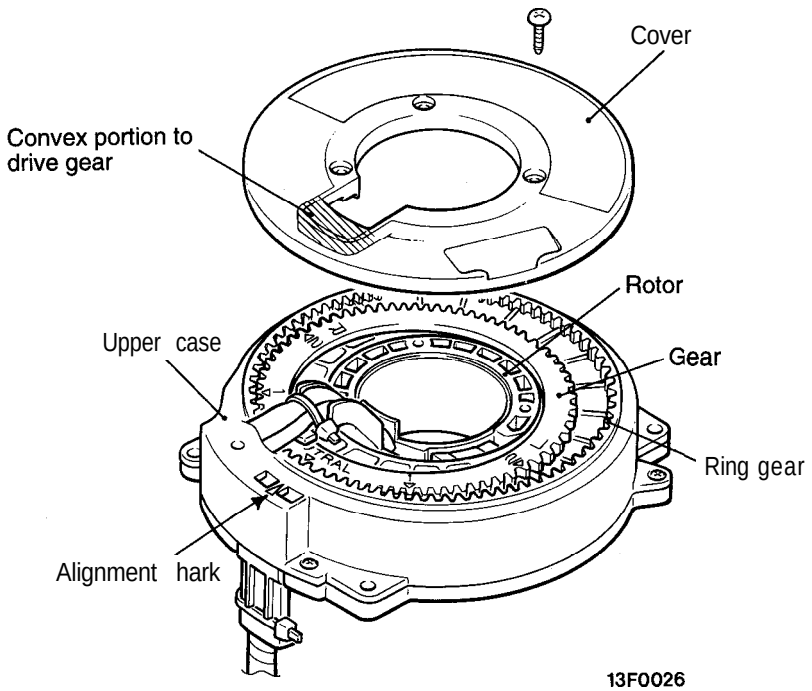
The system consists of a ring gear (number of teeth: 90) provided in the upper case, a transparent cover mounted on the rotor with screws, and a gear (number of teeth: 80) which is in mesh with the ring gear and is driven by the convex portion of the cover.

The upper case is mounted on the steering column and is always held in position.

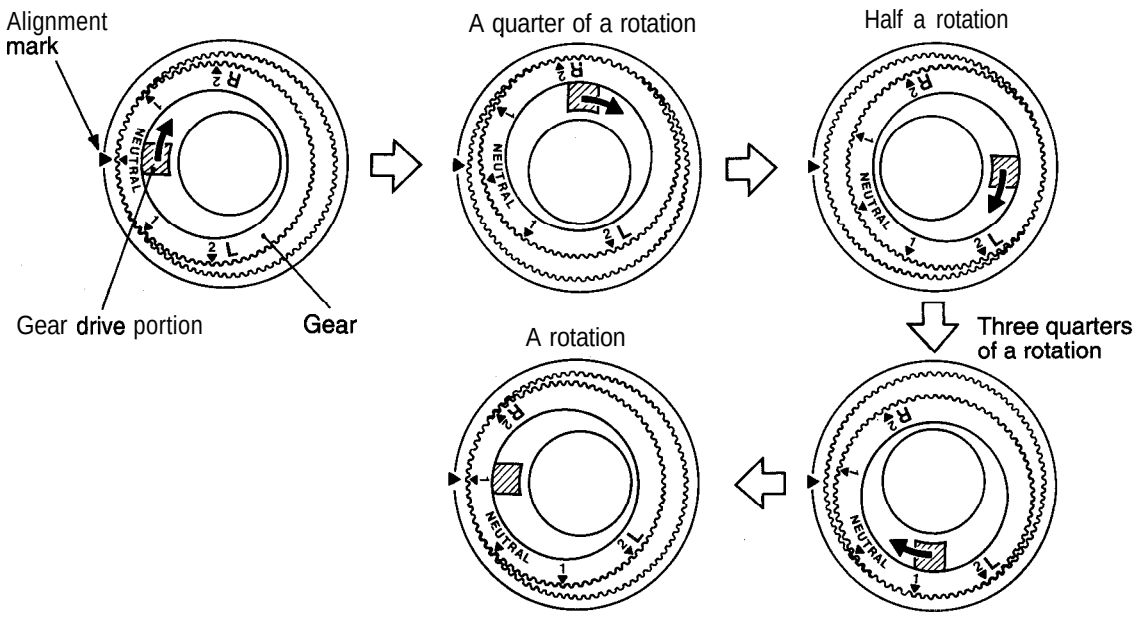
The rotor coupled with the steering shaft and always operates with the steering wheel. The gear is always kept in mesh with the ring gear by the convex portion of the cover. If the rotor turns through a rotation, the convex portion of the cover also turns through a rotation. So the gear is displaced in the opposite direction to the rotating direction of the rotor by the difference in the number of teeth between the gear and ring gear or by 10 teeth.

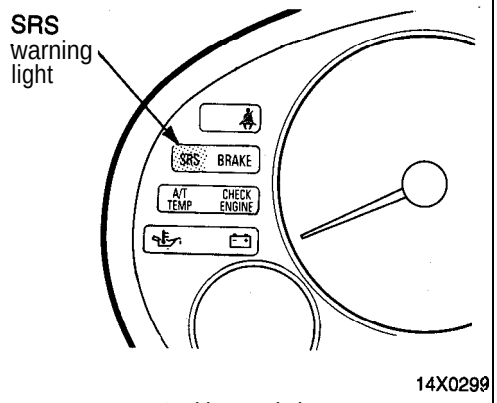
Markings R2, 1, NEUTRAL, 1, and 2L are made on the gear for every 10 teeth. An alignment mark is made on the upper case. The clock spring is placed in the neutral (straight ahead) position by lining up the alignment mark with the mark NEUTRAL of the gear. The mark "R" on the gear indicates that the rotor has been turned clockwise, whereas the mark "L" indicates counterclockwise rotation of the rotor.

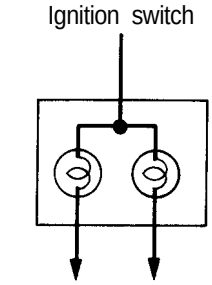
How the gear operates when the rotor is turned one rotation clockwise



How the clear operates when the rotor is turned one rotation clockwise







SRS WARNING LIGHT

The SRS warning light is provided at the left side of the combination meter.

When the SRS is in good order, the light should illuminate for approximately 7 seconds after the ignition key has been turned ON, or the engine has been started, and will then go out.

The SRS warning light has only one display area but contains two lights. Even if one of the lights is defective, the other one can be lit.

The SRS warning light is checked by the SRS diagnostic unit for defective light.

EQUIPMENT

CONTENTS

N?7zAOOhA

BATTERY 5
- Specifications 5

COMBINATION METERS 11
- Electric Type Speedometer 12
- Meters and Gauges 11
- Vehicle Speed Sensor 12

ETACS 17
- Functions and Summary of Operation 17
- Input Check Facility of ETACS 29
- Operation 20
- Parts and Funcitons Related with ETACS 29

FEATURES 2

HEATER AND AIR CONDITIONING 31
- A/C Functional Components List 35
- Auto Compressor-ECM 36
- Compressor 3 7
- Condenser Fan and Radiator Fan Control 40
- Construction Diagram 32
- Features 31
- Reciever 4 0
- Refrigerant Temperature Switch <Turbo> 36
- Service Valve.....4 0
- Specifications 31

IGNITION SWITCH 6
- Ignition Key Push Type Double-action Ignition Switch <M/T> 6
- Operation 7

LIGHTING 6
- Headlight 9
- Specifications 8

ON-BOARD DIAGNOSTIC SYSTEM 3
- Data Link Connectors 4

RADIO AND TAPE PLAYER, CD PLAYER, CD AUTO CHANGER, SPEAKER, ANTENNA 15

THEFT-ALARM SYSTEM 30

WIPERS AND WASHERS 13
- Rear Wiper and Washer 14
- Windshield Wipers and Washers 13

FEATURES

Nrn8QoAA

Improved reliability	1. Gold plating of electronic control system terminals 2. MWP (Multipole Water Proof type) connector
Improved visibility and safety	1. Double action ignition switch (ignition key push type) adopted to prevent locking the steering wheel during driving by accidentally removing the ignition key <M/T vehicles> 2. Large-sized combination meter adopted 3. High-mounted stop light used. 4. Multi-reflector type headlights adopted.
Improved usability and convenience	1. ETACS adopted for centralized control of the alarm buzzer and timer functions 2. Electric type speedometer whose pointer moves smoothly without vibrations as the speed changes
Improved serviceability	1. Data link connectors (centralized terminals for inspection) adopted to allow inspection of the diagnostic functions by a scan tool 2. Dedicated connectors for adjustment of ignition timing, engine speed detection and fuel pump operation check adopted 3. Plug-in type combination meter easy to mount and demount adopted 4. Wiper motor and link system removable as a unit.

ON-BOARD DIGNOSTIC SYSTEM

N77ZC00AA

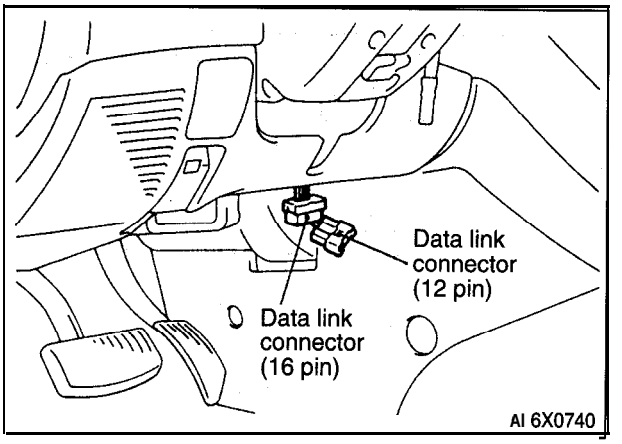
The on-board diagnostic system comprises the following functions to assure better serviceability.

Electronics system / Functions	MFI	ELC-4A/T	Auto-cruise control	ABS		SRS
				FWD	AWD	
Diagnostic trouble code (low speed signal) output	0	0	0		0	
Diagnostic trouble code (high speed signal) output	0	0		0		0
Service data (high speed signal) output	0	○		0		
Actuator test (low speed signal)					0	
Actuator test (high speed signal)	0	0		0		
Simplified inspection code output (Same indication pattern as for diagnosis code)				0		
Diagnostic trouble code retained in memory	0 Until battery is OFF				○* EEPROM	
Diagnostic trouble code erased by scan tool	0	0		0	0	0

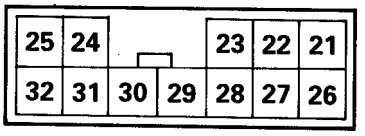
NOTE
*: Data is retained in memory until it is electrically cleared.

DATA LINK CONNECTORS

Data link connectors (centralized terminals for inspection) have been adopted to allow inspection of the diagnosis functions by the scan tool.

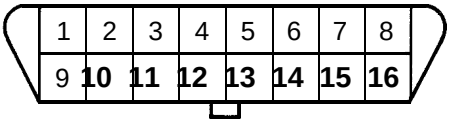


Data link connector (12 pin)



16R1338

Data link connector (16 pin)



16X0621

Data link connector (12 pin)

21. –
22. –
23. –
24. –
25. SCI Eng. RX*1
26. –
27. CCD Bus (+)*2
28. CCD Bus (–)*2
29. -
- –
- –
32. –

Data link connector (J1962-16 pin)

1. Diagnosis control
2.
3. I
4. Chassis ground
5. Signal ground
6. ELC-4A/T
7. 9141 -K*3/SCI-2 TX*'
8. ABS (AWD)
9. ETACS (One shot pulse signal)
10. –
11. –
12. SRS
13. Auto-cruise control
14. Simulated vehicles speed
15. –
16. Battery power supply (+B)

NOTE
*1: Non-turbo
*2: Vehicles with F4AC1 automatic transaxle
*3: Engine (MFI), ABS (FWD)

BATTERY

N77ZD00AA

The battery of the following specifications has been established.

SPECIFICATIONS

Items	Specifications	
Type	B.C.I. Group size 86	B.C.I. Group size 86
Capacity (5HR) Ah	50	50
Reserve capacity min.	90	90
Cold cranking current A	430	525

IGNITION SWITCH

N77ZE00AA

The ignition key push type double-action ignition switch is installed that prevents the steering wheel from being locked up as a result of the ignition key being inadvertently removed from the key cylinder while the vehicle is in motion. This contributes to greater safety.

For additional convenience, an ignition switch illumination light has been adopted which is lit at night for approximately 10 seconds by the timer function of the ETACS-ECU so that the ignition key can be easily inserted.

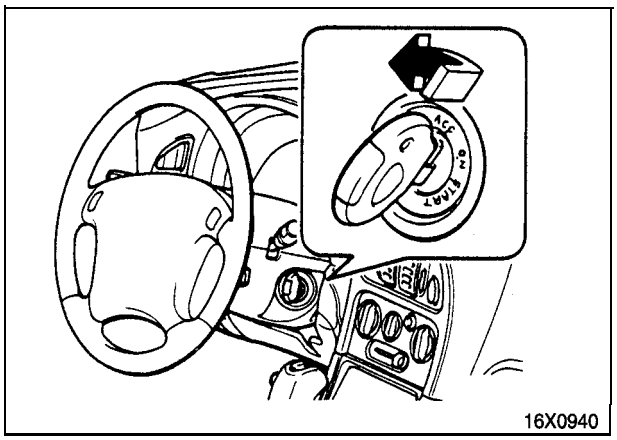
NOTE

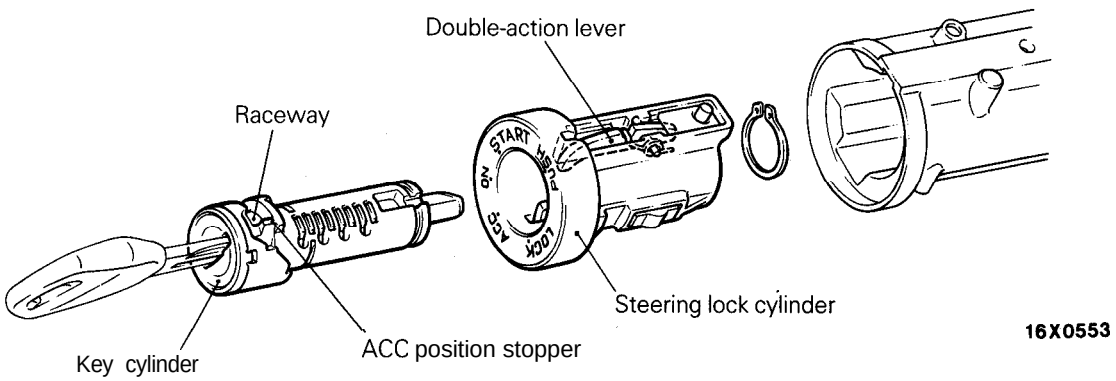
For the timer function of the ignition switch illumination light, refer to the section on the ETACS-ECU on P.7-23.

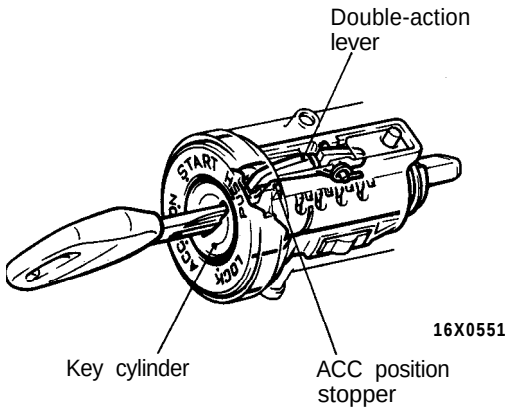
IGNITION KEY PUSH TYPE DOUBLE-ACTION IGNITION SWITCH <M/T>

N77ZE01AA

A double-action lever has been provided in the steering lock cylinder, and a raceway for orbital motion of the double-action lever and an ACC position stopper provided in the key cylinder to make sure that the ignition key cannot be removed unless the driver rotates it to the LOCK position, while pushing the key in.



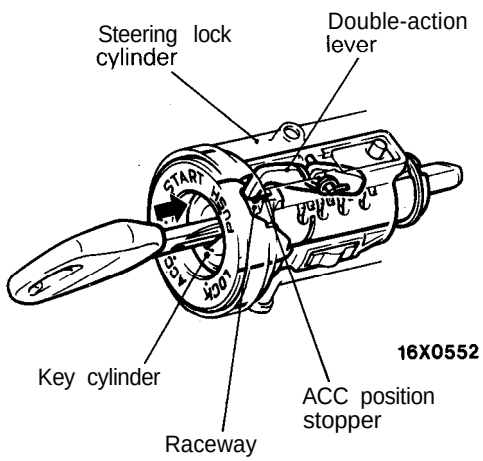




OPERATION

With the ignition key not pushed in (at the ACC position)

The key cylinder is locked by the double-action lever pressed against the ACC position stopper. Therefore, the ignition key cannot be rotated from the ACC position to the LOCK position.



With the ignition key pushed in (at the ACC position)

The key cylinder is forced into the steering lock cylinder, and the double-action lever is moved away from the ACC position stopper. The double-action lever can now move along the raceway, so the ignition key can be rotated to the LOCK position.

LIGHTING

N77ZF00AA

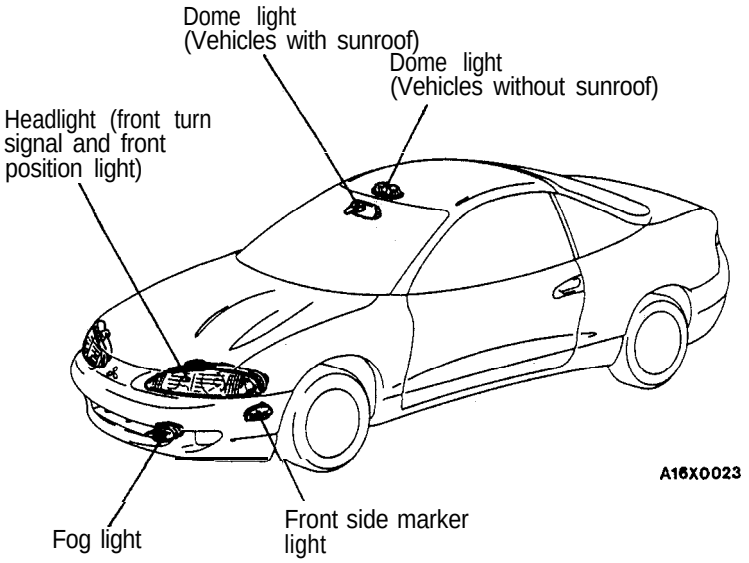
The headlight system is a thin, flush-surfaced, 4-lamp type with on-board aiming mechanism. The headlight is a multi-reflector design in which the light rays from the bulb are directed by the multi-stepped reflector. The front turn signal light and the front position light are combined with the headlight to form one headlight unit.
The front side marker lights are mounted on the front bumper.

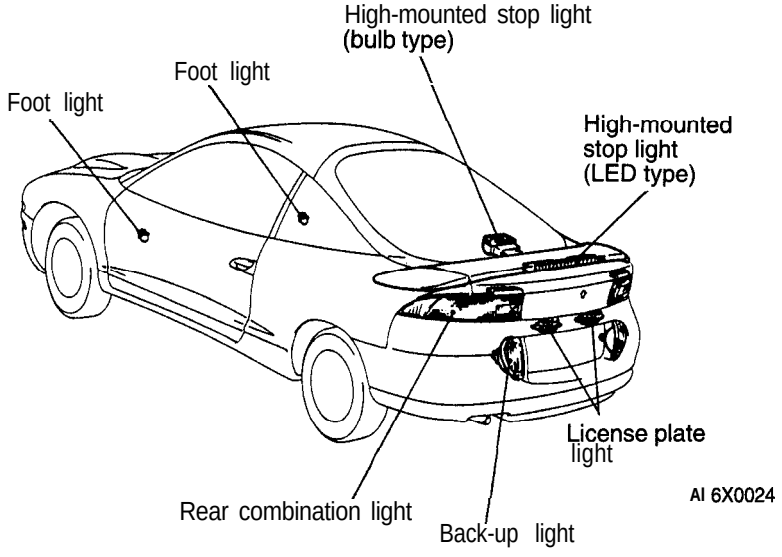
The LED (Light Emitting Diode) type high-mounted stop light is used on rear spoiler equipped vehicles, while the bulb type is installed on the vehicles not equipped with rear spoiler. The dome light of vehicles with a sunroof is incorporated in the inside rear view mirror.

SPECIFICATIONS

Items		Specifications
Exterior lights		
Headlight		
High-beam	W	60
Low-beam	W	51
Turn signal light/position light	CP	32/3
Front side marker light	CP	3
Fog light	W	55
Rear combination light		
Turn-signal and stop light/tail light	CP	32/2
Side marker light	CP	2
Back-up light	CP	32
License plate light	CP	3
High-mounted stop light	CP	45 or LED*
Interior lights		
Dome light		
Vehicles with sunroof	CP	6
Vehicles without sunroof	W	10
Foot light	W	1.4
Luggage compartment light	W	5

NOTE
*: Rear-spoiler equipped vehicle



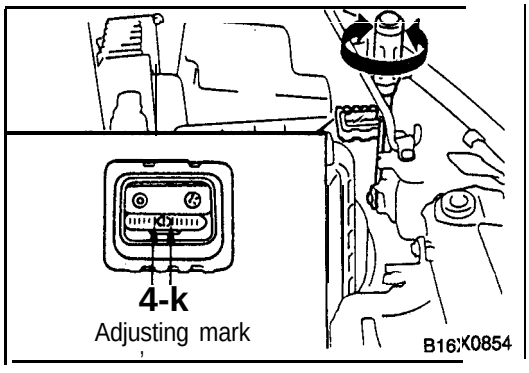


HEADLIGHT

ON-BOARD AIMING MECHANISM

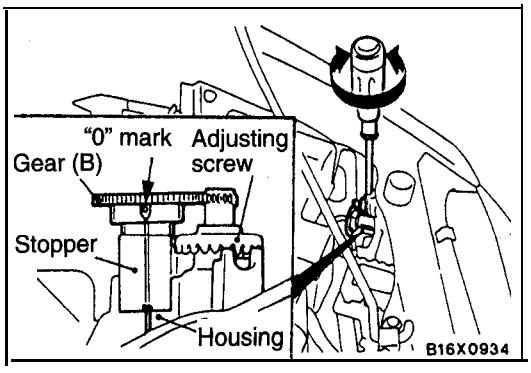
The vertical aiming adjustment can be made by turning the vertical adjusting screw to bring the bubble of the vertical adjusting gauge to the position between the adjusting marks.

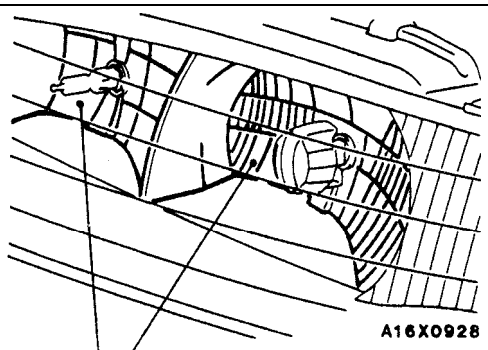
<Vertical adjusting>

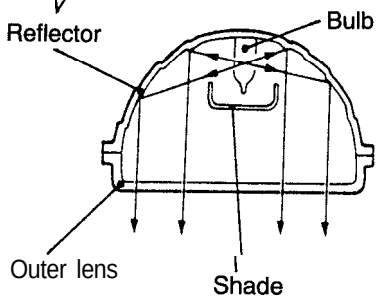


The horizontal aiming adjustment can be accomplished by turning the horizontal adjusting screw to align the "0" mark of the gear (B) with the line of the stopper and that of the headlight housing.

<Horizontal adjusting>







A16X0929

MULTI-REFLECTOR

The reflector is divided into minor sections to produce an adequate light pattern.
This design eliminates the lens cut from the outer lens, providing a characteristic appearance.

COMBINATION METERS

METERS AND GAUGES

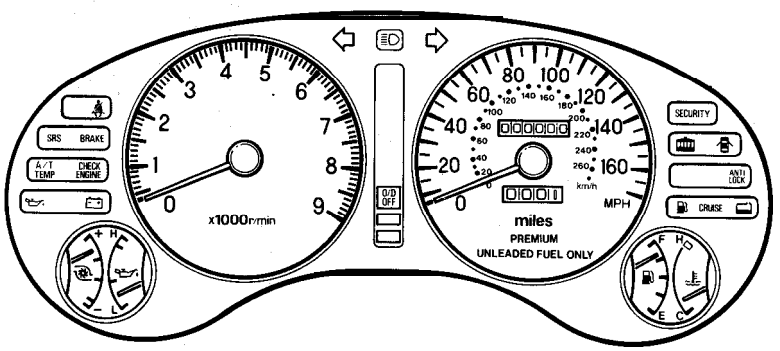
N77ZG00AA

The combination meter is of the plug-in type to facilitate its removal and installation. It is also a pointer type to provide good visibility.
The combination meter has large speedometer and tachometer located in the middle, with the fuel gauge, engine coolant temperature gauge, boost gauge, and oil pressure gauge on both sides.

The speedometer is an electric type speedometer whose pointer moves smoothly without vibrations in response to a pulse signal from the vehicle speed sensor as the speed changes.

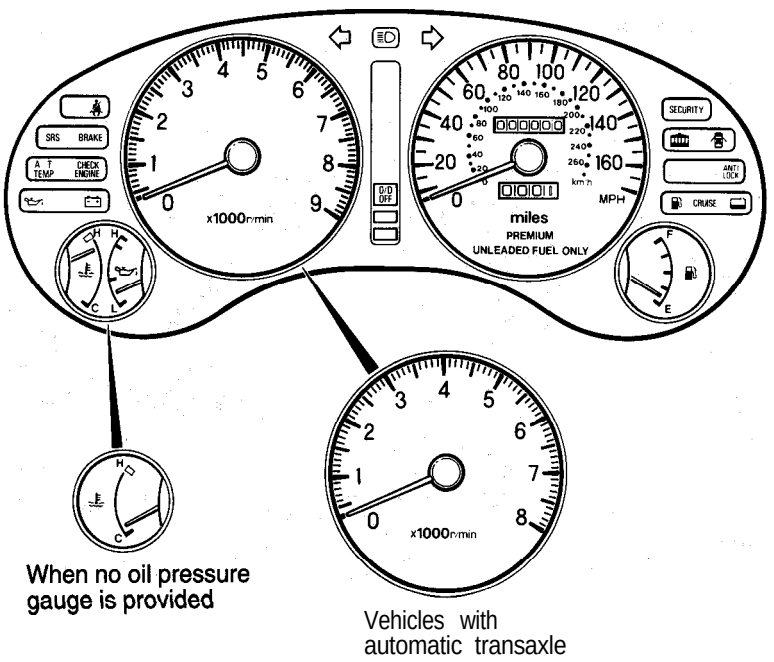
NOTE
The indicator lamps and warning lamps vary on different models.

<Turbo>



16X0956

<Non-turbo>

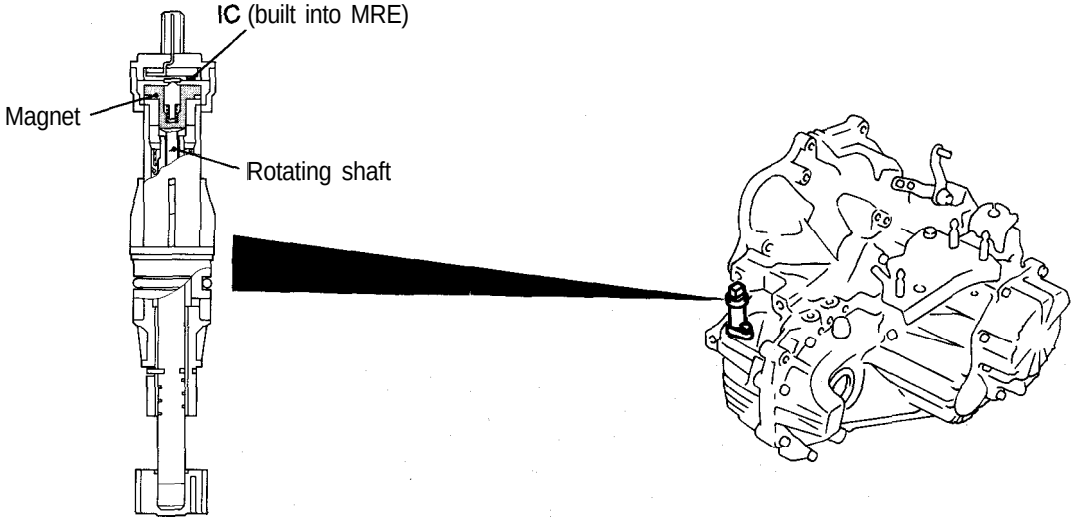


16X0955

VEHICLE SPEED SENSOR

The rotating shaft of the vehicle speed sensor is mounted directly on the transaxle speedometer driven gear. The rotation of the driven gear is transmitted to a magnet via the rotating shaft. The IC built into the Magneto Resistive Element (MRE) in the top of the magnet detects the rotation of the magnet and generates a **4-pulse** electric signal for each rotation of the speedometer driven gear.

NOTE
For the operation, refer to the 1991 3000GT Technical Information Manual (Pub. No. PXSE9001).



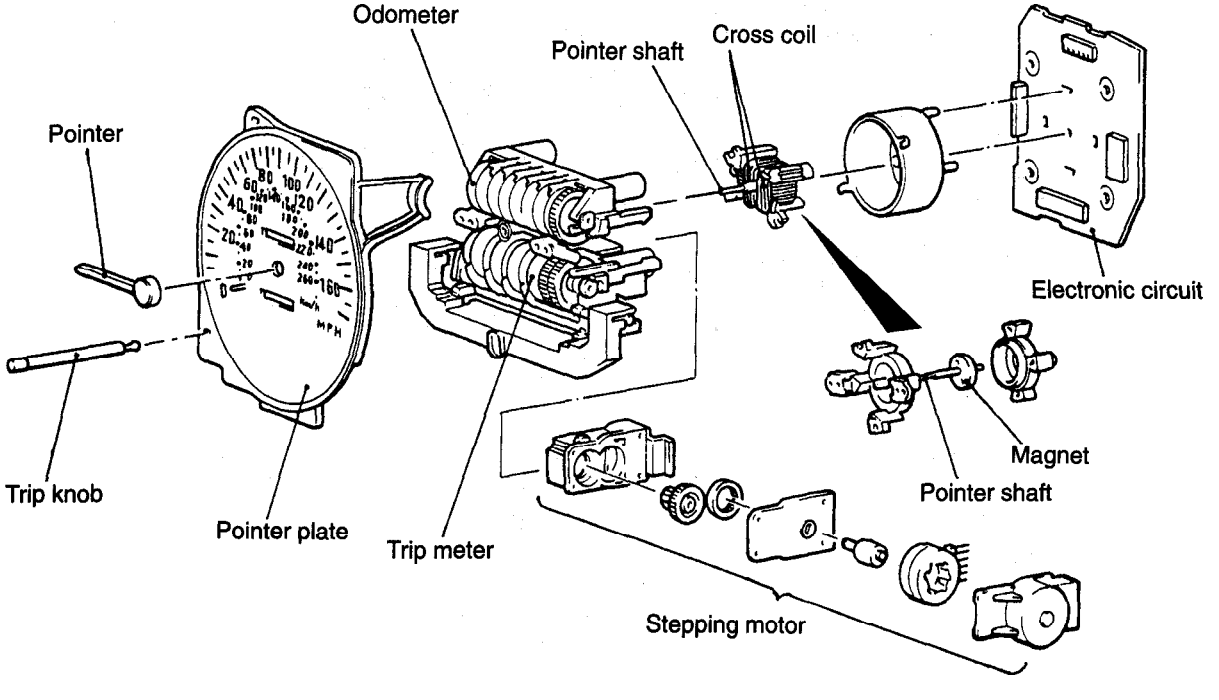
16X0931

16X0913

ELECTRIC TYPE SPEEDOMETER

The electric type speedometer uses an electronic circuit to control the electric signal from the vehicle speed sensor and a cross coil type speedometer that has a magnet fixed to the pointer shaft and two coils that pass directly through it. Furthermore, the odometer and trip meter are directly driven by the stepping motor with built-in gear.

NOTE
For the operation, refer to the 1991 3000GT Technical Information Manual (Pub. No. **PXSE9001).**



AI 6X0930

WIPERS AND WASHERS

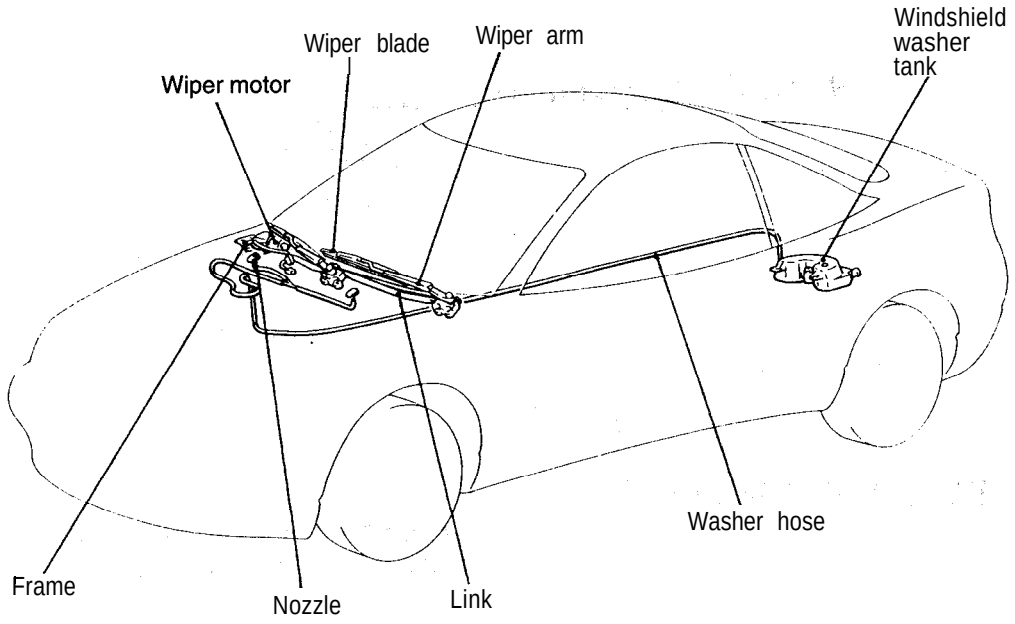
N77ZH00AA

WINDSHIELD WIPERS AND WASHERS

The windshield wiper comes in two types; two speed type with fixed interval intermittent function, and two speed type with variable intermittent function. They have the following characteristics.

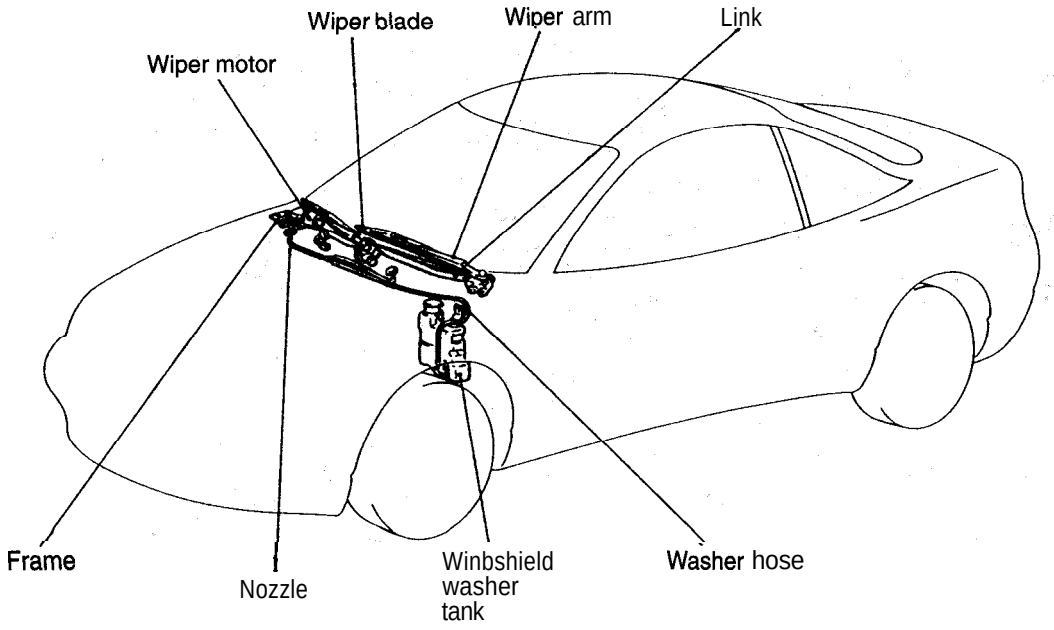
- The wiper motor and links are mounted as a unit on a frame to enhance the serviceability.
- A washer interlocked wiper function and mist wiper function have been adopted for greater convenience.
- The washer nozzle is a 2-nozzle, 4-jet type.
- The windshield washer tank is installed in the L.H. side of the engine compartment on non-turbo vehicles and in the R.H. side of the luggage compartment on turbo vehicles.

<Turbo>



AI 6X0661

<Non-turbo>



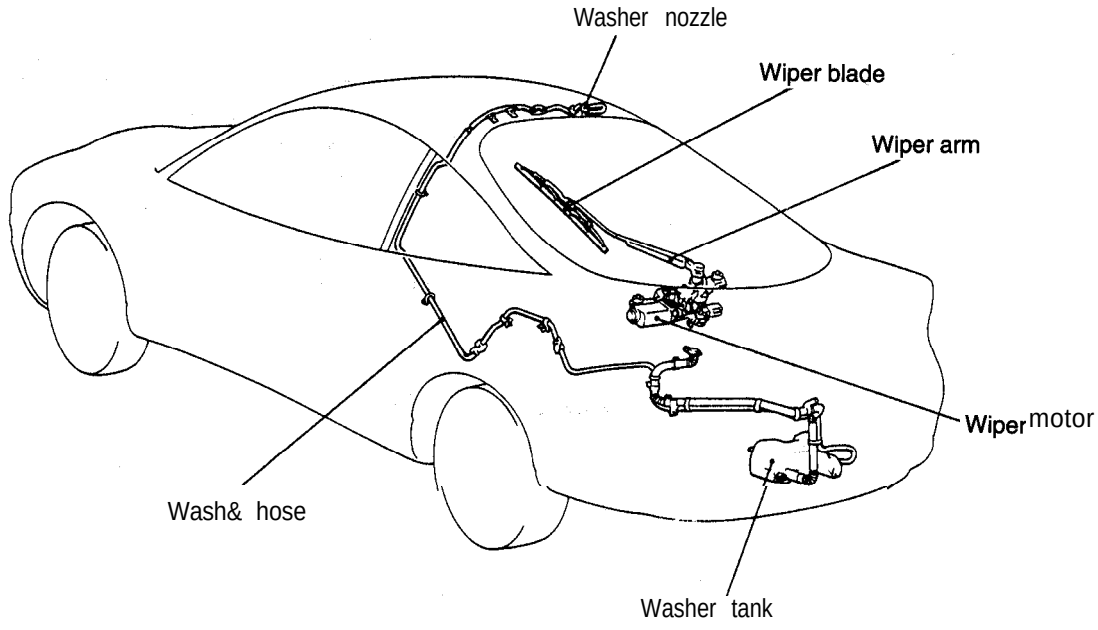
A16X0660

REAR WIPER AND WASHER

The rear wiper has an intermittent wiper function for better rear visibility in the event of a light rain. It offers the following features.

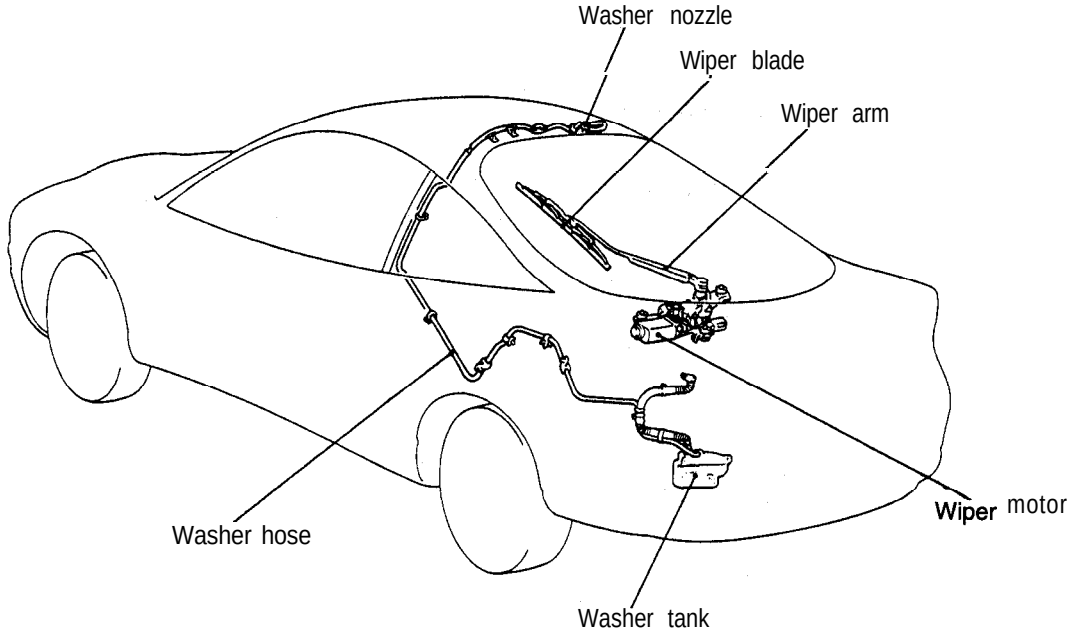
- On non-turbo vehicles, the rear washer tank is installed in the L.H. side of the luggage compartment. On turbo vehicles, the windshield washer tank is also used as a rear washer tank.
- The washer is one-nozzle, two-jet type.

<Turbo>



AI 8X0773

<Non-turbo>



AI 8X0772

RADIO AND TAPE PLAYER, CD PLAYER, CD AUTO CHANGER, SPEAKER, ANTENNA

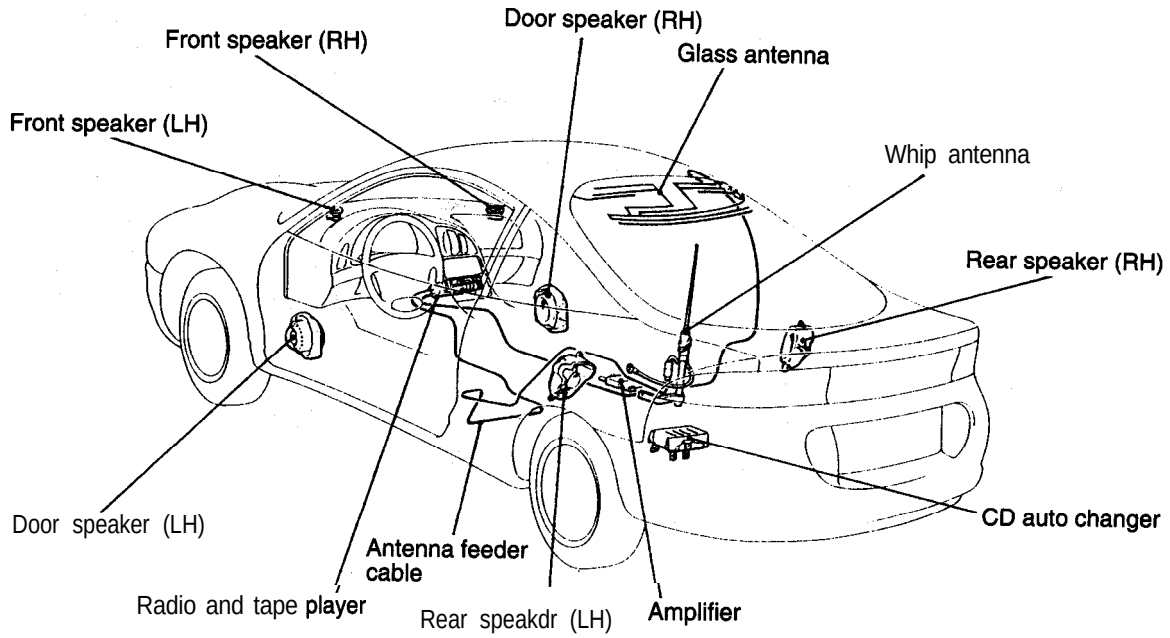
NT??TIOOAA

The following radio, cassette tape player, CD player, CD auto changer, speakers and antenna are available:

Radio and Tape Player, CD Player, CD Auto Changer
- AM/FM electronic tuning radio
- AM/FM electronic tuning radio with tape player
- CD player
- CD auto changer

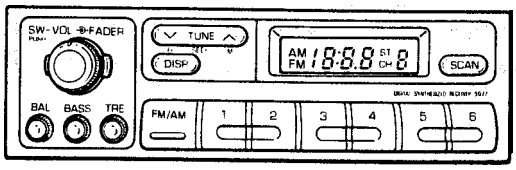
Speaker
- 4-speaker <Door speaker: 13 cm (5.1 in.) – single cone, Rear speaker: 16 cm (6.3 in.) – double cone>
- 6-speaker <Front speaker: 8 cm (3.1 in.) -single cone, Door speaker: 13 cm (5.1 in.) – single cone, Rear speaker: 16 cm (6.3 in.) – double cone>
- 6-speaker <Front speaker: 8 cm (3.1 in.) -single cone, Door speaker: 16 cm (6.3 in.) – double cone, Rear speaker: 6 in. x 9 in. – single cone>
- 8-speaker <Front speaker: 2.5 in. -single cone, Door speaker: 6.5 in. -single cone, Rear speaker: 6 in. x 9 in. + 2.5 in. – coaxial 2 way>

Antenna
- Whip antenna
- Glass antenna



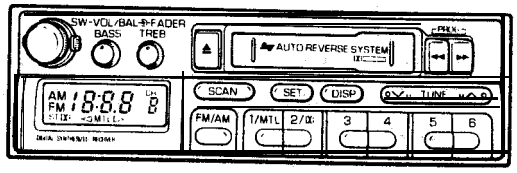
AI 6X0941

<AM/FM Electronic Tuning Radio>



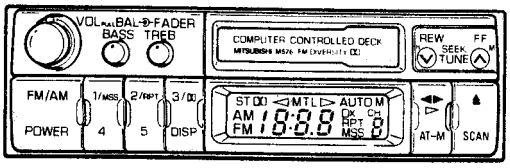
16X0922

<AM/FM Electronic Tuning Radio and Tape Player>



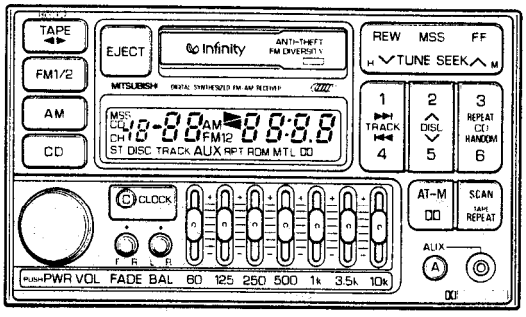
16x0940

<AM/FM Electronic Tuning Radio and Tape Players

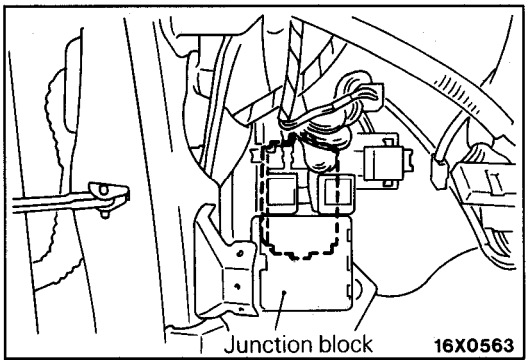


16X0949

<AM/FM Electronic Tuning Radio and Tape Player with Equalizer>



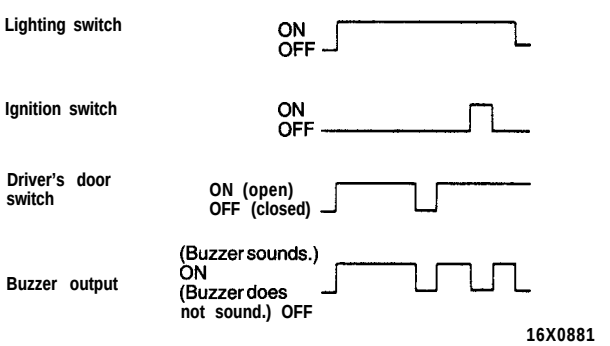
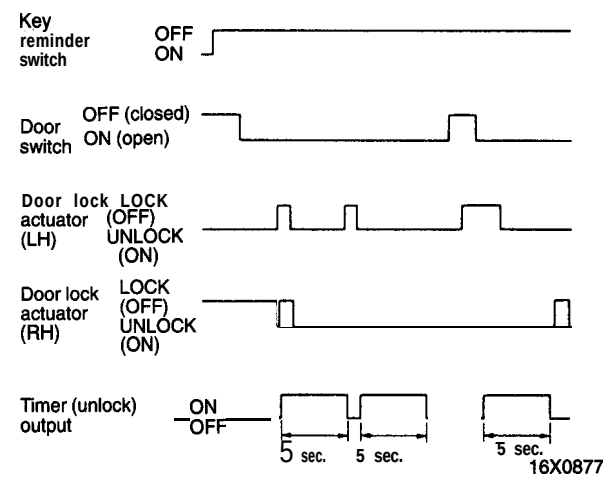
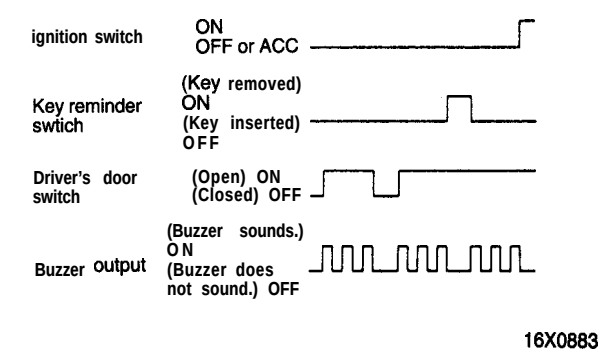
16X0921

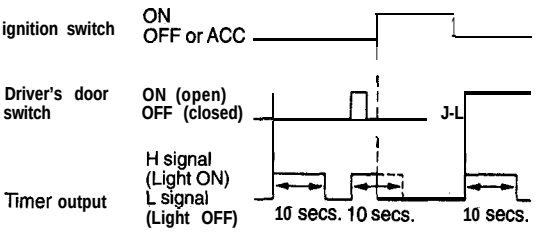
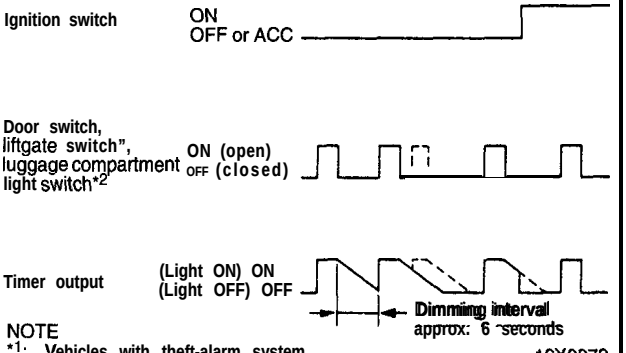
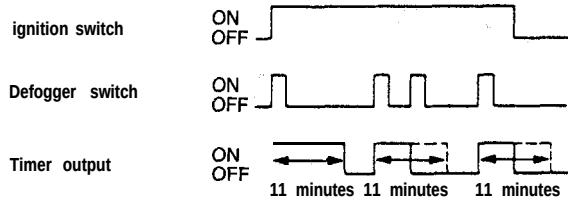


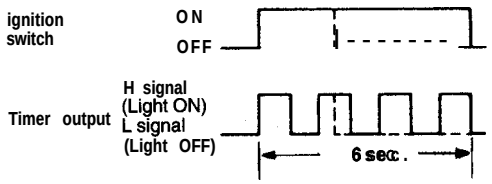
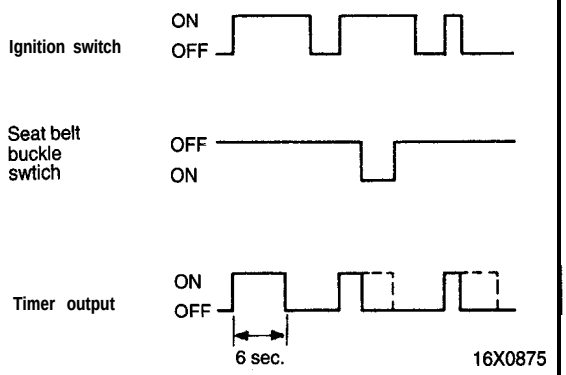
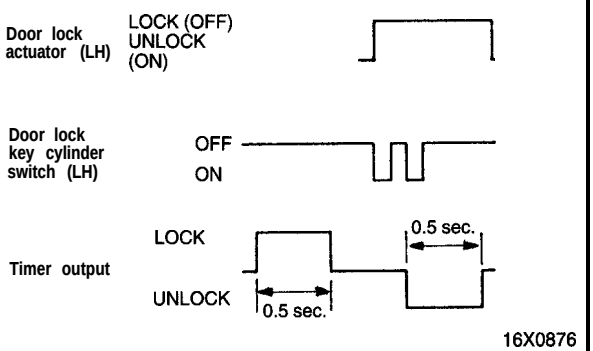
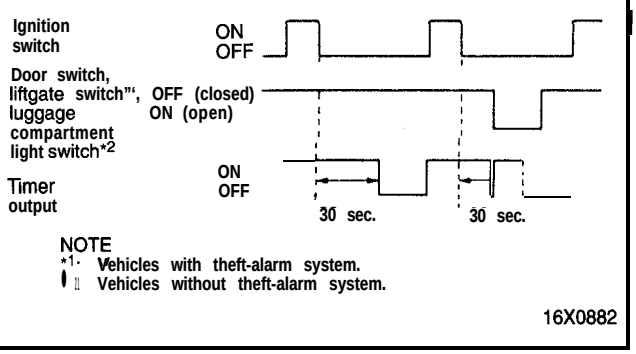
ETACS NrmWM

The ETACS (Electronic Time and Alarm Control System) has been adopted for centralized control of various timer and alarm functions.
The ETACS control unit has an input check function which makes it possible to easily check whether the circuit from the input switch to the microprocessor in the control unit is functioning properly or not.

FUNCTIONS AND SUMMARY OF OPERATION

Item	Function and Summary of Operation	
Light reminder alarm function	When the ignition key is removed from the ignition switch and the driver's door is opened while the lighting switch is ON (PARKING or HEAD), the buzzer will sound continuously to remind the driver that the lights are ON.	
Ignition key reminder timer function	To prevent accidental door locking with the key still in the ignition, the following will take place. If the driver's door is opened, and the driver or passenger lock knob is operated, the system will automatically release the lock. NOTE This function has priority over the central door lock system function.	
Ignition key reminder alarm function	When the driver's door is opened without removing the ignition key (OFF or ACC position), the buzzer will sound intermittently to remind that the ignition key has not been removed.	

Item	Function and Summary of Operation	
Ignition switch illumination light timer function	When the driver's seat door is opened with the ignition switch in the OFF or ACC position, the ignition switch illumination light will light for approximately 10 seconds so that the ignition key can be easily inserted even at night. However, if the ignition key is placed in the ON position within the 1 O-second interval, the ignition switch illumination light will go out immediately.	 16X0878
Dome light and foot light dimming timer function	When all the doors and tailgate are closed with the dome light switch in the door interlocked position (vehicles with sunroof) or OFF (vehicles without sunroof) and with the ignition switch in the OFF or ACC position, the dome light and foot light will slowly dim, and will go out in approximately six seconds. When the ignition switch is in the ON position, however, no dimming operation will be performed.	 NOTE *1: Vehicles with theft-alarm system. *2: Vehicles without theft-alarm system. 16X0879
Defogger timer function	When the defogger switch is turned ON with the ignition switch in the ON position, the defogger will operate for 11 minutes. If the defogger switch is pressed again during the 11 -minute interval, however, the defogger will stop operating,	 16X0880

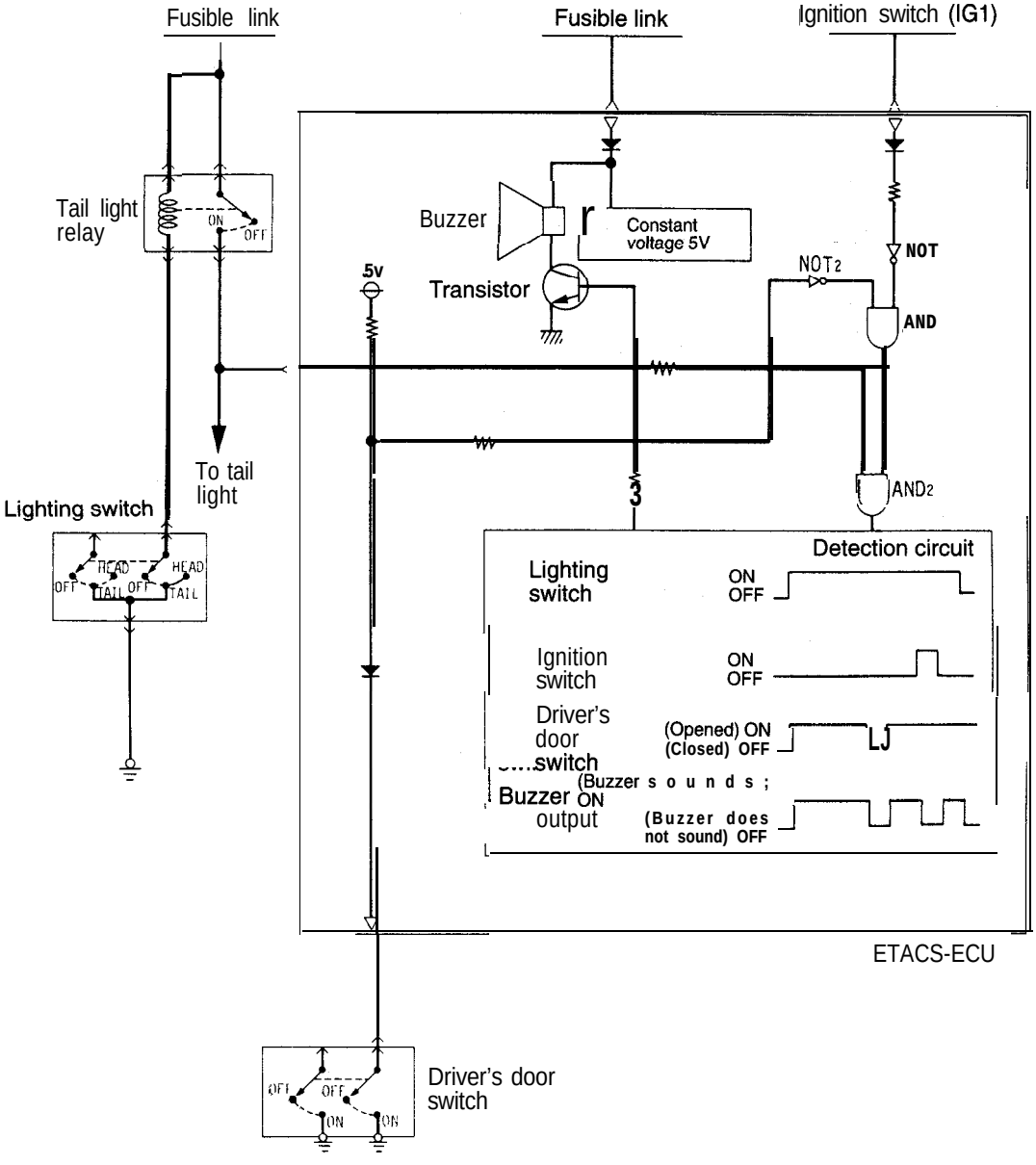
Item	Function and Summary of Operation	
Seat belt warning timer fuction <Warning light>	When the ignition key is turned on, the seat belt warning light flashes for 6 seconds (4 times).	
<Buzzer>	If the driver's seat belt is not worn when the ignition switch is turned to the ON position, the buzzer sounds intermittently for six seconds, urging the driver to wear the seat belt.	
Central door lock timer function	When the driver's door is locked by means of its key or inside lock knob, all doors can be locked. With the driver's door unlocked, unlocking for the second time by means of the key unlocks all other doors.	
Power window timer function	When the ignition key is turned off, the ETACS timer function is activated, and the power window can be opened and closed using the power window switch for 30 seconds. The power window timer stops, however, if a door or liftgate is opened within 30 seconds.	

OPERATION

LIGHT REMINDER ALARM FUNCTION

1. When the lighting switch is in the ON (TAIL or HEAD) position, the tail light relay is in the ON state, so the H signal from the tail light is input to AND_2.
2. When the ignition switch is in the OFF position, the H signal of the ignition switch inverted by NOT_1 is input to AND_1.
3. As a result, when the driver's door is opened (door switch ON), the H signal of the door switch inverted by NOT_2 is input to AND_1. Then AND_1 outputs H signal.
4. When the H signal output from AND_1 is input to AND_2, the signal output from AND_2 also changes to H signal which operates the detector circuit. Then the buzzer output causes the transistor to be ON, and the buzzer sounds continuously to remind the driver that the lights (tail lights or headlights) are ON.

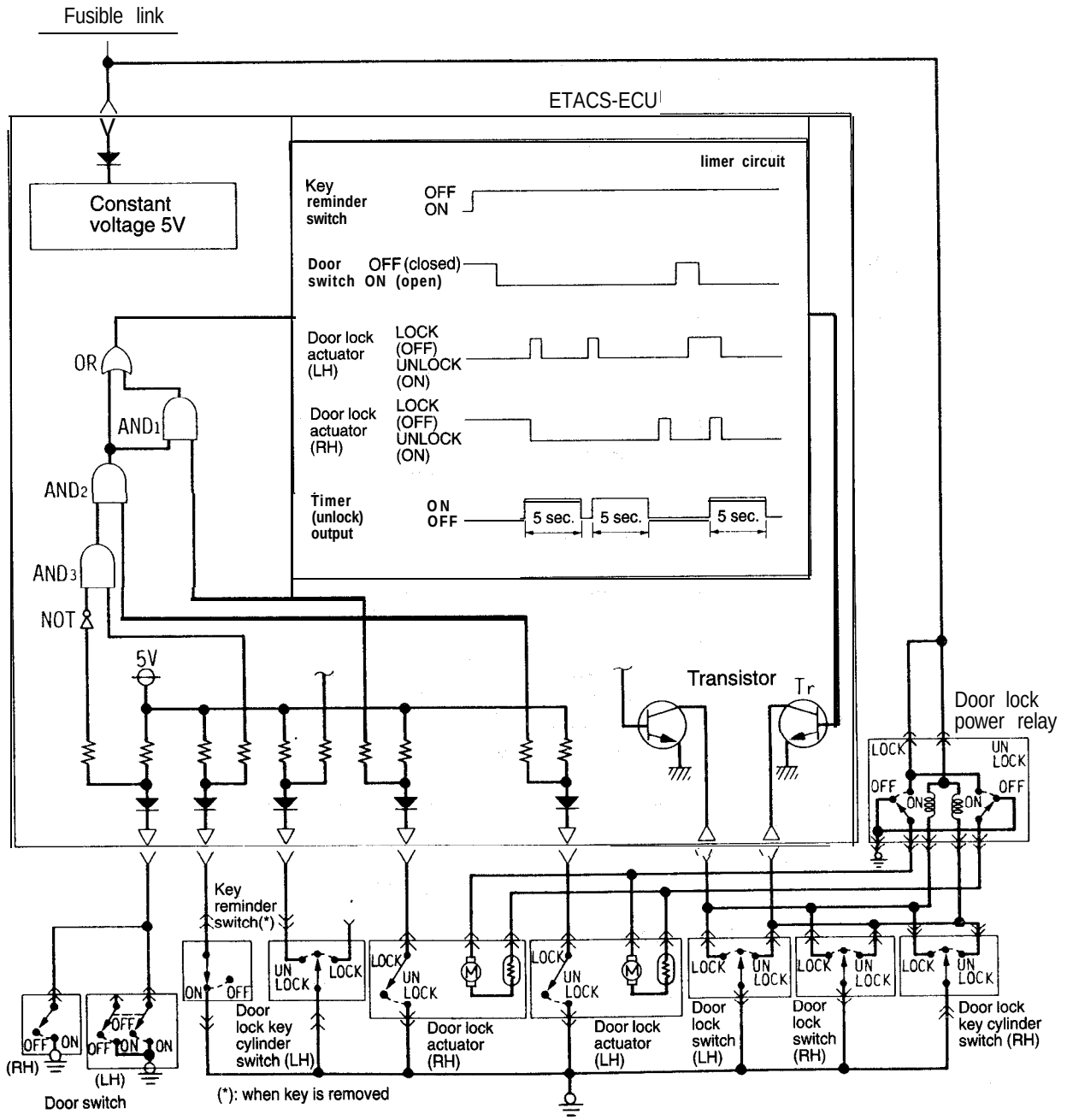
NOTE
If the ignition key is left inserted with the ignition switch in the OFF position, even if the conditions for the light reminder function hold good, the buzzer will sound intermittently, as the ignition key reminder alarm function takes precedence.



16X0881

IGNITION KEY REMINDER TIMER FUNCTION

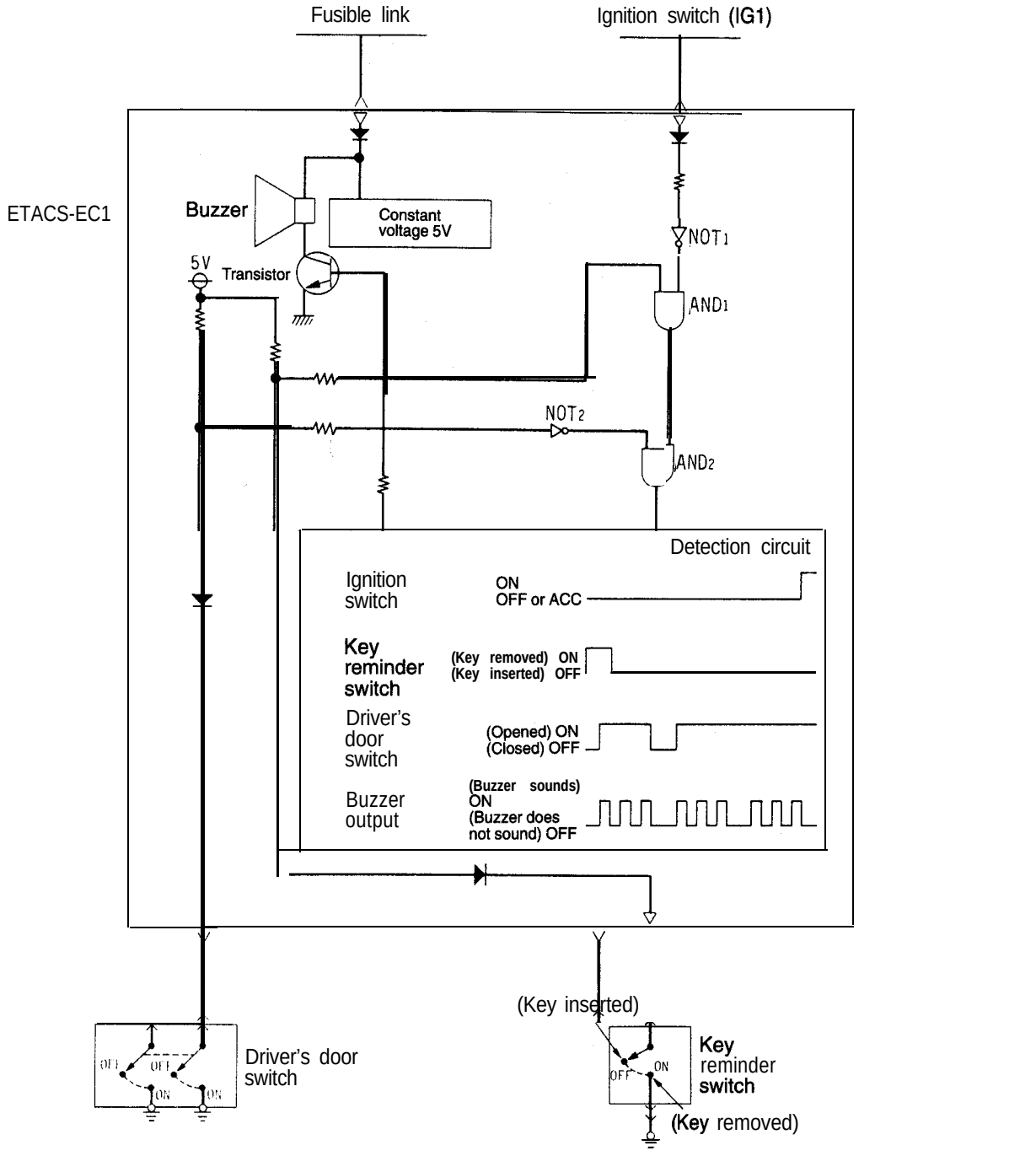
(1) While the ignition key is inserted in the ignition switch (key reminder switch OFF), the H signal of the key reminder switch is input to AND_3.
(2) If either front door is open (door switch ON) at that time, the L signal from the door switch is reversed to the H signal by NOT and applied to AND_3.
(3) As a result, AND_3 outputs the H signal and inputs it to AND_2.
(4) If the inside lock knob of the driver's door is pushed forward at that time (the door lock actuator LOCK), the H signal from the door lock actuator is applied to AND_2.
(5) As a result, AND_2 outputs the H signal, which is input to the timer circuit through OR to operate the timer circuit, turn ON the transistor Tr for five seconds, and unlock all doors.
(6) If the front passenger's door is opened and the inside lock knob is pushed forward (door lock actuator LOCK) while the ignition key is inserted in the ignition switch (key reminder switch OFF) and the driver's door is locked (door lockactuator LOCK), AND_1 outputs the H signal. The signal is input to the timer circuit through OR to operate the timer circuit, turning ON the transistor Tr for five seconds and unlocks all doors.



16X0877

IGNITION KEY REMINDER ALARM FUNCTION

1. When the ignition key is left inserted with the ignition switch in the OFF or ACC position, the H signals of the key reminder switch and the ignition switch inverted by NOT_1 are input to AND_1. As a result, AND_1 outputs H signal.
2. When the driver's door is opened (door switch ON), the H signal of the door switch inverted by NOT_2 and the H signal output from AND_1 are input to AND_2. Then AND_2 outputs H signal to cause the detector circuit to operate.
3. The buzzer output causes the transistor to be alternately ON and OFF, and the buzzer sounds intermittently to remind the driver that the ignition key has not been removed.

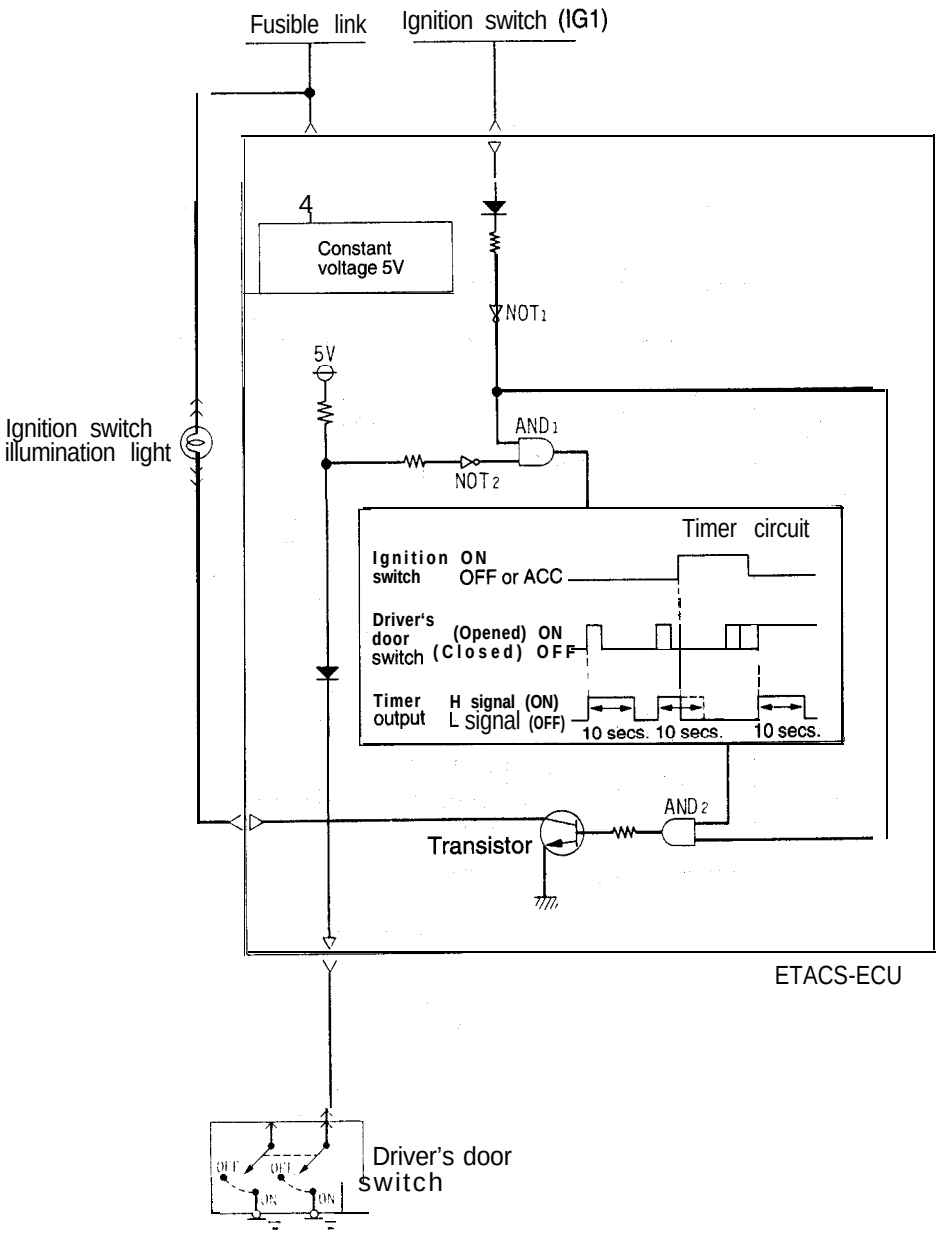


16X0883

IGNITION SWITCH ILLUMINATION LIGHT TIMER FUNCTION

1. When the ignition switch is in the OFF or ACC position, the H signal of the ignition switch inverted by NOT_1 is input to AND_1 and AND_2.
2. When the driver's door is opened (door switch ON), the H signal of the door switch inverted by NOT_2 is input to AND_1. As a result, AND_1 outputs H signal to cause the timer circuit to operate.
3. Accordingly, when the H signal output from the timer is input to AND_2, the output signal from AND_2 changes to H signal which causes the transistor to be ON for 10 seconds to light the ignition switch illumination light.
4. When the ignition switch is placed in the ON position during operation of the timer, the L signal of the ignition switch inverted by NOT_1 is input to AND_2. As a result, AND_2 outputs L signal which causes the transistor to be OFF, and the ignition switch illumination light goes out immediately.

NOTE
Even if the driver's door is opened and closed (door switch caused to be ON and OFF) while the timer is in operation, no input signal is accepted.



16X0878

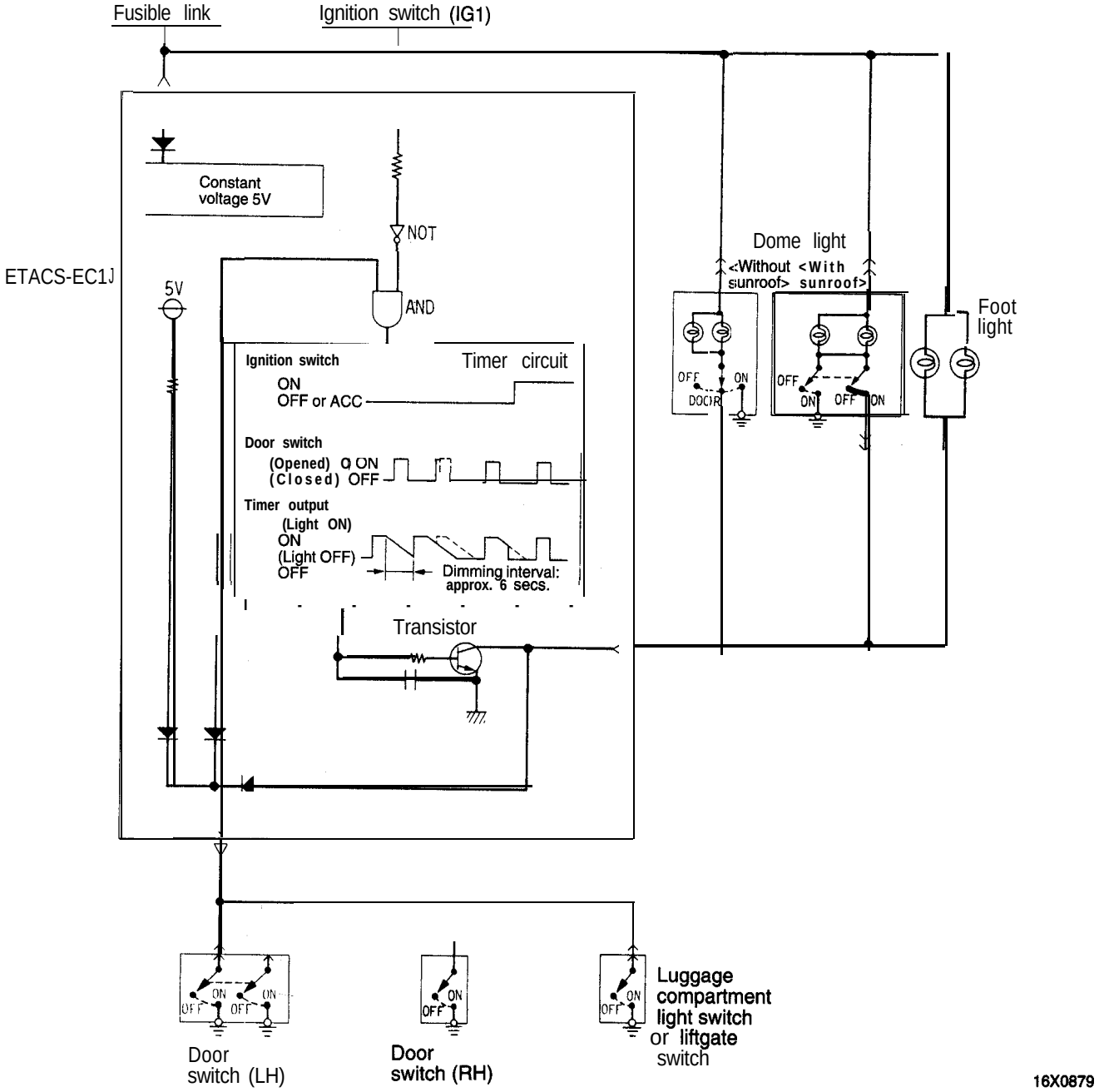
DOME LIGHT AND FOOT LIGHT DIMMING TIMER FUNCTION

1. When any of the doors or tailgate is opened (door switch ON or luggage compartment light switch* ON) with the dome light switch in the DOOR position (vehicles without sunroof) or OFF position (vehicles with sunroof), the dome light will light ON.

   NOTE
   When the front doors or tailgate is opened, the foot light comes on regardless of the light switch position.

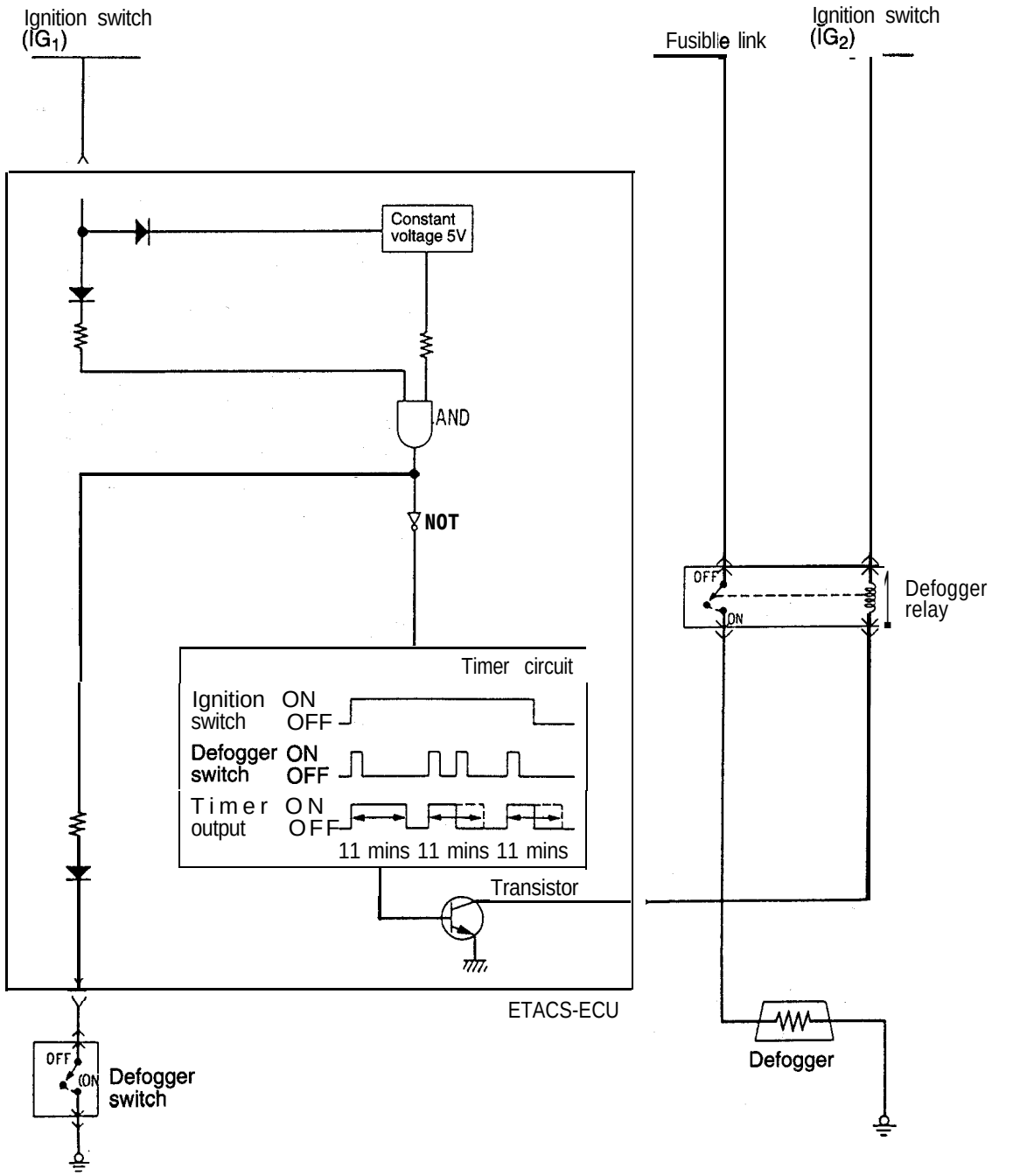
2. When all the doors and tailgate are closed with the ignition switch in the OFF or ACC position (door switch OFF and luggage compartment light switch* OFF), the H signal of the ignition switch inverted by NOT and the H signal of the door switch are input to AND. As a result, AND outputs H signal which operates the timer circuit.
3. The timer output provides signals which slowly reduce the voltage to the transistor in approximately six seconds , thereby dimming the dome light and foot light.
4. When the ignition switch is placed in the ON position during operation of the timer, the L signal of the ignition switch inverted by NOT is input to AND. As a result, AND outputs L signal, and the timer circuit stops operation. The dome light and foot light, therefore, goes out immediately without dimming.

NOTE
*: On vehicles with theft-alarm system, this switch is the liftgate switch.



DEFOGGER TIMER FUNCTION

1. When the ignition switch is turned to the ON position, the H signal of the ignition switch and the H signal of the constant voltage are input to AND. As a result, AND outputs H signal.
2. When the defogger switch is placed in the ON position, the H signal inverted by NOT is input to timer circuit to activate the timer circuit.
3. Since the defogger switch (auto reset switch) placed in the ON position is automatically reset to the OFF state, the L signal which is opposite to the signal in Item (2) is input to the timer circuit after the switch has been caused to be ON, but the timer keeps on operating.
4. The timer output causes the transistor to be ON for 11 minutes. The defogger relay is also placed in the ON position to operate the defogger.
5. When the ignition switch is placed in the OFF position or when the defogger switch is placed in the ON position again during operation of the timer, the H signal is input to the timer circuit again. As a result, the timer circuit stops operating, and the transistor is forced to the OFF state. The defogger relay is also placed in the OFF oosition and the defogger stops operating.



16X0880

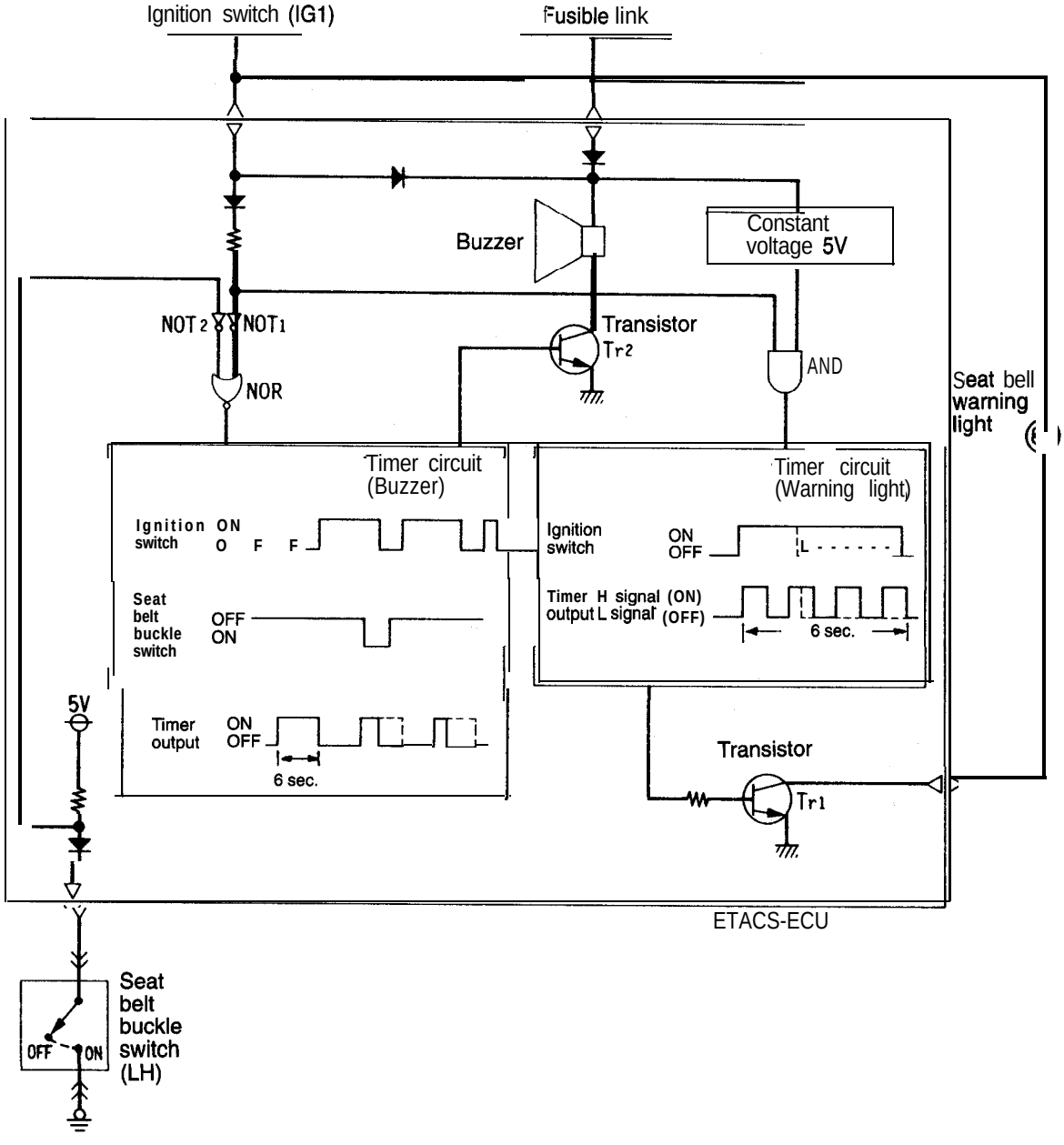
SEAT BELT WARNING TIMER FUNCTION

<Warning light>

(1) Placing the ignition switch to the ON position will apply the H signal of the ignition switch and the H signal of constant voltage circuit to AND. Then AND outputs the H signal to operate the timer circuit.
(2) The timer output turns the transistor Trl ON and OFF alternately four times in six seconds and seat belt warning lamp blinks to remind the driver of wearing the seat belt.
(3) If the ignition switch is turned OFF while the timer is in operation, the H signal of the ignition switch mentioned in (1) above changes to the L signal to stop the timer circuit operation and to turn off the warning light.

<Buzzer>

(1) Placing the ignition switch in the ON position will apply the L signal inverted by NOT_1 to NOR. If the seat belt is not worn at this time (seat belt buckle switch OFF), the L signal inverted by NOT_2 is applied to NOR. As a result, NOR outputs the H signal and operates the timer circuit. The buzzer output turns on the transistor Tr2 and sounds the buzzer intermittently for six seconds to remind the driver of wearing the seat belt.
(2) If, during timer operation, the seat belt is worn (seat belt buckle switch ON) or the ignition switch is placed in the OFF position, the L signal from NOT changes to H signal and NOR outputs the L signal. Then the timer circuit stops operation and the buzzer stops sounding.



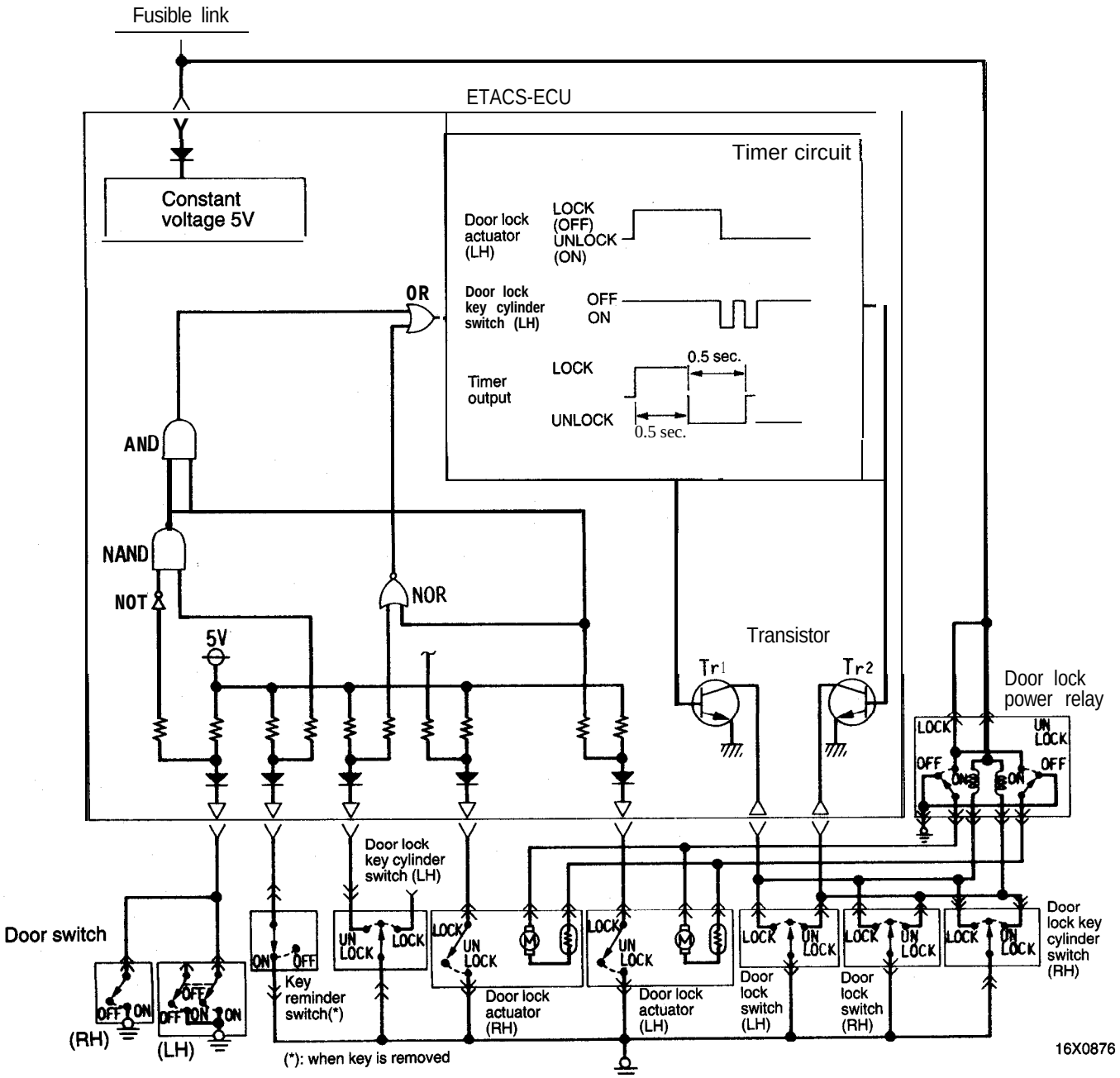
16X0875

CENTRAL DOOR LOCK TIMER FUNCTION

(1) If the ignition key has already been removed from the ignition switch (key reminder switch ON), the L signal of the key reminder switch is applied to NAND. Or if all doors have been closed (door switches OFF), the H signal of the door switch inverted to L by NOT is applied to NAND.
(2) If the ignition key has been removed from the ignition switch or all doors have been closed, NAND outputs the H signal to be applied to AND.
(3) At this time, pushing the inside lock knob of the driver's door forward (door lock actuator LOCK) will apply the H signal to AND.
(4) As a result, AND outputs the H signal and is input to the timer circuit through OR to operate the timer circuit, turning on the transistor Trl for 0.5 second to lock all doors.

NOTE
The door key cylinder and door lock actuator are connected together by the rod through the door latch. When, therefore, the driver's door is locked by means of the key, similar operation is accomplished.

(5) When the driver's door is in the unlocked condition, the L signal of the door lock actuator is applied to NOR.
(6) If, in this condition, the unlocking operation of the driver's door using the ignition switch is done for the second time, the L signal of the door lock key cylinder switch is applied to NOR.
(7) As a result, NOR outputs the H signal to NOR and outputs it to the timer circuit through OR to operate the timer circuit, turning on the transistor Tr2 for 0.5 second to unlock all doors.



POWER WINDOW TIMER FUNCTION

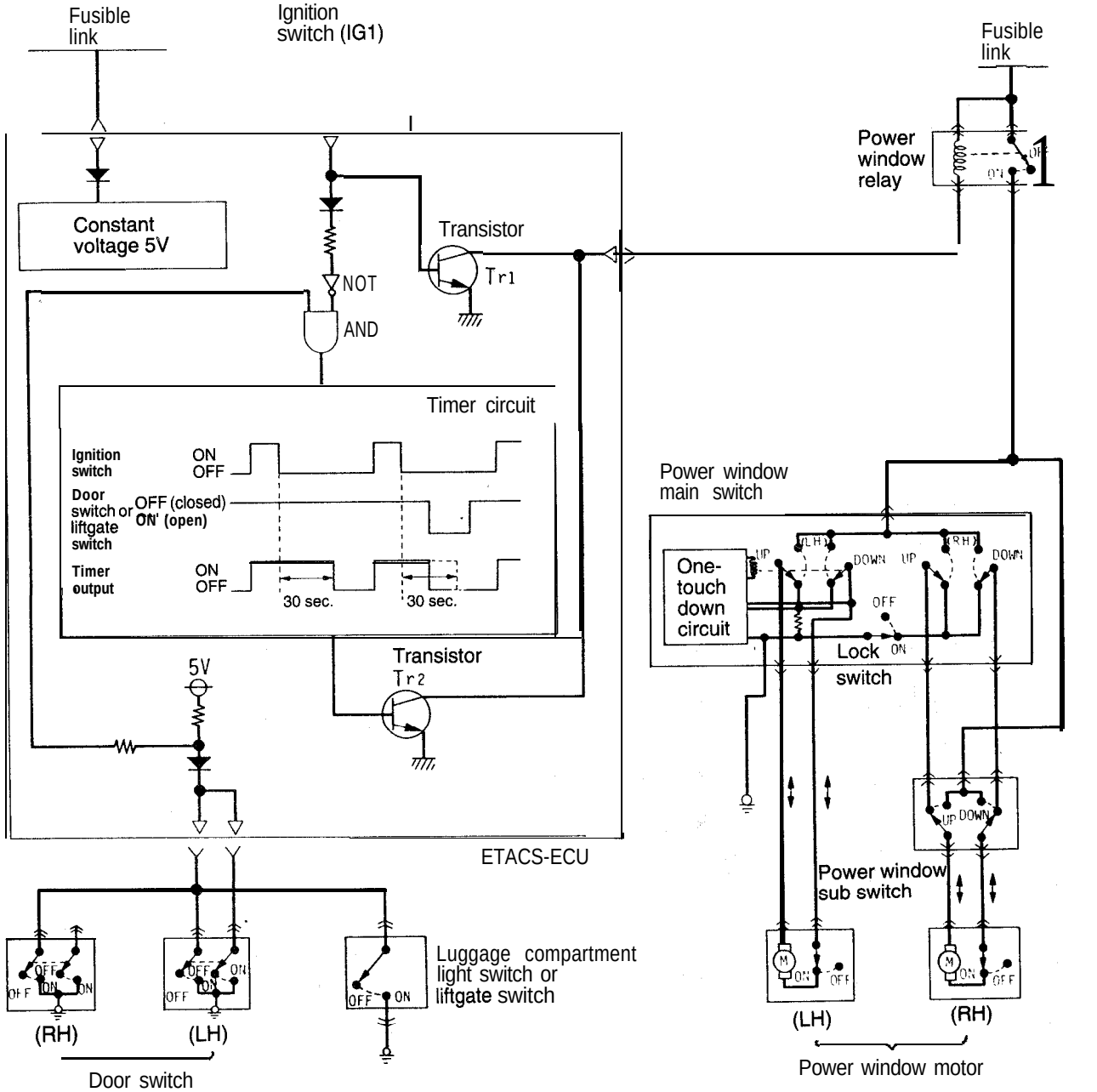
(1) If the ignition switch is placed in the ON position, the transistor Trl is turned ON and the power window relay is also turned ON, allowing the power window to be opened/closed by the power window switch (main or sub switch).

(2) Turning the ignition switch from ON to OFF will turn OFF the transistor Trl. At this time, the ignition switch signal inverted by NOT to H is applied to AND. In addition, when all doors and liftgate are closed, the H signal from the door switches and the luggage compartment light switch is also applied to AND. Therefore, AND outputs the H signal to operate the timer circuit and turn on the transistor Tr2 for 30 seconds, allowing the window to be opened and closed.

(3) If any door or the liftgate is opened while the timer is in operation, the L signal from the door switch or luggage compartment light switch* is applied to AND. Therefore, AND outputs the L signal to stop operation of the timer circuit. As a result, the transistor Tr2 is turned off, making it impossible to open and close the window.

NOTE

*: On vehicles with theft-alarm system, the luggage compartment light switch is the liftgate switch.



16X0882

PARTS AND FUNCTIONS RELATED WITH ETACS

Components \ Functions				Light reminder alarm function	Ignition key reminder timer function	Ignition key reminder alarm function	Ignition switch illumination light timer function	Dome light dimming timer function	Defogger timer function	Seat belt warning timer function	Central door lock timer function	Power window timer function
Input side	Ignition switch	ON*	IG1	×		×	×	×	×	×		×
			IG2						×			
	Key reminder switch*				×	×						
	Liftgate switch*											×
	Door switch*	Driver's door		×		×	×					
		All doors			×			×				×
	Door lock actuator*		LH		×						×	
			RH		×							
	Defogger switch*								×			
	Tail light			×								
	Seat belt buckle switch*									×		
	Door lock key cylinder switch (LH)*										×	
	Generator (L-terminal)*								×			
Output side	Tail light relay			×								
	Dome light, foot light							×				
	Door lock power relay		LOCK								×	
			UNLOCK		×						×	
	Power window relay											×
	Seat belt warning light									×		
	Ignition switch illumination light						×					
	Defogger relay								×			

NOTE
(1) * mark indicates a switch or sensor that can be used for input inspection with a scan tool or voltmeter.
(2) x mark indicates a part relevant for each function.

INPUT CHECK FACILITY OF ETACS

The ETACS-ECU has an input check facility which enables you to check all the circuits between the individual switches and the ETACS-ECU on the basis of a change in voltage at the ETACS terminal of the data link connector by use of a scan tool or voltmeter.

NOTE
For the location and pin positions of the data link connector, refer to P.7-4.

The input check facility of the ETACS includes the following functions.

1. Ignition switch
2. Door switch
3. Defogger switch
4. Tail light
5. Key reminder switch
6. Door lock switch
7. Seat belt buckle switch
8. Door lock key cylinder switch (LH)
9. Liftgate switch

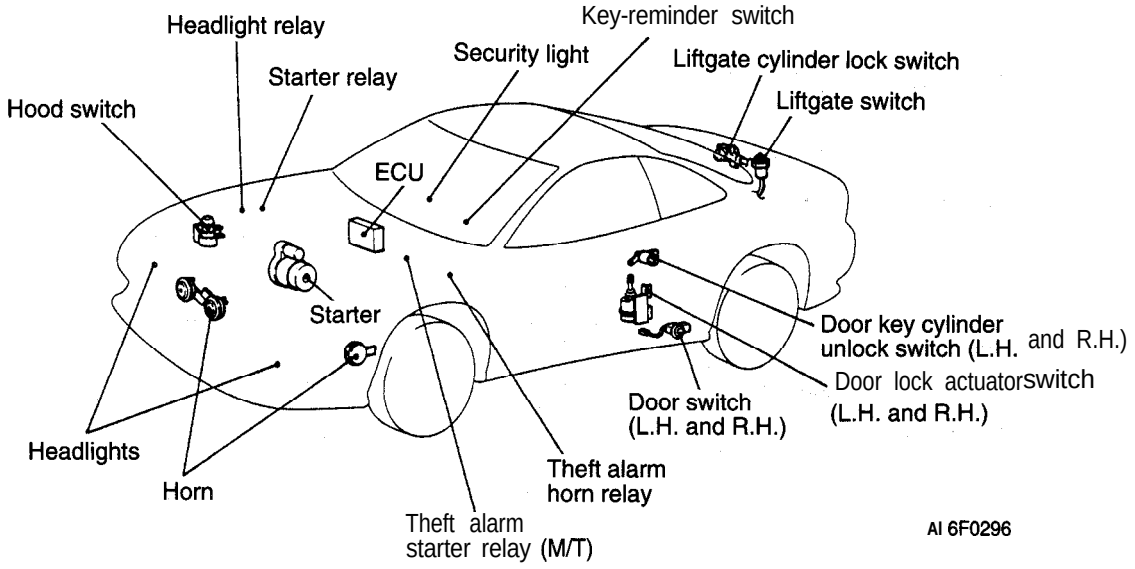
THEFT-ALARM SYSTEM

N77ZK00AA

When the door, liftgate or hood locked by the specified procedure is opened without using the key or remote control switch (keyless entry system), the horn sounds intermittently and the headlights blink to give visual and audible alarm.
Furthermore, the starter circuit is interrupted in such a way that the engine cannot be started, if the ignition key is not used.
Note that this system is controlled by the Electronic Control Unit (ECU) as one function of the ETACS (Electronic Time and Alarm Control System).

The system is composed of the components described below.

NOTE
For arming/disarming the system, activating/deactivating the alarm and checking the system operation, refer to the 1991 Model 3000GT Technical Information Manual (Pub.No.PXSE9001).



HEATER AND AIR CONDITIONING

N77ZL00AA

The heating system is a high-performance and low-noise full-air-mix system that provides a two-layer stratified airflow. It features an independent face-level air flow and cool air by-passing functions.
The air conditioning system is essentially the same as the conventional ones, but they incorporate a new CFC-free refrigerant (R134a) system that uses hydro fluorocarbon (HFC) containing hydrogen atoms as the refrigerant gas to meet the CFC control regulations that call for protection of the ozone layer.

FEATURES

Improvement in comfort

1. Full-air-mix heater providing two-layer stratified air flow.
2. Cool air by-passing function capable of sending fresh air to the face even with the heater unit in operation.
3. Independent face-level air flow function capable of sending air constantly from the side ventilators.
4. Scroll type variable delivery air compressor that offers improved cooling performance and quietness. <Turbo>

Maintenance of visibility (for enhanced safety)

Independent face-level air flow from side ventilators.

Protection of global environment

Adoption of new refrigerant (R134a) system.

Improvement in reliability and seviceability

1. Adoption of flange fitting design and O-ring slip-off preventing construction for piping joints to improve serviceability and reliability.
2. Compressor lock controller for protecting the drive belt when compressor is locked. <Non-turbo>

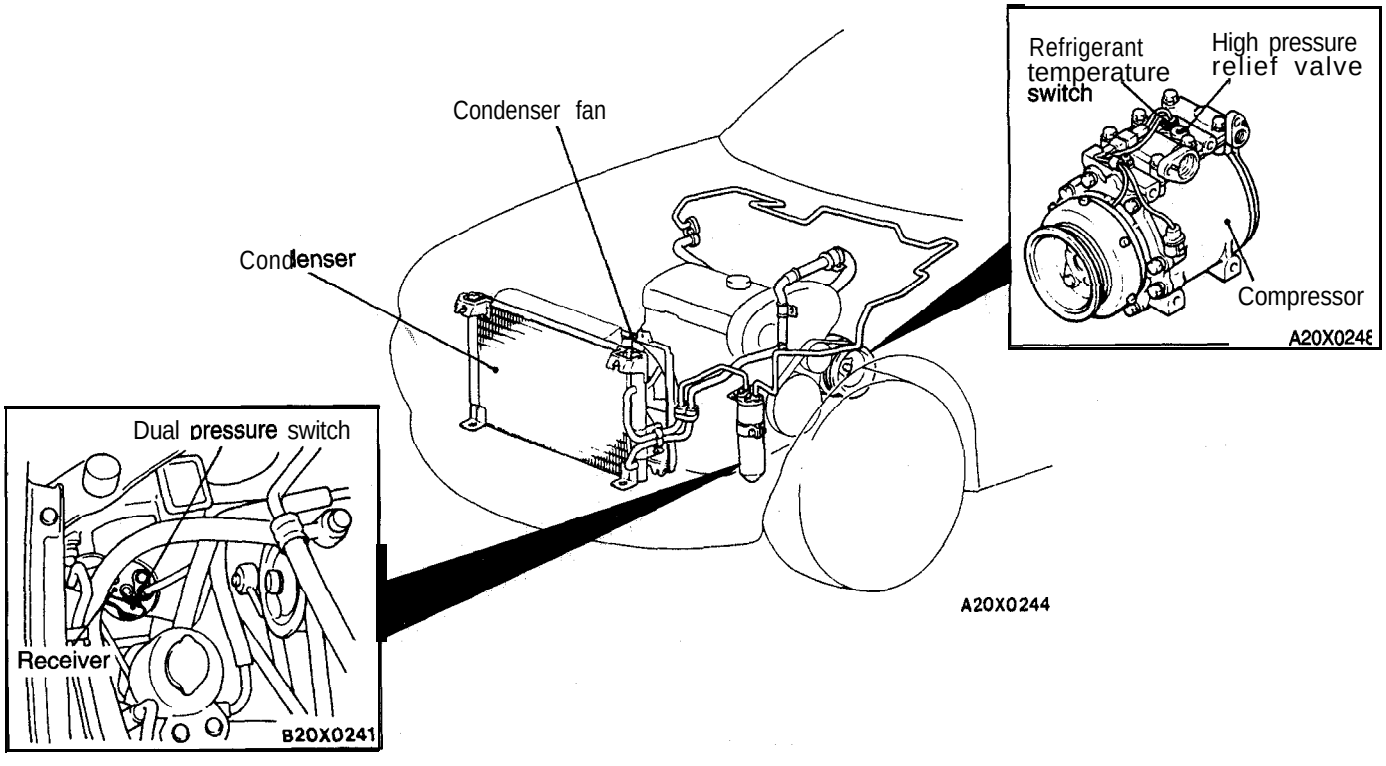
SPECIFICATIONS

Item		Specifications
Heater unit		
Type		Two-way-flow full-air mix system
Heater control switch		Dial and lever type
Compressor		
Model		
<Turbo>		Scroll type <MSC 105 CVS>
<Non-turbo>		Inclined-plate type <10PA17C>
Dual pressure switch	kPa (psi)	
High pressure switch		OFF: 3,140 (456) ON: 2,550 (370)
Low pressure switch		OFF: 200 (29) ON: 220 (32)
Refrigerant and quantity	g (oz.)	R134a (HFC-134a), Approx. 700-740 (24.69-26.10)

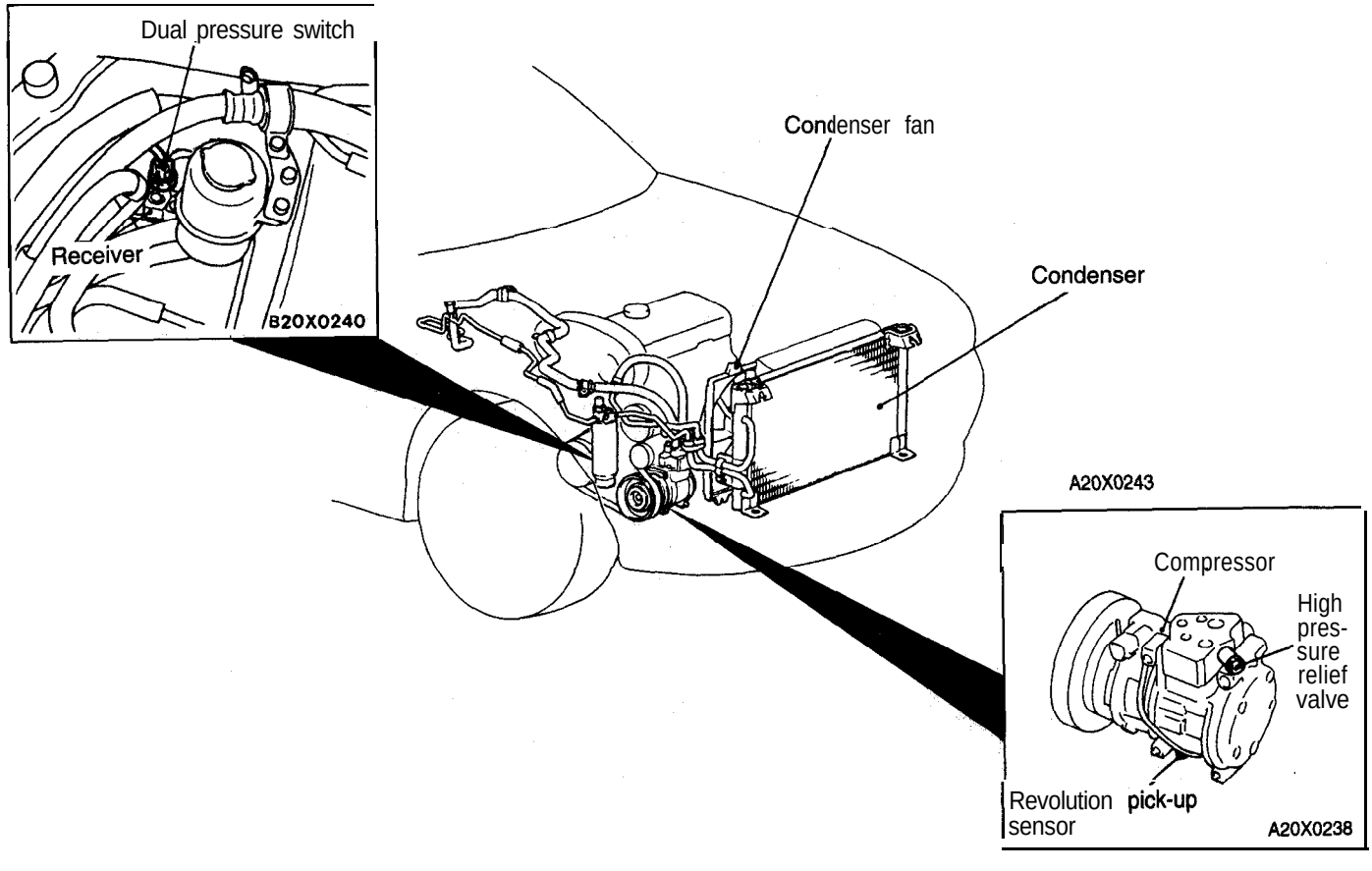
CONSTRUCTION DIAGRAM

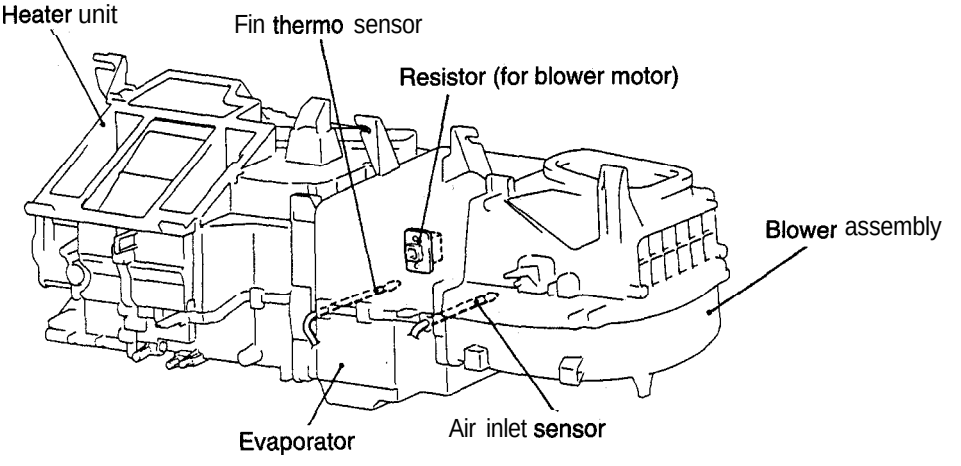
<AIR CONDITIONING>

<Turbo>



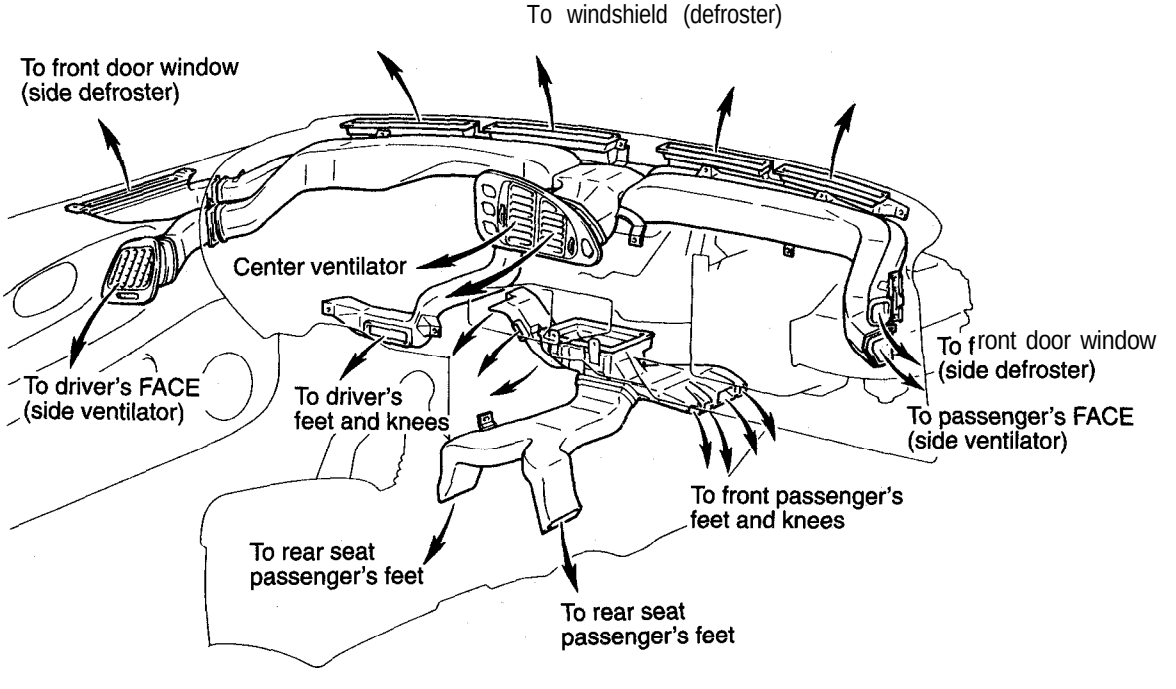
<Non-turbo>





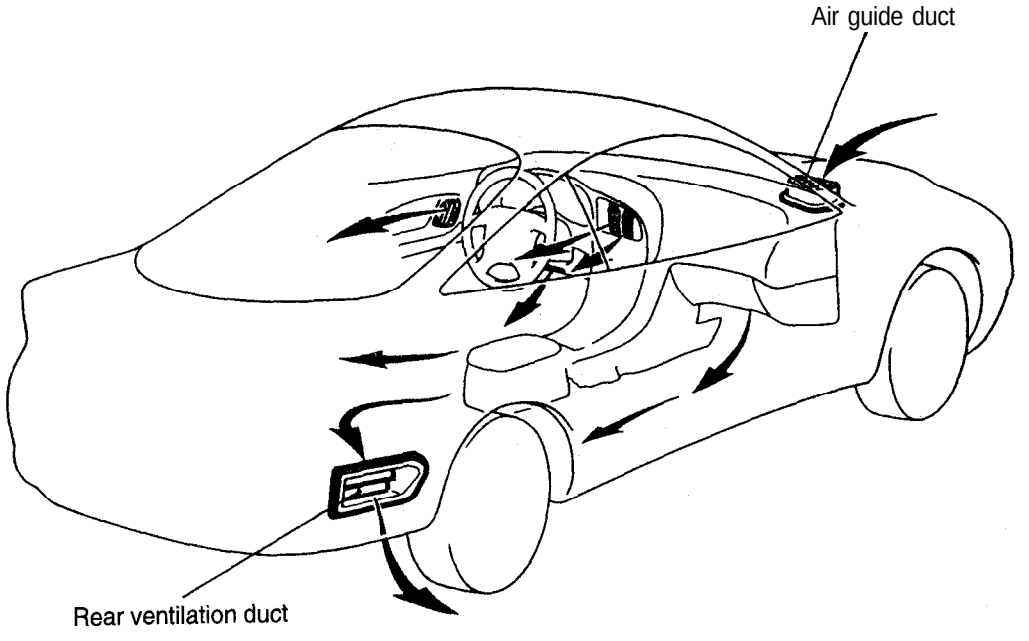
A20X0242

<HEATER>



20X0245

<VENTILATION>

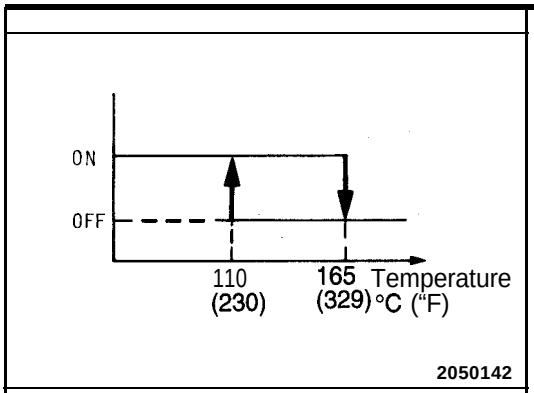


A20X0247

A/C FUNCTIONAL COMPONENTS LIST

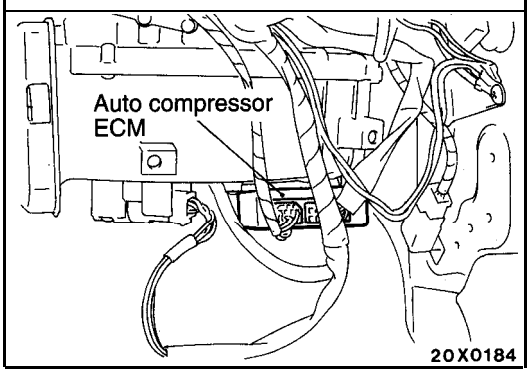
The following table relates the A/C system's functions to its components.

Components \ Functions		Air flow control	Temperature control	Inside/outside-air select	Outlet select	Compressor control	Idle-up control	Condenser fan control
Heater/A/C control	Blower switch, resistor	○	○					
	Temperature control dial		○					
	Outlet selector dial				○			
	Inside/outside-air selector lever			○				
Blower motor, heater unit		○	○	○	○			
Blower relay		○						
Ducts					○			
Refrigerant circuit	Compressor		○					
	Condenser		○					
	Receiver		○					
	Expansion valve		○					
	Evaporator		○					
Dual pressure switch (low-high-pressure switch)			○			○		○
Air inlet sensor			○			○		
Fin thermo sensor			○			○		
A/C switch			○			○	○	○
Auto compressor-ECM			○			○	○	○
A/C compressor clutch relay						○		
Condenser fan motor relay								○
Engine control module						○	○	
Condenser fan								○
Refrigerant temperature switch <Turbo>						○		
Idle air control (IAC) motor							○	



REFRIGERANT TEMPERATURE SWITCH <TURBO>

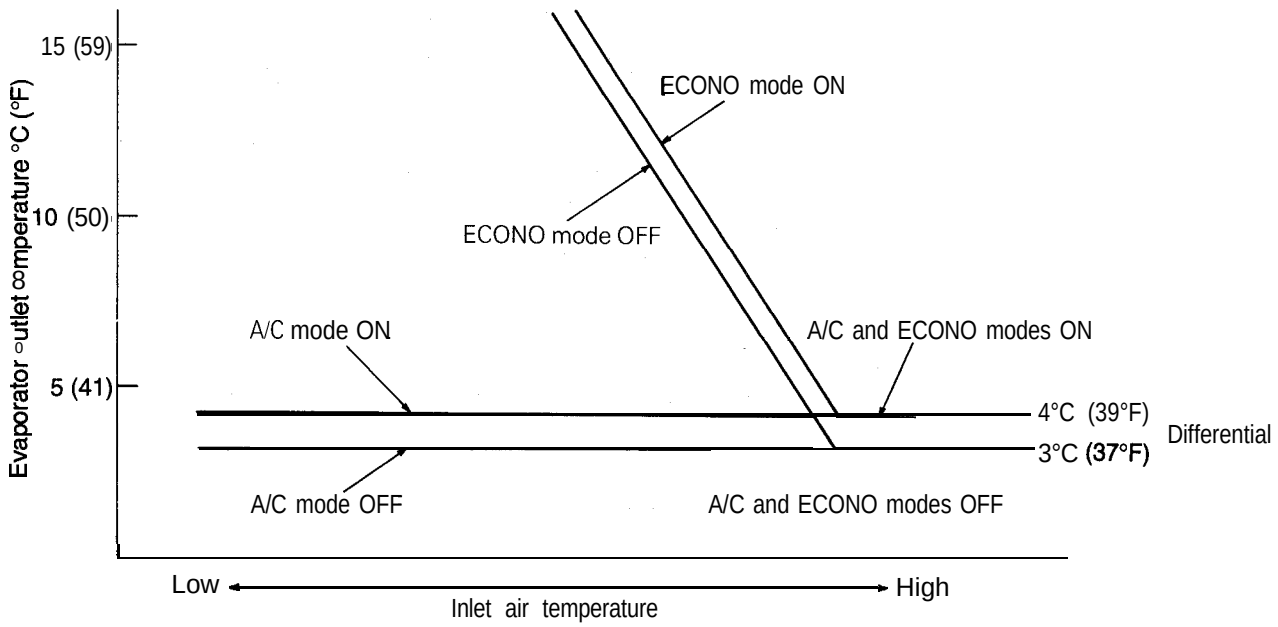
The refrigerant temperature switch detects the temperature of the refrigerant at the delivery port of the A/C compressor to provide the ON/OFF control of the A/C compressor.
For the location of the refrigerant temperature switch, refer to the Construction Diagram on P.7-32.



AUTO COMPRESSOR-ECM

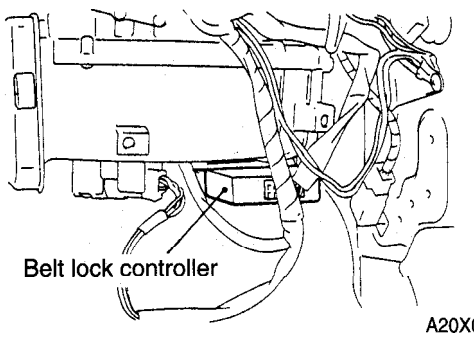
The auto compressor-ECM uses the signals sent from the A/C switch, fin thermo sensor and air inlet sensor to provide the ON/OFF control of the magnetic clutch.

AUTO COMPRESSOR-ECM CONTROL CHARACTERISTICS DIAGRAM

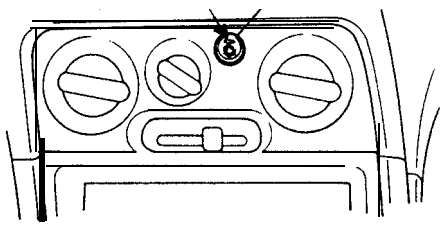


COMPRESSOR

- The A/C system on the non-turbo models incorporates a belt locking control function which prevents the belts from being broken due to a slip that would occur when the compressor is locked. This function is achieved by the belt lock controller located below the blower motor. The controller compares the compressor speed obtained from the compressor revolution pick-up sensor with the engine speed and stops the A/C if the result of the calculation exceeds the predetermined value.
  When the compressor is locked, the compressor operation indicator light in the A/C switch blinks to warn the driver of the abnormal condition.
- A high pressure relief valve is provided to limit the release of the refrigerant into air to a minimum when the high-pressure side pressure becomes too high.

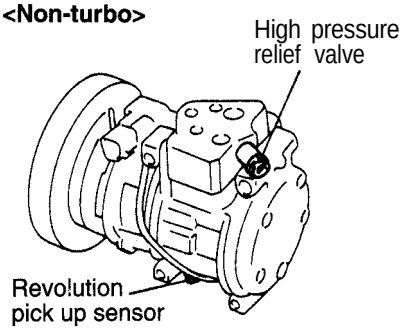


A20X0246



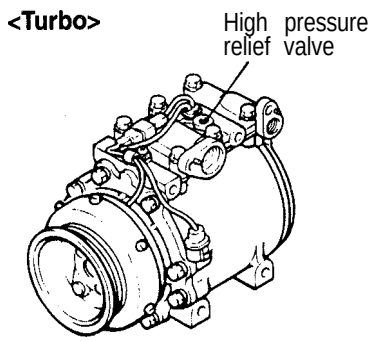
A20X0239

<Non-turbo>

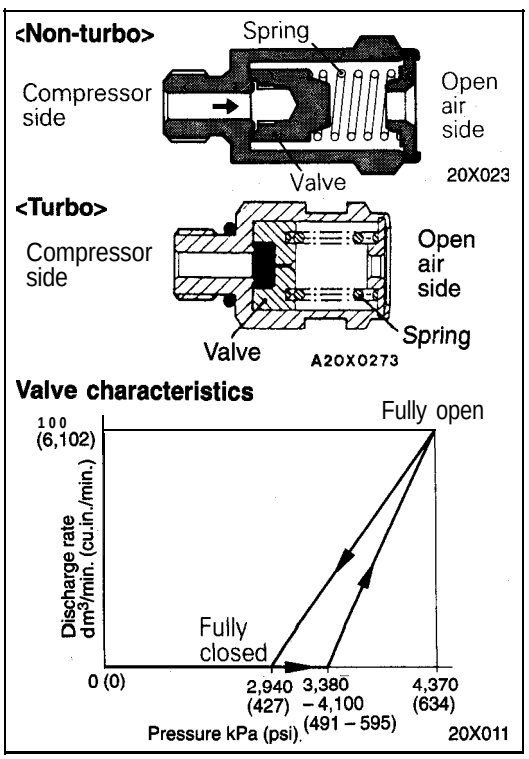


B20X0238

<Turbo>



B20X0248



HIGH PRESSURE RELIEF VALVE

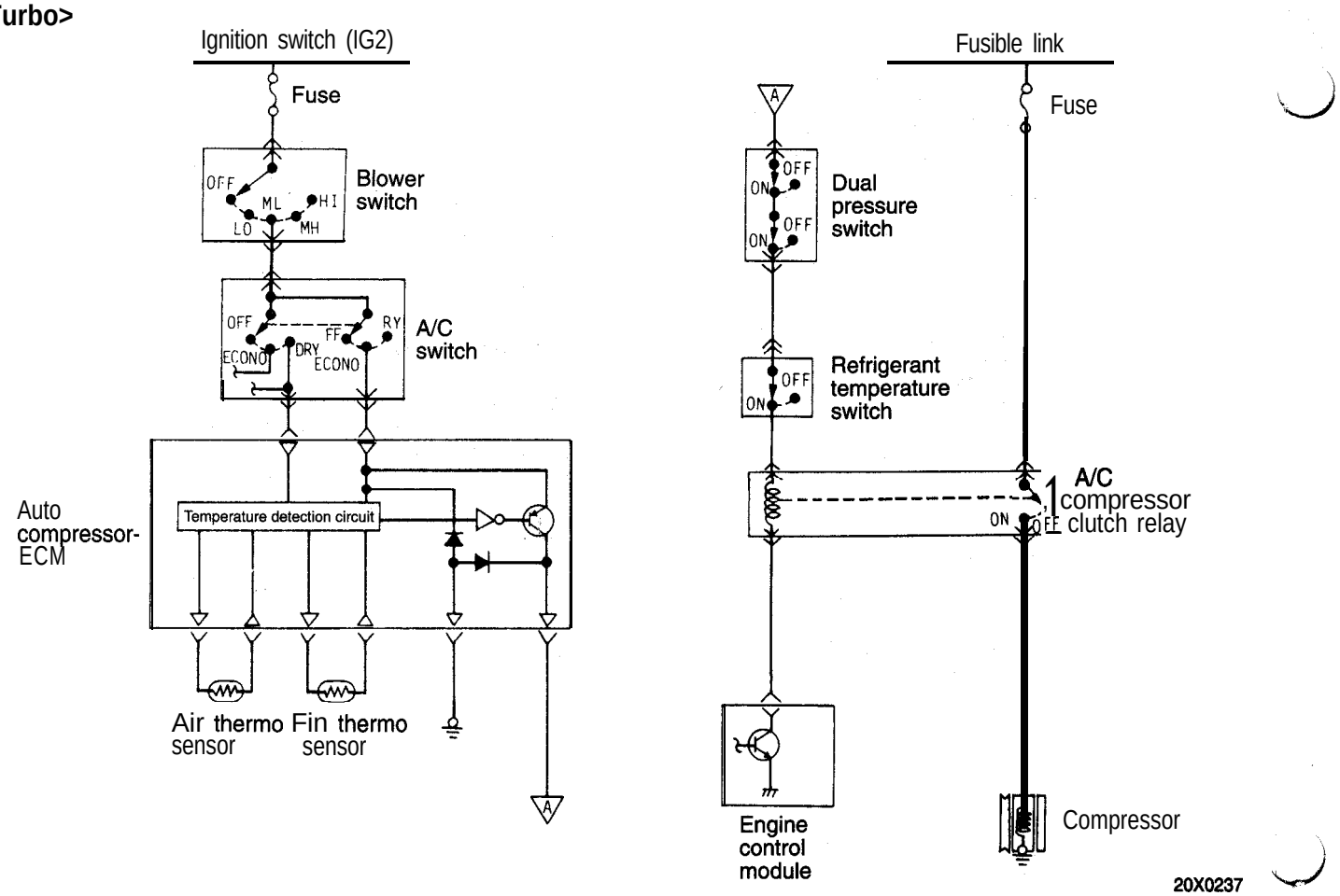
The valve, which is normally closed by the spring force, is forced open to release the refrigerant into open air when the high-pressure side pressure becomes so high that it overcomes the spring force. When the pressure is lowered back to the normal level, the valve is closed by the spring force not to let out any more refrigerant.

A/C COMPRESSOR CONTROL

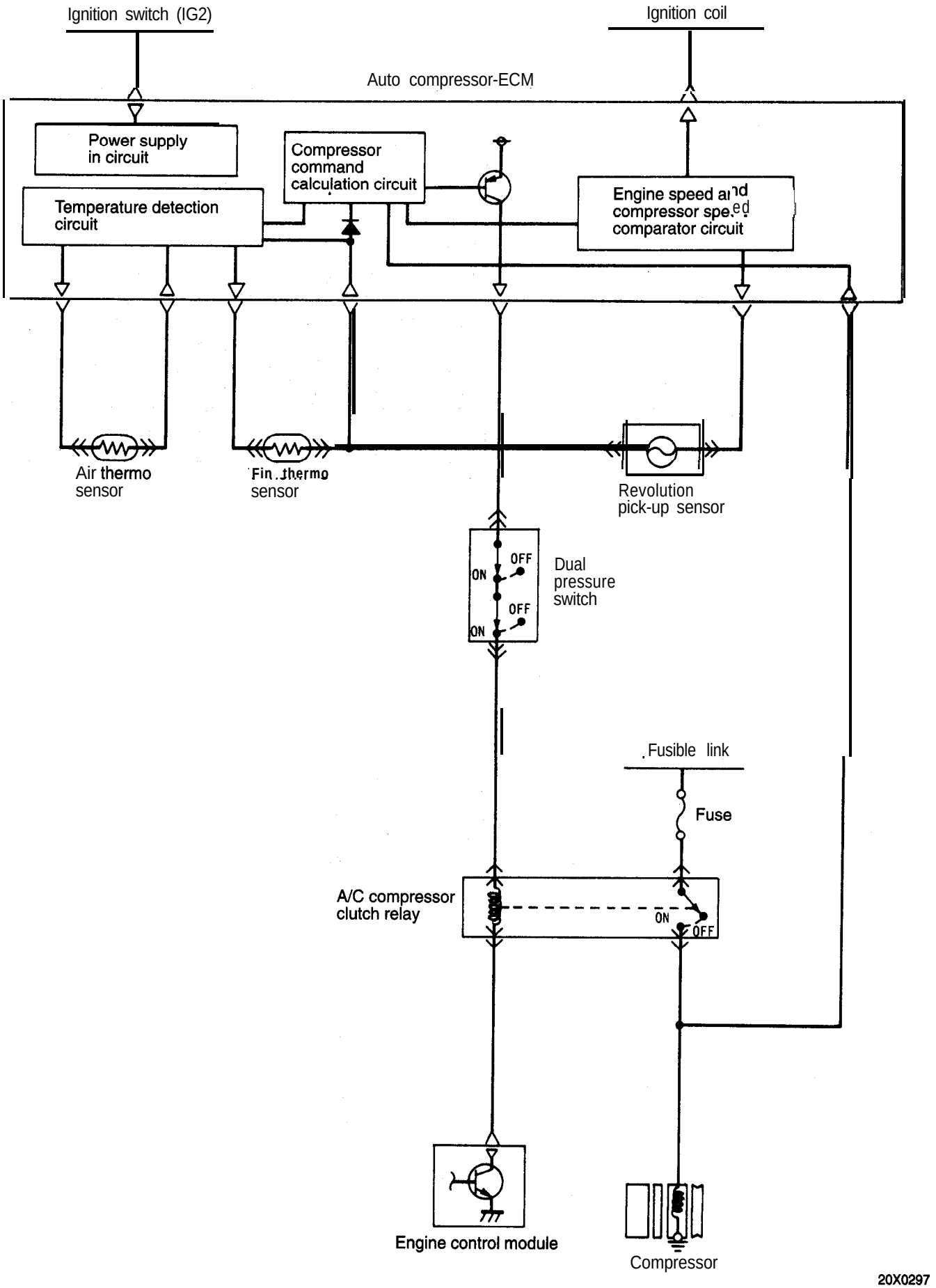
If any of the switches and sensors is caused to be OFF, the compressor clutch relay and compressor magnet clutch are forced to the OFF state.

Switch and sensor conditions	Blower switch		Manually set to ON and OFF
	A/C switch		Manually set to ON and OFF
	Dual pressure switch	Low pressure switch	OFF at 200 kPa (29 psi) or lower; ON at 220 kPa (32 psi) or higher
		High pressure switch	OFF at 3,140 kPa (456 psi) or lower; ON at 2,550 kPa (370 psi) or higher
	Refrigerant temperature switch <Turbo>		ON at approx. 110°C (230°F) or lower; OFF at approx. 165°C (329°F) or higher
	Air inlet sensor		Measure the evaporator inlet air and surface temperatures and input the measured data to the auto compressor-ECM. (Refer to the auto compressor-ECM control characteristic diagram on P.7-36.)
	Fin thermo sensor		
	Revolution pick-up sensor <Non-turbo>		OFF when compressor slipping rate(s) is 70% or more

<Turbo>

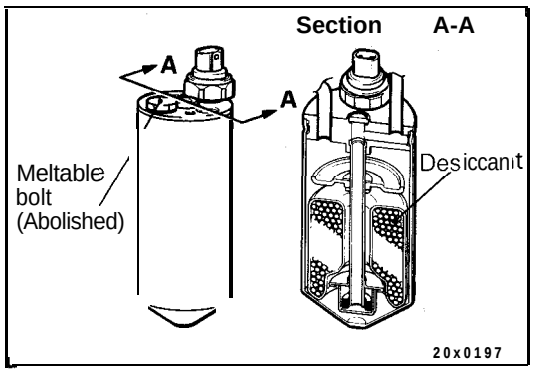


<Non-turbo>


Ignition switch (IG2)
Ignition coil
Auto compressor-ECM
Power supply in circuit
Compressor command calculation circuit
Temperature detection circuit
Engine speed and compressor speed comparator circuit
Air thermo sensor
Fin thermo sensor
Revolution pick-up sensor
ON
OFF
OFF
ON
Dual pressure switch
Fusible link
Fuse
A/C compressor clutch relay
ON
OFF
Engine control module
Compressor
20X0297

CONDENSER FAN AND RADIATOR FAN CONTROL

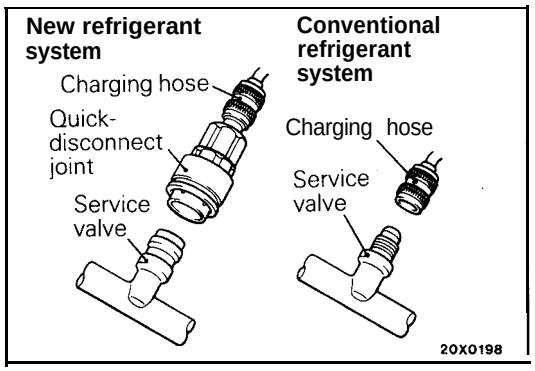
For information on condenser fan and radiator fan control, refer to Group 1 Control System of Engine.



RECEIVER

- The new refrigerant (R134a) is highly hygroscopic and would require much more amount of conventional desiccant (silica gel) to be kept dry.
  The new desiccant (molecular sieve) used for drying the refrigerant has enough capacity to absorb moisture without need for change to the receiver capacity.
- In the conventional design, the meltable bolt on the receiver fuses to let out the refrigerant gas in its entirety into open air when the high-pressure side pressure becomes too high.
  The new system has a relief valve in the compressor which plays the same role as the meltable bolt but closes after release of only necessary quantity of refrigerant, so that the amount of released refrigerant is limited to the minimum.

  NOTE
  For details about the relief valve, see COMPRESSOR, P.7-37.



SERVICE VALVE

A quick-disconnect type joint, instead of conventional screw-in type joint, is used for the service valve to prevent incorrect charging and enhance serviceability.