ISUZU

GMC
MEDIUM DUTY TRUCKS

MEDIUM DUTY TRUCKS

ISUZU COMMERCIAL TRUCK
FORWARD
TILTMASTER

FRR (WT5500)

SERVICE MANUAL SUPPLEMENT
(2002)

FOREWORD

This service supplemental manual contains diagnosis, on-vehicle service, wiring diagrams, and component unit repair for Medium Duty Steel Tilt Cab Vehicles FRR/WT5500.

When used with the Isuzu Commercial Truck Service Manual:
Pub. No. FRR97-WSM-C01, FRR00-WSM-CS1, and FSE01-ESM-C01, complete service coverage is provided.

Keep this manual in a handy place for ready reference. If properly used, it will enable the technician to serve the owners of these vehicles.

CAUTION:

This service manual is intended for use by professional, qualified technicians. Attempting repairs or service without the appropriate training, tools, and equipment could cause injury to you or others and damage to your vehicle that may cause it not to operate properly.

These vehicles contain parts dimensioned in the metric system as well as in the customary system. Some fasteners are metric and are very close in dimension to familiar customary fasteners in the inch system. It is important to note that, during any vehicle maintenance procedures, replacement fasteners must have the same measurements and strength as those removed, whether metric or customary. (Numbers on the heads of metric bolts and on surfaces of metric nuts indicate their strength. Customary bolts use radial lines for this purpose, while most customary nuts do not have strength markings.) Mismatched or incorrect fasteners can result in vehicle damage or malfunction, or possibly personal injury. Therefore, fasteners removed from the vehicle should be saved for re-use in the same location whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original. For information and assistance, see your authorized dealer.

CAUTION

To reduce the chance of personal injury and/or property damage, the following instructions must be carefully observed.

Proper service and repair are important to the safety of the service technician and the safe, reliable operation of all motor vehicles. If part replacement is necessary, the part must be replaced with one of the same part number or with an equivalent part. Do not use a replacement part of lesser quality.

The service procedures recommended and described in this service manual are effective methods of performing service and repair. Some of these procedures require the use of tools specially designed for the purpose.

Accordingly, anyone who intends to use a replacement part, service procedure or tool, which is not recommended by the vehicle manufacturer, must first determine that neither his safety nor the safe operation of the vehicle will be jeopardized by the replacement part, service procedure or tool selected.

It is important to note that this manual contains various **Cautions** and **Notices** that must be carefully observed in order to reduce the risk of personal injury during service or repair, or the possibility that improper service or repair may damage the vehicle or render it unsafe. It is also important to understand that these 'Cautions' and 'Notices' are not exhaustive, because it is impossible to warn of all the possible hazardous consequences that might result from failure to follow these instructions.

2002

SERVICE MANUAL

(SUPPLEMENT)

FRR/WT5500 MODEL

PUBLICATION No. FRR02-WSM-CS1
Isuzu Motors Limited:

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TABLE OF CONTENTS

The Table of Contents on this page indicates the sections covered in this manual. At the beginning of each individual section is a Table of Contents which gives the page number on which each major subject begins.

MEDIUM DUTY STEEL TILT MODEL DATA

Truck Model	Engine	Clutch	Transmission	Propeller Shaft	Rear Axle	Front Axle	Brake
FRR/ WT5500	6HK1-TCN	Spicer 14"-1	MLD6, S1000	SPL90	R065	F036	A.H.B. +ABS

*A.H.B.: Air Over Hydraulic Brake
*ABS: Anti-Lock Brake System

MEMO

SECTION 0

GENERAL INFORMATION

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SECTION 0A

GENERAL INFORMATION

CONTENTS

HANDLING ELECTROSTATIC DISCHARGE (ESD) SENSITIVE PARTS

When handling an electronic part that has an ESD sensitive sticker (figure 1), the service technician should follow the guidelines described below to reduce any possible electrostatic charge built up on the service technician's body and the electronic part in the dealership:

1. Do not open the package until installing the part.
2. Avoid touching electrical terminals of the part.
3. Before removing the part from its package, ground the package to a known good ground on the vehicle.
4. Always touch a known good ground before handling the part. This should be repeated while handling the part and more frequently after sliding across the seat, sitting down from a standing position or walking a distance.

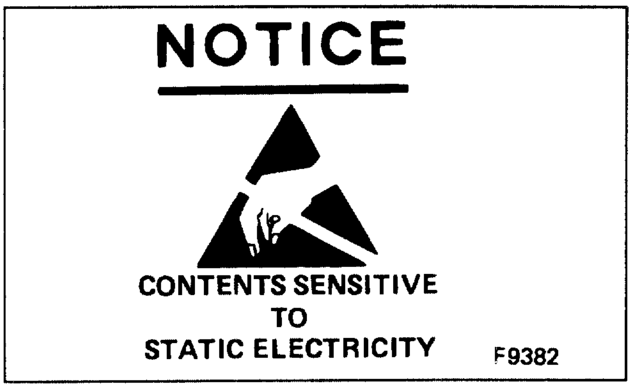


Figure 1 - Electrostatic Discharge Warning

SERVICE PARTS IDENTIFICATION LABEL

The Service Parts Identification Label (figure 2) is provided on all vehicle models. It is located on the lower right side of the dashboard. The label lists the VIN (Vehicle Identification Number), wheelbase, paint information and all production options or special equipment on the vehicle when it was shipped from the factory. Always refer to this information when ordering parts.

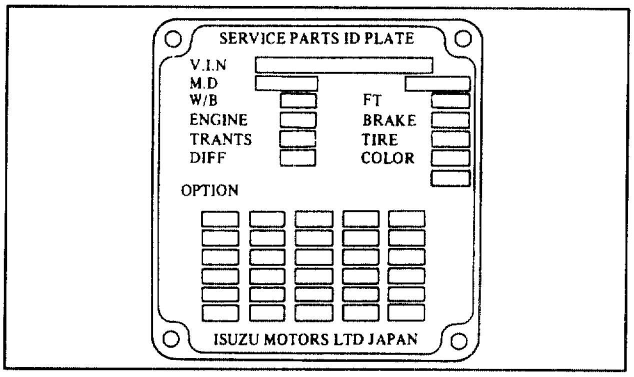


Figure 2 – Service Parts Identification Label

RPO (REGULAR PRODUCTION OPTIONS) LIST

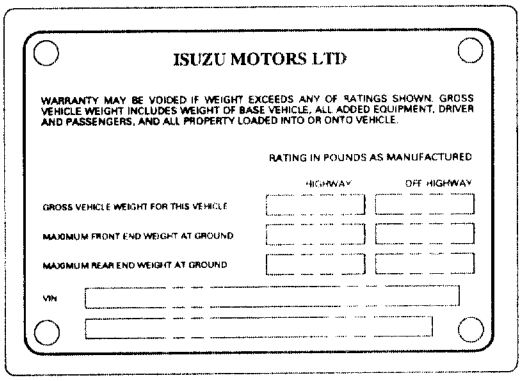
The following list contains RPOs available on this model. Also, refer to the "Service Parts Identification" label in your vehicle for the RPOs on that specific vehicle.

OPTION CODE	OPTION DESCRIPTION
729	BODY COLOR CODE-ARC WHITE W301–P801
B4G	ANTI CORROSION
SP5	CANADA EQUIPMENT
WK8	U.S.A EQUIPMENT
PS1	GMC BRAND PACKAGE
ST4	PRESSURE METER – KPA
WQ1	PRESSURE METER – PSI
6FM	US TERRITORY
W60	CAB UP (+60MM)
VG7	BUMPER – REINFORCEMENT
SDK	CAB SUSPENSION – SEMI FLOATING
YM4	GLASS – LAMINATE, WINDSHIELD TINTED
YS1	MIRROR – OUTSIDE REARVIEW, FLAT
A30	POWER WINDOW
SKF	DOOR WINDOW CONTROL – MANUAL
B30	FLOOR COVERING – CARPET (VINYL)
A83	SEAT ASSEMBLY – VINYL W/RECLINING
AK3	BELTS – FRONT SEAT & SHOULDER, W/RETRACTOR
PR2	DRIVING POSITION – WIDE LEG SPACE
D20	SUN VISOR – ASSIST
C41	HEATER & DEFROSTER
37W	WHEEL BASE 3700 MM
42W	WHEEL BASE 4200 MM
45W	WHEEL BASE 4500 MM
48W	WHEEL BASE 4800 MM
55W	WHEEL BASE 5500 MM
F59	STABILIZER SHAFT – FRONT
C5K	HUB LUBRICATION – OIL BATH
PQ6	FRONT AXLE – TOE-IN "0"
W1N	AXLE RATIO – 4.333 (39/9) 13.5" HYPOID
W1P	AXLE RATIO – 3.900 (39/10) 13.5" HYPOID
W4M	AXLE RATIO – 3.545 (39/11) 13.5" HYPOID
Z05	AIR OVER HYDRAULIC DUAL CIRCUIT
BCU	BRAKE AUTO ADJUSTER
SKR	BRAKE LINING MATERIAL – NON ASBESTOS
NF8	EXHAUST BRAKE
B1T	PARKING BRAKE DRUM – 10"
82L	ENGINE – 6 CYLINDER 6HK1TC-N
TCA	EMISSION REGULATION – W/CONVERTER
E6U	AIR CLEANER – DRY DONALDSON 13"
E1Q	AIR COMPRESSOR – HEAVY DUTY
KC2	FILTER – OIL, PARTIAL (CARTRIDGE TYPE)
E2J	OIL FILLER – CAB BACK
WY9	ENGINE OIL LEVEL GAUGE – WIDE NECK
KA3	FAN – FLUID DRIVE
8AA	LONG LIFE COOLANT – 50%
WD3	ENGINE OIL HEATER
K05	HEATER – ENGINE BLOCK
K97	AC GENERATOR – DENSO 12V 80A (1KW)
RC6	STARTER – DENSO
KB6	ENGINE SHUTOFF – AUTOMATIC (ELECTRIC)
SFF	CLUTCH – 14" SIGNAL PLATE (SPICER)
WY5	CLUTCH – CERAMETALIX FACED DISC
B1Y	CLUTCH SYSTEM – SLAVE CYLINDER
MT9	ALLISON AT542 A/T
X5J	MANUAL TRANSMISSION – ISUZU MLD6Q
X9A	MANUAL TRANSMISION – ISUZU
X9D	TRANSMISSION – AUTOMATIC
SHT	FUEL TANK 160L RECTANGULAR
WC2	SUB FUEL TANK
PS9	FUEL SEDIMENTER
N37	STEERING COLUMN – TILT TELESCOPING
N40	STEERING – POWER
22N	TIRE – FRT, RR 225/70R19.5
SMA	DISC WHEEL – FRT, RR 6STUD 19.5X6.00
W20	DISC WHEEL -SPECIAL PAINTED (WHITE)
R46	SPARE TIRE&DISC WHEEL – REAR TIRE (ONE)
P10	CARRIER – SPARE WHEEL (FRAME REAR)
TN8	BATTERY – DELCO 31-751
TR4	HEADLAMPS – RECTANGULAR
U01	LAMPS – FIVE, ROOF MARKER
UY9	SPEEDOMETER – KILO&MILES, MILES ODOMETER
U19	SPEEDOMETER – KILO&MILES, KILO ODOMETER
UD7	TACHOMETER
UG2	GAGE – DUAL AIR
C13	WIPER – WITH INTERMITTENT
UJ2	INDICATOR LAMP – LOW BRAKE FLUID
WX7	BRIGHT CONTROL – METER
SL1	TOOL B KIT
RR8	CAUTIONS – ENGLISH

VEHICLE IDENTIFICATION NUMBER (VIN)

A vehicle may be specifically identified by referring to the VIN (Vehicle Identification Number) Plate (figure 3). This plate is located on the driver's door frame under the striker.

The VIN is the legal identifier of your vehicle. In order to find out the manufacturer, chassis type, engine type, GVW range, model year, plant code and sequential number for the vehicle, refer to figure 4.



ISUZU MOTORS LTD

WARRANTY MAY BE VOIDED IF WEIGHT EXCEEDS ANY OF RATINGS SHOWN. GROSS VEHICLE WEIGHT INCLUDES WEIGHT OF BASE VEHICLE, ALL ADDED EQUIPMENT, DRIVER AND PASSENGERS, AND ALL PROPERTY LOADED INTO OR ONTO VEHICLE.

RATING IN POUNDS AS MANUFACTURED

	HIGHWAY	OFF HIGHWAY
GROSS VEHICLE WEIGHT FOR THIS VEHICLE		
MAXIMUM FRONT END WEIGHT AT GROUND		
MAXIMUM REAR END WEIGHT AT GROUND		

VIN

Figure 3 - VIN Plate

WEIGHT RATINGS

Your VIN Plate also shows the GVWR and the front and rear GAWR's for your vehicle. Refer to "Certification Label" for more information on vehicle weights.

CERTIFICATION LABEL

The Certification Label shows the GVWR and the front and rear GAWR's for your vehicle (figure 5).

Gross Vehicle Weight (GVW) is the weight of originally equipped vehicle and all items added to it after it has left the factory. This would include bodies, winches, etc.; the driver and all occupants; and the load the vehicle is carrying. The GVW must not exceed the GVWR. Also, the front and rear gross axle weights must not exceed the front and rear GAWRs.

TIRES

The tires on your vehicle must be of the proper size and properly inflated for the load which the vehicle are carrying.

The Vehicle Certification Label shows the originally equipped tire size and recommended inflation pressures.

MODEL REFERENCE

The model designation for this vehicle is FRR/WT5500 (figure 6). It will be referred to as a Steel Tilt model.

STEEL TILT CAB

MODEL FRR/WT5500 4X2

Figure 6 - Model Reference

ENGINE IDENTIFICATION NUMBER

The engine identification number is on the front right-hand side of the cylinder block.

EMERGENCY STARTING YOUR VEHICLE DUE TO A DISCHARGED BATTERY

If your vehicle will not start due to a discharged battery, it can often be started by using energy from another battery, a procedure called "jump starting."

This vehicle has a 12-volt starting system and a negative ground electrical system. Make sure that the other vehicle also has a 12-volt starting system, and that it is the negative ("–") terminal which is grounded (attached to the engine block or frame rail). Its operator's manual may give you that information. Do not try to jump start if you are unsure of the other vehicle's voltage or ground (or if the other vehicle's voltage and ground are different from your vehicle).

Some diesel engine vehicles have more than one battery because of the higher torque required to start a diesel engine. This procedure can be used to start a single-battery vehicle from any of the diesel vehicle's batteries. However, it may not be possible to start a diesel engine from a single battery in another vehicle at low temperatures.

NOTICE: Never tow the vehicle to start, because the surge forward when the engine starts could cause a collision with the tow vehicle. Also, since this vehicle has a 12-volt battery, be sure the vehicle or equipment used to jump start your vehicle is also 12-volt.

Use of any other type system may damage the vehicle's electrical components.

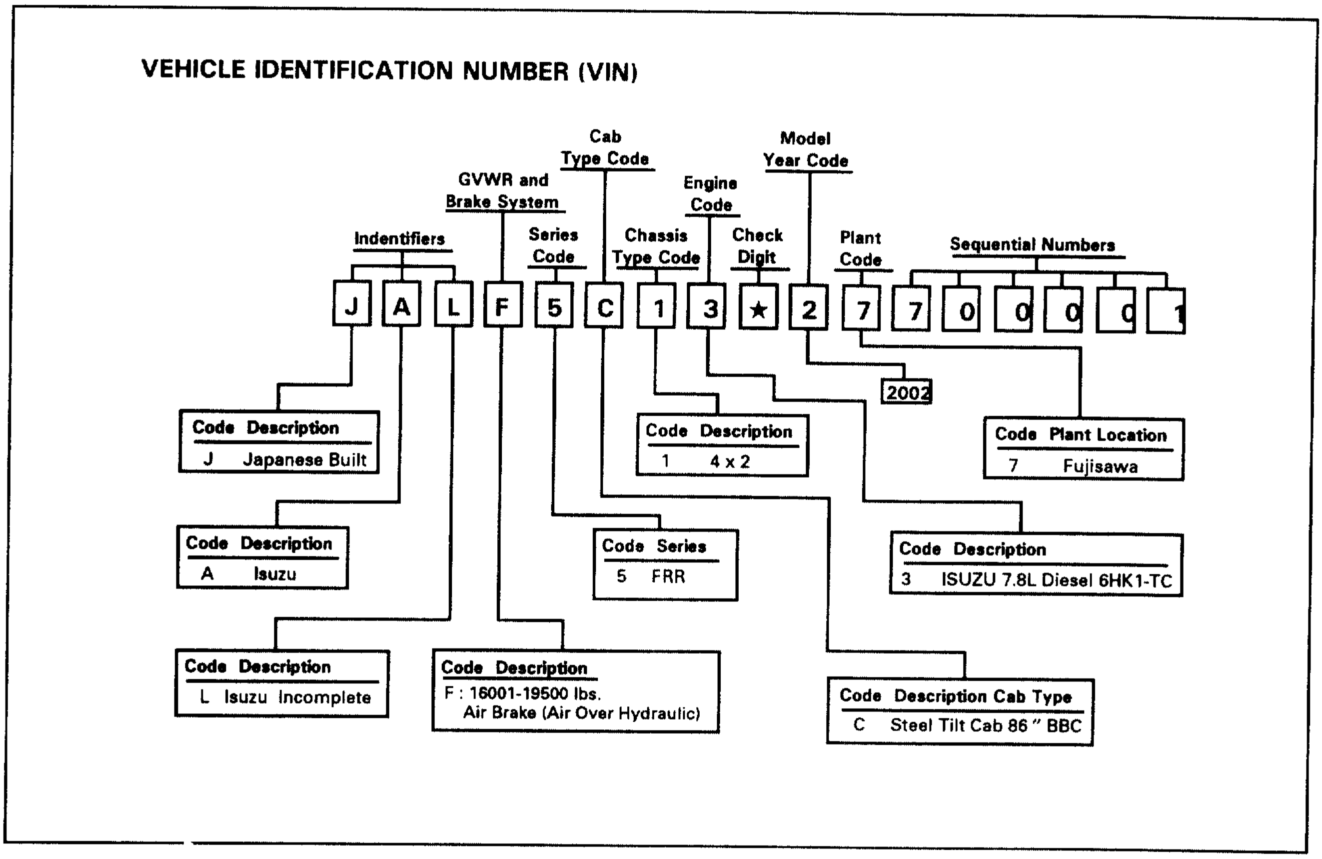
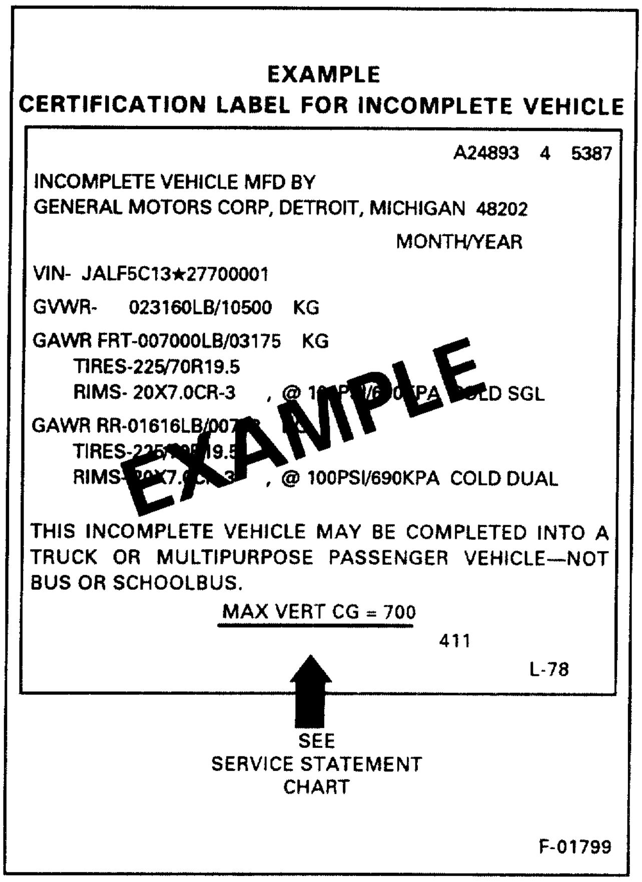


Figure 4 – Vehicle Identification (VIN) Number



EXAMPLE
CERTIFICATION LABEL FOR INCOMPLETE VEHICLE

A24893 4 5387

INCOMPLETE VEHICLE MFD BY
GENERAL MOTORS CORP, DETROIT, MICHIGAN 48202

MONTH/YEAR

VIN- JALF5C13★27700001

GVWR- 023160LB/10500 KG

GAWR FRT-007000LB/03175 KG
TIRES-225/70R19.5
RIMS- 20X7.0CR-3 , @ 100PSI/690KPA COLD SGL

GAWR RR-01616LB/007[illegible] KG
TIRES-225/70R19.5
RIMS-20X7.0CR-3 , @ 100PSI/690KPA COLD DUAL

THIS INCOMPLETE VEHICLE MAY BE COMPLETED INTO A TRUCK OR MULTIPURPOSE PASSENGER VEHICLE—NOT BUS OR SCHOOLBUS.

MAX VERT CG = 700

411

L-78

Figure 5 – Certification Label

JUMP STARTING INSTRUCTIONS

CAUTION: Batteries produce explosive gases, contain corrosive acid and supply levels of electrical current high enough to cause burns. Therefore, to reduce the risk of personal injury when working near a battery:

- **Always shield your eyes and avoid leaning over a battery whenever possible.**
- **Do not expose a battery to open flames or sparks.**
- **Be sure any batteries that have filler caps are properly filled with fluid.**
- **Do not allow battery acid to contact eyes or skin. Flush any contacted area with water immediately and thoroughly, and get medical help.**
- **Follow each step in the jump starting instructions.**

1. Position the vehicle with the good (charged) battery so that the booster (jumper) cables will reach, but never let the vehicles touch. Also, be sure booster cables to be used do not have loose or missing insulation.

2. In both vehicles:
   - Turn off ignition (engine control switch), all lights and accessories except the hazard flasher or any light needed for the work area.
   - Apply the parking brake firmly and shift the transmission to Neutral.
3. Making sure the cable clamps do not touch any other metal parts, clamp one end of the first booster cable to the positive (+) terminal on one battery, and the other end to the positive terminal on the other battery (figure 7). Never connect (+) to (–).
4. Clamp one end of the second cable to the negative (–) terminal of the good (charged) battery and the final connection to the frame rail, chassis, or to any solid, stationary metallic object on the engine at least 450 millimeters (18 inch) from the discharged battery. Make sure the cables are not on or near pulleys, fans, or other parts that will move when the engine is started.
5. Start the engine of the vehicle with the good (charged) battery and run the engine at a moderate speed for several minutes. Then, start the engine of the vehicle that has discharged battery.
6. Remove the jumper cables by reversing the above installation sequence exactly. While removing each clamp, take care that it does not touch any other metal while the other end remains attached.

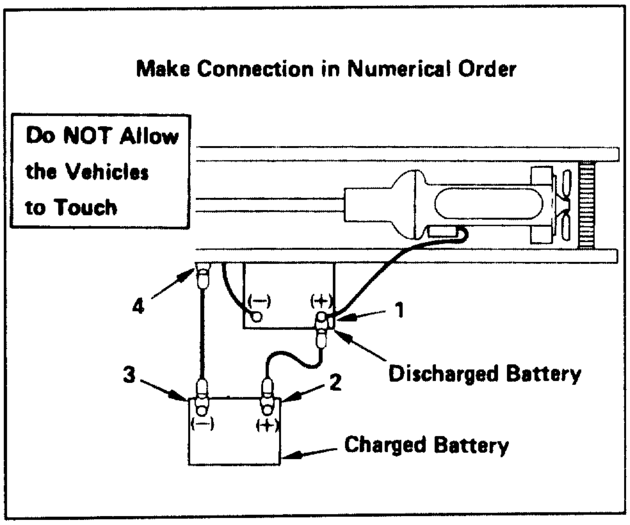


Figure 7 – Jump Starting Connections

TOWING PROCEDURE

Your vehicle should be towed by an authorized dealership or professional towing service to prevent damage. Proper equipment must be used and state (Provincial in Canada) and local laws that apply to vehicles in tow must be followed. Vehicles should not be towed in excess of 55 mph (90 km/h).

Connect to the main structural parts of the vehicle. Do not attach to bumpers, tow hooks or brackets. Use only equipment designed for this purpose. Follow the instructions of the wrecker manufacturer. A safety chain system must be used.

FRONT END TOWING (FRONT WHEELS OFF THE GROUND)

Before Towing

To prepare a disabled vehicle for front end towing with front wheels raised off ground, the following steps are necessary.

- Block the rear wheels of the disabled vehicle.
- Remove the air deflector if equipped from beneath the front bumper to prevent damage from towing equipment.
- Release the parking brake.

Manual Transmission Models
- Shift into neutral position.
- If there is damage or suspected damage to the transmission, disconnect the propeller shafts at the rear axle.

  Secure the propeller shafts to the frame or crossmember.

Automatic Transmission Models
- Disconnect the propeller shafts at the rear axle. Secure the propeller shaft to the frame or crossmember.

  NOTICE: Never tow the vehicle with propeller shafts is connected, as this may cause damage to the automatic transmission.

- If there is damage or suspected damage to the rear axle, remove the axle shafts. Cover the hub openings to prevent the loss of lubricant or entry of dirt or foreign objects.

After Towing

- Block the rear wheels and install the axle and propeller shafts if removed.
- Apply the parking brake before disconnecting from the towing vehicle.
- Check and fill rear axle with oil if required.
- Install air deflector, if applicable.

FRONT END TOWING
(ALL WHEELS ON THE GROUND)

Before Towing

Your vehicle may be towed on all wheels provided the steering is operable. Remember that power steering and brakes will not power assist. There must be a tow bar installed between the towing vehicle and the disabled vehicle.

To prepare a disabled vehicle for front end towing with all wheels on the ground, the following steps are necessary.

- Block the rear wheels of the disabled vehicle.
- Release the parking brake.

Manual Transmission Models

- Shift into neutral position.
- If there is damage or suspected damage to the transmission, disconnect the propeller shafts at the rear axle.
  Secure the propeller shafts to the frame or crossmember.

Automatic Transmission Models

- Disconnect the propeller shafts at the rear axle. Secure the propeller shaft to the frame or crossmember.
  NOTICE: Never tow the vehicle with propeller shafts is connected, as this may cause damage to the automatic transmission.

- If there is damage or suspected damage to the rear axle, remove the axle shafts. Cover the hub openings to prevent the loss of lubricant or entry of dirt or foreign objects.

After Towing

- Block the rear wheels and install the axle and propeller shafts if removed.
- Apply the parking brake before disconnecting from the towing vehicle.
- Check and fill rear axle with oil if required.

REAR END TOWING
(REAR WHEELS OFF THE GROUND)

Before Towing

- Release the parking brake.
- Secure the steering wheel to maintain straight ahead position.
- Be certain that the front axle is not loaded above the front axle Gross Axle Weight Rating (GAWR) as indicated on the vehicle's VIN and Weight Rating plate.

After Towing

- Block the rear wheels and release the steering.
- Apply the parking brake before disconnecting from the towing vehicle.
- Check and fill the rear axle with oil as required.

SPECIAL TOWING INSTRUCTIONS

1. Call your local authorized dealership or professional towing service.
2. All state and local laws regarding such items as warning signals, night illumination, speed, etc. must be followed.
3. Safety chains must be used.
4. No vehicle should ever be towed over 55 mph (90 km/h).
5. Loose or protruding parts of damaged vehicles should be secured prior to moving.
6. A safety chain system completely independent of the primary lifting and towing attachment must be used.
7. Operators should refrain from going under a vehicle that is being lifted by the towing equipment unless the vehicle is adequately supported by safety stands.
8. No towing operation that for any reason jeopardizes the safety of the wrecker operator or any bystanders or other motorists should be attempted.

GRAPHIC SYMBOLS

Graphic symbols are used on some controls and displays on the vehicle (figure 8). Many of these symbols are used internationally.

ACTION SYMBOLS

Much of the general narrative in this manual has been replaced with step-by-step procedures and the addition of "Action Symbols." To improve readability and to provide emphasis where necessary, the following symbols are used in many portions of the text:

Assemble

Disassemble

Remove or Disconnect

Install or Connect

Tighten

Inspect

Clean

Measure

Adjust

Important

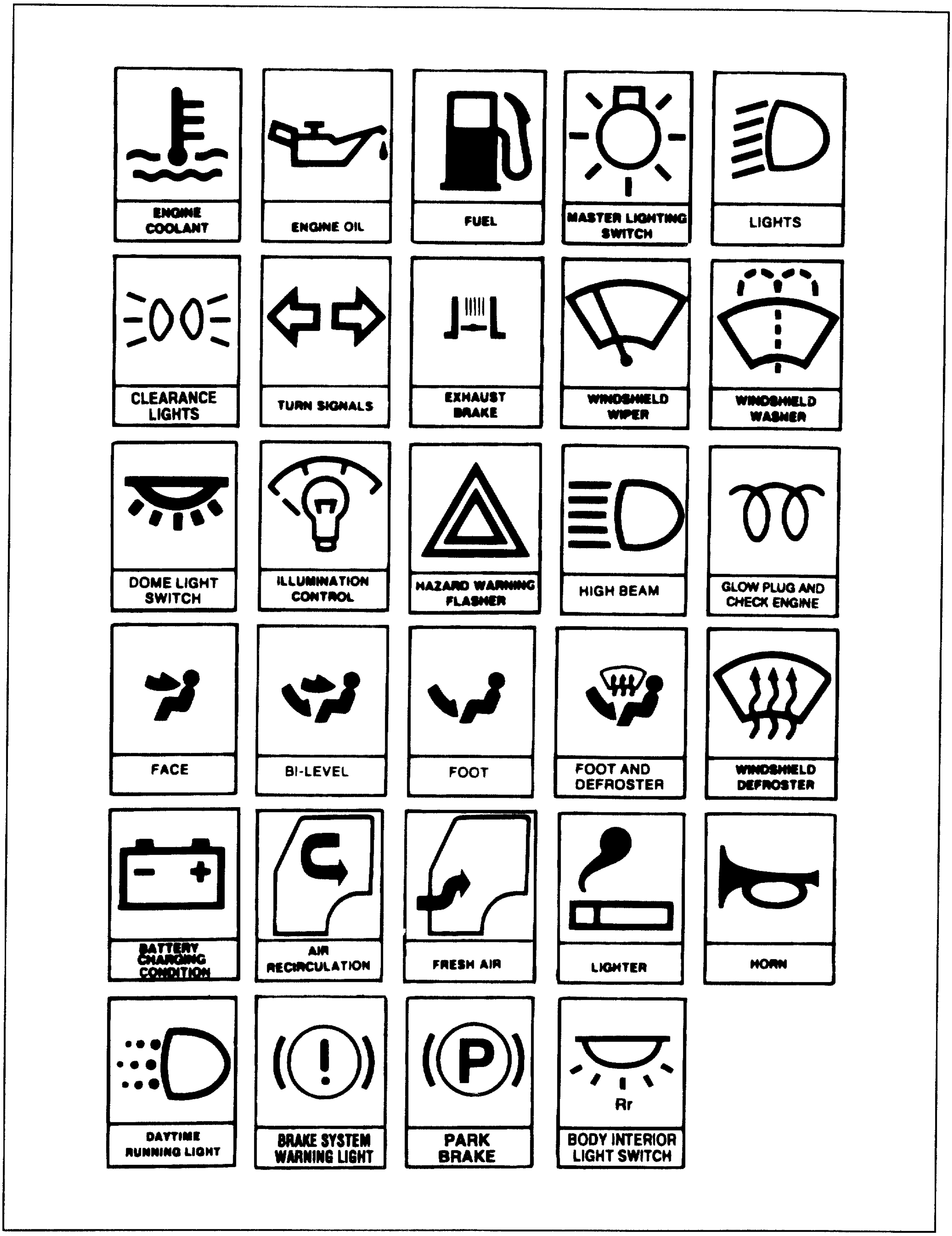


Figure 8 – Graphic Symbols

COMMON AUTOMOTIVE ABBREVIATIONS

LIST OF AUTOMOTIVE ABBREVIATIONS WHICH MAY BE USED IN THIS MANUAL

A – Ampere(s)
ABS – Antilock Brake System
AC – Alternating Current
A/C – Air Conditioning
ACCEL – Accelerator
ACC – Accessary
ACL – Air Cleaner
Adj – Adjust
A/F – Air Fuel Ratio
AIR – Secondary Air Injection System
Alt – Altitude
AMP – Ampere(s)
ANT – Antenna
ASM – Assembly
A/T – Automatic Transmission
ATDC – After Top Dead Center
ATF – Automatic Transmission Fluid
Auth – Authority
Auto – Automatic
BARO – Barometric Pressure
Bat – Battery
B+ – Battery Positive Voltage
Bbl – Barrel
BHP – Brake Horsepower
BPT – Back Pressure Transducer
BTDC – Before Top Dead Center
°C – Degrees Celsuis
CAC – Charge Air Cooler
Calif – California
cc – Cubic Centimeter
CID – Cubic Inch Deplacement
CKP – Crankshaft Position
CKT – Circuit
CL – Closed Loop
CLCC – Closed Loop Carburetor Control
CMP – Camshaft Position
CO – Carbon Monoxide
Coax – Coaxial
Conn – Connector
Conv – Converter
Crank – Crankshaft
Cu.In. – Cubic Inch
CV – Constant Velocity
Cyl – Cylinder(s)
DI – Distributor Ignition
Diff – Differential
Dist – Distributor
DLC – Data Link Connector
DOHC – Double (or Dual) Overhead Camshaft
DTC – Diagnostic Trouble Code
DTM – Diagnostic Test Mode
DTT – Diagnostic Test Terminal
DVM – Digital Voltmeter (10 meg.)
DVOM – Digital Volt Ohmmeter
EBCM – Electronic Brake Control Module
ECM – Engine Control Module
ECT – Engine Coolant Temperature
EEPROM – Electronically Erasable Programmable Read Only Memory
EGR – Exhaust Gas Recirculation
EI – Electronic Ignition
ETR – Electronically Tuned Receiver
EVAP – Evaporation Emission
Exh – Exhaust
°F – Degrees Fahrenheit
Fed – Federal (All States Except Calif.)
FF – Front Drive Front Engine
FL – Fusible Link
  – Front Left
FLW – Fusible Link Wire
FP – Fuel Pump
FR – Front Right
FRT – Front
ft – Foot
FWD – Front Wheel Drive
4WD – Four Wheel Drive
4 × 4 – Four Wheel Drive
4 A/T – Four Speed Automatic Transmission
g – Gram
Gal – Gallon (3.785 ℓ)
GAWR – Gross Axle Weight Rating
GEN – Generator
GND – Ground
Gov – Governor
GVWR – Gross Vehicle Weight Rating
Harn – Harness
HC – Hydrocarbons
HD – Heavy Duty
Hg – Hydrargyrum (Mercury)
HiAlt – High Altitude
HO2S – Heated Oxygen Sensor
HU – Hydraulic Unit
HVAC – Heater-Vent-Air Conditioning
IAC – Idle Air Control
IAT – Intake Air Temperature
IC – Integrated Circuit
  – Ignition Control
ID – Identification
  – Inside Diameter
IGN – Ignition
Int – Intake
IP – Instrument Panel
IPC – Instrument Panel Cluster
ISC – Idle Speed Control

COMMON AUTOMOTIVE ABBREVIATIONS

LIST OF AUTOMOTIVE ABBREVIATIONS WHICH MAY BE USED IN THIS MANUAL

J/B – Junction Block
kg – Kilograms
km – Kilometers
km/h – Kilometer per Hour
kPa – KiloPascals
KS – Knock Sensor
kV – Kilovolts (thousands of volts)
kW – Kilowatts
L – Liter
lb·ft – Foot Pounds
lb·in – Inch Pounds
LF – Left Front
LH – Left Hand
LR – Left Rear
LS – Left Side
LWB – Long Wheel Base
L-4 – In-line Four Cylinder Engine
L-6 – In-line Six Cylinder Engine
MAF – Mass Air Flow
MAN – Manual
MAP – Manifold Absolute Pressure
Max – Maximum
MC – Mixture Control
MFI – Multiport Fuel Injection
MIL – Malfunction Indicator Lamp
Min – Minimum
mm – Milimeter
MPG – Miles per Gallon
MPH – Miles per Hour
M/T – Manual Transmission/Transaxle
MV – Millivolt
NA – Natural Aspirated
NC – Normally Closed
N·m – Newton Meters
NO – Normally Open
NOx – Nitrogen Oxides
OBD – On-Board Diagnostic
OD – Outside Diameter
O/D – Over Drive
OHC – Overhead Camshaft
OL – Open Loop
O2 – Oxygen
O2S – Oxygen Sensor
PAIR – Pulsed Secondary Air Injection System
P/B – Power Brakes
PCM – Powertrain Control Module
PCV – Positive Crankcase Ventilation
PRESS – Pressure
PROM – Programmable Read Only Memory
PNP – Park/Neutral Position
P/S – Power Steering
PSI – Pounds per Square Inch
PSP – Power Steering Pressure
Pt. – Pint = 1/8 gallon 0.473125 ℓ
Pri – Primary
PWM – Pulse Width Modulate
Qt – Quart = 1/4 gallon 0.94625 ℓ
REF – Reference
RF – Right Front
RFI – Radio Frequency Interference
RH – Right Hand
RPM – Revolutions per Minute
RPM Sensor – Engine Speed Sensor
RPO – Regular Production Option
RPS – Revolution per Second
RR – Rear
  – Right Rear
RS – Right Side
RTV – Room Temperature Vulcanizing
RWAL – Rear Wheel Antilock Brake
RWD – Rear Wheel Drive
SAE – Society of Automotive Engineers
Sec – Secondary
SFI – Sequential Multiport Fuel Injection
SI – System International
SIR – Supplemental Inflatable Restraint System
SOHC – Single Overhead Camshaft
Sol – Solenoid
SPEC – Specification
Speedo – Speedometer
SRS – Supplemental Restraint System
ST – Start
  – Scan Tool
Sw – Switch
SWB – Short Wheel Base
SYN – Synchronize
Tach – Tachometer
TB – Throttle Body
TBI – Throttle Body Fuel Injection
TCC – Torque Converter Clutch
TCM – Transmission Control Module
TDC – Top Dead Center
Term – Terminal
TEMP – Temperature
TP – Throttle Position
TRANS – Transmission/Transaxle
TURBO – Turbocharger
TVRS – Television & Radio Suppression
TVV – Thermal Vacuum Valve
TWC – Three Way Catalytic Converter
3 A/T –Three Speed Automatic Transmission/Transaxle
2WD – Two Wheel Drive
4 × 2 – Two Wheel Drive

COMMON AUTOMOTIVE ABBREVIATIONS

LIST OF AUTOMOTIVE ABBREVIATIONS WHICH MAY BE USED IN THIS MANUAL

U-joint – Universal Joint
V – Volt(s)
VAC – Vacuum
VDC – Volts DC
VIN – Vehicle Identification Number
VRRRE – Vehicle Refrigerant Recovery and Recycling Equipment
V-ref – ECM Reference Voltage
VSS – Vehicle Speed Sensor
VSV – Vacuum Switching Valve
V-6 – Six Cylinder "V" Engine
V-8 – Eight Cylinder "V" Engine
W – Watt(s)
w/ – With
w/b – Wheel Base
W/L – Warning Light
w/o – Without
WOT – Wide Open Throttle
WSS – Wheel Speed Sensor

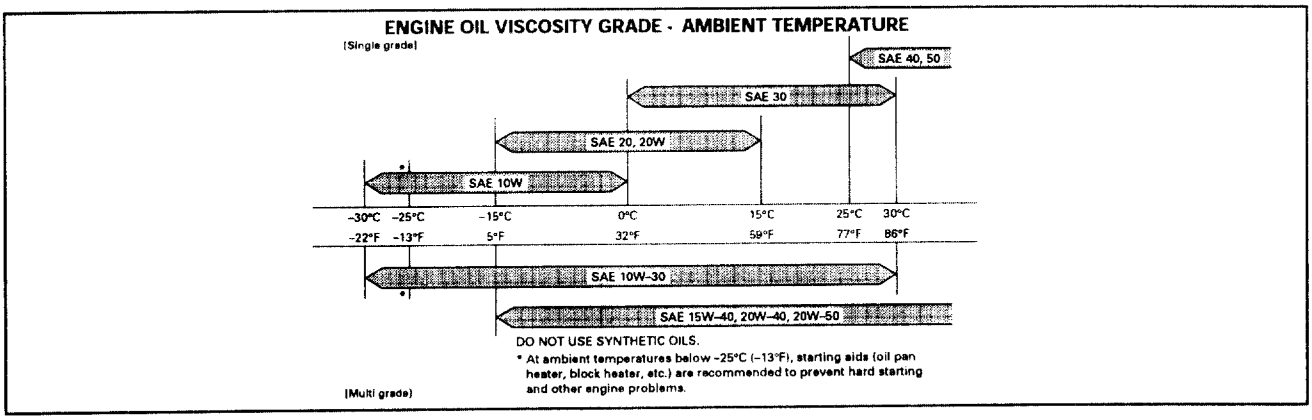
MEMO

SECTION 0B

MAINTENANCE AND LUBRICATION

CONTENTS

ENGINE OIL AND VISCOSITY RECOMMENDATIONS



DO NOT USE SYNTHETIC OILS.

* At ambient temperatures below -25°C (-13°F), starting aids (oil pan heater, block heater, etc.) are recommended to prevent hard starting and other engine problems.

Figure 1 - Engine Oil Viscosity Grade

CHOOSING THE RIGHT QUALITY OIL

Engine oils are labeled on the containers with various API (American Petroleum Institute) designations of quality. Use an oil labeled with the designations CD, or with both designations SF and CD, or with both designations SG and CE.

These designations may be separated by commas, slashes or dashes; it does not matter, as long as "SF" and "CD" (or "SG" and "CE") appear.

Oils which are not labeled "CD", "SF/CD" or "SG/CE" should not be used. For example, do not use oils labeled with only SA, SB, SC, SD, SE, SF, CA, CB or CC; or oils with a combination of any of these letters (such as "SC/CC") as this may cause engine damage. Do not use synthetic oils.

CHOOSING OIL VISCOSITY (Figure 1)

Engine oil viscosity (thickness) has an effect on fuel economy and cold-weather starting. Lower viscosity engine oils can provide better fuel economy; however, higher temperature weather conditions require higher viscosity engine oils for satisfactory lubrication.

When choosing an oil, consider the range of temperature your vehicle will be operated in before the next oil change. Then, select the recommended oil viscosity from the chart.

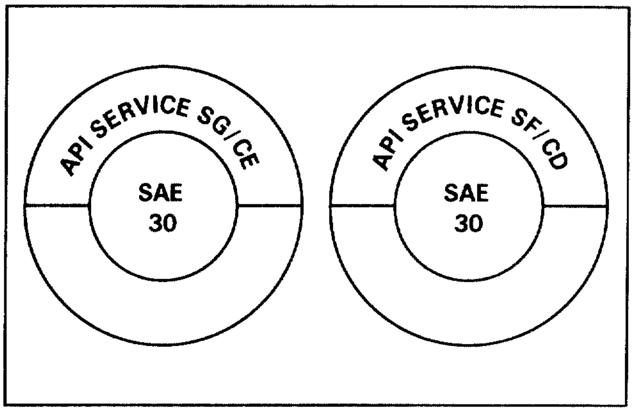


Figure 2 – SAE Logo

Do not use any viscosity oil not recommended. Such oils could cause engine damage, and such damage is not covered by the vehicle warranty.

OIL IDENTIFICATION LOGO (Figure 2)

Starting in 1983, a logo (symbol) was added to some oil containers to help you select the oil you should use. The top portion of the logo shows the oil quality by API designations – such as SF/CD, SG/CE, or others. The center portion of the logo shows the SAE viscosity grade, such as SAE 30.

CHANGE INTERVALS

The oil and filter change intervals for your engine are based on the use of recommended oil quality and viscosity, as well as high-quality filters. Using oil other than recommended, or oil and filter change intervals longer than recommended, could reduce engine life.

Damage to engine due to improper maintenance or use of incorrect oil quality and/or viscosity is not covered by the new vehicle warranty.

Your engine was filled with a high-quality engine oil when it was built. You do not have to change this oil before the first recommended change interval.

Oil and filter change intervals depend on how you use your vehicle. For information on the proper oil and filter change intervals, refer to the maintenance schedule in this section.

ENGINE OIL ADDITIVES

Engine oils contain a variety of additives. Your engine should not need any extra additives if you use the recommended oil quality and change intervals.

The use of proprietary blends of supplementary additives or concentrates such as engine oil supplements, break-in oils, tune-up compounds, friction reducing compounds, etc., is not recommended in lubricating oils for the diesel engine in these vehicles, unless approved by the engine manufacturer.

MAINTENANCE SCHEDULE

MAINTENANCE SCHEDULE AND LOG

MAINTENANCE SERVICES SHOULD BE DONE BY YOUR AUTHORIZED TRUCK DEALER OR ANY OTHER QUALIFIED MEDIUM DUTY TRUCK SERVICE OR REPAIR ESTABLISHMENT WHICH IS ABLE TO PROVIDE SUCH SERVICES AND WHICH CAN BE RELIED UPON TO USE PROPER PARTS AND PRACTICES.

In addition to the in-shop type services detailed in the schedule, this section also includes safety and general maintenance which you or a qualified technician should perform periodically. See "Owner Safety and Routine Maintenance" for details.

MAINTENANCE SCHEDULE LIST FOR THE FRR/WT5500 MODEL

No.	Interval (Kilometers)	10 400	20 800	31 200	41 600	52 000	62 400	72 800	83 200	93 600	104 000	114 400	124 800	135 200	145 600	156 000	Service Interval Months or Miles (kilometers) whichever comes first
	Interval (Miles) Item	6,500	13,000	19,500	26,000	32,500	39,000	45,500	52,000	58,500	65,000	71,500	78,000	84,500	91,000	97,500	
1	Engine Noise Check	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	or every 1 month
2	Curb Idle Speed	I							I								or every 12 months
3	Valve Lash								A								or every 12 months
4	Injection Timing								I								or every 12 months
5	Injector Service								I								or every 12 months
6	Engine Oil & Oil Filter	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	or every 3 months
7	Fuel Filter		R		R		R		R		R		R		R		or every 6 months
8	Air Cleaner Filter				R				R				R				or every 12 months
9	Air Intake System (Duct, Hose & Clamps)				I				I				I				
10	Drive Belt				I				R				I				or every 6 months
12	Engine Bolt Torque (Manifold Mounting)								T								or every 6 months
14	Pre Fuel Filter Element		R		R		R		R		R		R		R		or every 6 months
15	Rubber Hose (Oil Level Gage)															I	or every 12 months
16	Exhaust System (Muffler, Pipe & Clamps)	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	or every 1 month
17	Cooling System (Fan & Radiator)		I		I		I		I		I		I		I		
18	Engine Coolant					R					R					R	or every 12 months
19	Fuel System				I				I				I				or every 12 months
20	Clutch Pedal Free Play	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	or every 3 months
21	• Transmission Oil: Automatic		I	I		I	I	I		I	I	I		I	I	I	or every 1 month
	• Transmission Oil: Automatic	Every 50,000 miles (80,000 km) or 24 months: R															
	• Transmission Oil: Manual	I	I	I	I	I		I	I	I	I	I		I	I	I	or every 3 months
	• Transmission Oil: Manual						R						R				or every 12 months
22	Automatic T/M Oil Filter	First 5,000 miles (8,000 km) and every 50,000 miles (80,000 km) or 24 months: R															
23	Transmission Control Function				I				I				I				or every 6 months
24	Brake Valve								O								or every 12 months
25	Brake Lining for Wear	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	or every 3 months
26	Brake Drum for Wear and Damage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	or every 6 months
27	Brake Hose				I								I				or every 6 months
28	Brake Hose								R								or every 12 months
29	• Spring Brake Valve (Cab)								O								or every 12 months
	• Brake Fluid Level	I	I	I	I		I	I	I	I		I	I	I	I		or every 3 months
	• Brake Fluid					R					R					R	or every 12 months
	• Brake Air Master								O								or every 12 months
	• Brake Wheel Cylinder								O								or every 12 months
30	Quick Release Valve								O								or every 12 months
31	Parking Brake Function				I				I				I				or every 6 months
32	Parking Brake Lining for Wear				I				I				I				or every 6 months

(I): Inspect and if necessary Clean, Correct, Replace or Adjust (R): Replace and Change (T): Tighten to specified torque (A): Adjust
(O): Overhaul (Inspect, Replace rubber parts. If necessary replace damaged parts)

No.	Interval (Kilometers)	10 400	20 800	31 200	41 600	52 000	62 400	72 800	83 200	93 600	104 000	114 400	124 800	135 200	145 600	156 000	Service Interval Months or Miles (kilometers) whichever comes first
	Interval (Miles) Item	6,500	13,000	19,500	26,000	32,500	39,000	45,500	52,000	58,500	65,000	71,500	78,000	84,500	91,000	97,500	
33	Power Steering Control	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	or every 3 months
34	Steering Gear Box Bolt Torque	T			T				T				T				or every 6 months
35	Power Steering Fluid	I	I	I	I	I		I	I	I	I	I		I	I	I	or every 3 months
36	Power Steering Fluid						R						R				or every 12 months
39	Wheel Alignment				I				I				I				or every 12 months
40	Wheel Turning Radius				I				I				I				or every 12 months
41	Differential Gear Oil	I	I	I	I	I		I	I	I	I	I		I	I	I	or every 3 months
42	Differential Gear Oil						R						R				or every 12 months
43	Suspension Bolt for Looseness				I				I				I				or every 6 months
44	Leaf Spring U-Bolt Torque (Initial 650 Miles)	T			T				T				T				or every 6 months
45	Spring for Damage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	or every 1 month
46	Shock Absorber for Leakage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	or every 3 months
47	Propeller Shaft for Looseness		T		T		T		T		T		T		T		or every 3 months
48	Universal Joint and Spline for Wear				I				I				I				or every 12 months
49	Wheel Nut Torque (Initial 650 Miles)	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	or every 1 month
50	Tire and Disc Wheel for Damage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	or every 1 month
51	Rotate Tires	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	
52	Hub for Looseness		I		I		I		I		I		I		I		or every 6 months
53	Wheel Hub Bearing Oil (Rear Axle Only)	I	I	I	I	I		I	I	I	I	I		I	I	I	or every 3 months
54	Wheel Hub Bearing Oil (Rear Axle Only)						R						R				or every 12 months
55	Starter: Brushes for Wear				I				I				I				or every 12 months
56	Generator Brushes for Wear				I				I				I				or every 12 months
	Greasing Points:																
1	Water Pump	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	or every 3 months
2	Steering Shaft	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	or every 3 months
3	Kingpin	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	or every 3 months
4	Spring Pin & Shackle Pin	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	or every 3 months
5	Wheel Hub Bearing Grease (Front Axle only)				R				R				R				or every 12 months

(R): Replace and Change (L): Lubricate (I): Inspect and if necessary Clean, Correct, Replace or Adjust (T): Tighten to specified torque

No.	★ Interval (Kilometers)	5 200	10 400	15 600	20 800	26 000	31 200	36 400	41 600	46 800	52 000	57 200	62 400	67 600	72 800	78 000	83 200	88 400	93 600	98 800	104 000	109 200	114 400	119 600	124 800	130 000	135 200	140 400	145 600
	★ Interval (Miles) Item	3,250	6,500	9,750	13,000	16,250	19,500	22,750	26,000	29,250	32,500	35,750	39,000	42,250	45,500	48,750	52,000	55,250	58,500	61,750	65,000	68,250	71,500	74,750	78,000	81,250	84,500	87,750	91,000
6	Clutch Shift Block	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
7	Propeller Shaft	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L

(L): Lubricate

★ Every month or mileage (kilometer), whichever comes first.

	Interval (Kilometers)	166 400	176 800	187 200	197 600	208 000	218 400	228 800	239 200	249 600	260 000	270 400	280 800	291 200	Service Interval Months or Miles (kilometers) whichever comes first
No.	Interval (Miles) Item	104,000	110,500	117,000	123,500	130,000	136,500	143,000	149,500	156,000	162,500	169,000	175,500	182,000	
1	Engine Noise Check	I	I	I	I	I	I	I	I	I	I	I	I	I	or every 1 month
2	Curb Idle Speed	I								I					or every 12 months
3	Valve Lash	A								A					or every 12 months
4	Injection Timing	I								I					or every 12 months
5	Injector Service	I								I					or every 12 months
6	Engine Oil & Oil Filter	R	R	R	R	R	R	R	R	R	R	R	R	R	or every 3 months
7	Fuel Filter	R		R		R		R		R		R		R	or every 6 months
8	Air Cleaner Filter	R				R				R				R	or every 12 months
9	Air Intake System (Duct, Hose & Clamps)	I				I				I				I	
10	Drive Belt					I								I	or every 6 months
11	Drive Belt	R								R					or every 24 months
12	Engine Bolt Torque (Manifold Mounting)	T								T					or every 6 months
13	Turbocharger									I					or every 12 months
14	Pre Fuel Filter Element	R		R		R		R		R		R		R	or every 6 months
16	Exhaust System (Muffler, Pipe & Clamps)	I	I	I	I	I	I	I	I	I	I	I	I	I	or every 1 month
17	Cooling System (Fan & Radiator)	I		I		I		I		I		I		I	
18	Engine Coolant					R					R				or every 12 months
19	Fuel System	I				I				I				I	or every 12 months
20	Clutch Pedal Free Play	I	I	I	I	I	I	I	I	I	I	I	I	I	or every 3 months
21	• Transmission Oil: Automatic		I	I	I		I	I	I		I	I	I		or every 1 month
	• Transmission Oil: Automatic	Every 50,000 miles (80,000 km) or 24 months: R													
	• Transmission Oil: Manual	I	I		I	I	I	I	I		I	I	I	I	or every 3 months
	• Transmission Oil: Manual			R						R					or every 12 months
22	Automatic T/M Oil Filter	First 5,000 miles (8,000 km) and every 50,000 miles (80,000 km) or 24 months: R													
23	Transmission Control Function	I				I				I				I	or every 6 months
24	Brake Valve	O								O					or every 12 months
25	Brake Lining for Wear	I	I	I	I	I	I	I	I	I	I	I	I	I	or every 3 months
26	Brake Drum for Wear and Damage	I	I	I	I	I	I	I	I	I	I	I	I	I	or every 6 months
27	Brake Hose					I								I	or every 6 months
28	Brake Hose	R								R					or every 12 months
29	• Brake Fluid Level	I	I	I	I		I	I	I	I		I	I	I	or every 3 months
	• Brake Fluid					R					R				or every 12 months
	• Brake Air Master	O								O					or every 12 months
	• Brake Wheel Cylinder	O								O					or every 12 months
30	Quick Release Valve	O								O					or every 12 months
31	Parking Brake Function	I				I				I				I	or every 6 months
32	Parking Brake Lining for Wear	I				I				I				I	or every 6 months

(I): Inspect and if necessary Clean, Correct, Replace or Adjust (R): Replace and Change (T): Tighten to specified torque (A): Adjust
(O): Overhaul (Inspect, Replace rubber parts. If necessary replace damaged parts)

	Interval (Kilometers)	166 400	176 800	187 200	197 600	208 000	218 400	228 800	239 200	249 600	260 000	270 400	280 800	291 200	Service Interval Months or Miles (kilometers) whichever comes first
No.	Interval (Miles) Item	104,000	110,500	117,000	123,500	130,000	136,500	143,000	149,500	156,000	162,500	169,000	175,500	182,000	
33	Power Steering Control	I	I	I	I	I	I	I	I	I	I	I	I	I	or every 3 months
34	Steering Gear Box Bolt Torque	T				T				T				T	or every 6 months
35	Power Steering Fluid	I	I		I	I	I	I	I		I	I	I	I	or every 3 months
36	Power Steering Fluid			R						R					or every 12 months
37	Power Steering Hose	R													or every 24 months
38	Front Axle Damage Distortion	I													or every 24 months
39	Wheel Alignment	I				I				I				I	or every 12 months
40	Wheel Turning Radius	I				I				I				I	or every 12 months
41	Differential Gear Oil	I	I		I	I	I	I	I		I	I	I	I	or every 3 months
42	Differential Gear Oil			R						R					or every 12 months
43	Suspension Bolt for Looseness	I				I				I				I	or every 6 months
44	Leaf Spring U-Bolt Torque (Initial 650 Miles)	T				T				T				T	or every 6 months
45	Spring for Damage	I	I	I	I	I	I	I	I	I	I	I	I	I	or every 1 month
46	Shock Absorber for Leakage	I	I	I	I	I	I	I	I	I	I	I	I	I	or every 3 months
47	Propeller Shaft for Looseness	T		T		T		T		T		T		T	or every 3 months
48	Universal Joint and Spline for Wear					I				I				I	or every 12 months
49	Wheel Nut Torque (Initial 650 Miles)	T	T	T	T	T	T	T	T	T	T	T	T	T	or every 1 month
50	Tire and Disc Wheel for Damage	I	I	I	I	I	I	I	I	I	I	I	I	I	or every 1 month
51	Rotate Tires	R	R	R	R	R	R	R	R	R	R	R	R	R	
52	Hub for Looseness	I		I		I		I		I		I		I	or every 6 months
53	Wheel Hub Bearing Oil (Rear Axle Only)	I	I		I	I	I	I	I		I	I	I	I	or every 3 months
54	Wheel Hub Bearing Oil (Rear Axle Only)			R						R					or every 12 months
55	Starter: Brushes for Wear	I				I				I				I	or every 12 months
56	Generator Brushes for Wear	I				I				I				I	or every 12 months
	Greasing Points:														
1	Water Pump	L	L	L	L	L	L	L	L	L	L	L	L	L	or every 3 months
2	Steering Shaft	L	L	L	L	L	L	L	L	L	L	L	L	L	or every 3 months
3	Kingpin	L	L	L	L	L	L	L	L	L	L	L	L	L	or every 3 months
4	Spring Pin & Shackle Pin	L	L	L	L	L	L	L	L	L	L	L	L	L	or every 3 months
5	Wheel Hub Bearing Grease (Front Axle only)	R				R				R				R	or every 12 months

(I): Inspect and if necessary Clean, Correct, Replace or Adjust (T): Tighten to specified torque (L): Lubricate (R): Replace and Change

	★ Interval (Kilometers)	150 800	156 000	161 200	166 400	171 600	176 800	182 000	187 200	192 400	197 600	202 800	208 000	213 200	218 400	223 600	228 800	234 000	239 200	244 400	249 600	254 800	260 000	265 200	270 400	275 600	280 800	286 000	291 200
No.	★ Interval (Miles) Item	94,250	97,500	100,750	104,000	107,250	110,500	113,750	117,000	120,250	123,500	126,750	130,000	133,250	136,500	139,750	143,000	146,250	149,500	152,750	156,000	159,250	162,500	165,750	169,000	172,250	175,500	178,750	182,000
6	Clutch Shift Block	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
7	Propeller Shaft	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L

(L): Lubricate

★ Every month or mileage (kilometer), whichever comes first.

EXPLANATION OF VEHICLE MAINTENANCE AND LOG

NORMAL VEHICLE USE – These owner's or driver's maintenance instructions are based on the assumption that your vehicle will be used as designed.

- To carry passengers and cargo within the limitations indicated on the Vehicle Identification Number (VIN) Plate.
- On reasonable road surfaces within legal operating limits, and
- On a daily basis, as a general rule, for at least several miles/kilometers.
- With proper fuels.

Unusual operating conditions, such as driving in dusty areas, will require more frequent vehicle maintenance.

If your vehicle is equipped with air conditioning or an automatic transmission, refer to the manufacturer's information booklet.

The log groups items according to mile/kilometer service intervals. Use the item codes (letter and number) to find the description of the maintenance and the time intervals. Follow whichever interval comes first, time or miles.

After the maintenance services are performed, insert the month, day and mileage/kilometers in the area provided next to the serviced item.

EXPLANATION OF MAINTENANCE ITEM FOR FRR/WT5500 MODEL

The following is a brief explanation of each of the services listed in the preceding Complete Vehicle Maintenance Schedule.

1. **ENGINE NOISE CHECK** – Sound absorption materials; inspect for tears, broken out section and attachment.
2. **CURB IDLE SPEED** – Check curb idle speed, if necessary.
3. **VALVE LASH** – Incorrect valve clearance will result in increased engine noise and lower engine output, thereby adversely affecting engine performance. Retorque rocker shaft bracket nuts before checking and adjusting valve clearance. Intake and exhaust valve 0.016-inch (0.4 mm) cold adjustment.
4. **INJECTION TIMING** – Refer to fuel supply pump installation procedure in the service manual.
5. **INJECTOR** – Check the injector orifices for accumulation of carbon. Remove any contamination with a injector cleaning tool, by thoroughly cleaning the outside of the injector end.
6. **ENGINE OIL AND OIL FILTER** – Check the engine oil. Oil capacity in oil pan: 14.79 qts (14.0 liters). Change the oil and oil filter at 6,500 miles (10,400 kilometers) or 3 months.
7. **FUEL FILTER** – Replace the fuel filter every 13,000 miles (20,800 kilometers) or 6 months.
8. **AIR CLEANER FILTER** – Replace the engine air cleaner filter under normal operations every 26,000 miles (41,600 kilometers). Operation of vehicle in dusty areas will require more frequent filter replacement. When the air cleaner filter becomes fouled, the "AIR CLEANER" restriction shown a red ring in the transparent area of the body.
9. **AIR INTAKE SYSTEM** – Check the air intake system installation to see that gaskets are seated properly and all hose connections, fasteners, and other components are tight.
10. **DRIVE BELT** – Check the fan and generator drive belts for cracks, fraying, wear, and proper tension. Adjust the belt tension as needed.
11. **DRIVE BELT** – When belt replacement becomes necessary both belts should be replaced at the same time.
12. **ENGINE BOLT TORQUE** – Manifold mounting and injector bracket nuts should be retightened to specified torque every 52,000 miles (83,200 kilometers).
13. **TURBOCHARGER** – Check and tighten (if necessary) all mounting bolts and nuts on the turbocharger, check the lube oil inlet and outlet lines for oil leaks on a daily basis. Also, check for unusual vibrations and/or excessive noise. If necessary inspect the turbocharger assembly for wear, damage or other abnormal conditions.
14. **PRE FUEL FILTER ELEMENT (located in Water Separator Housing)** – Wash the filter element every 13,000 miles (20,800 kilometers) or 6 months.
15. **RUBBER HOSE (OIL LEVEL GAGE)** – Check for cracks, damage or other abnormal condition.
16. **EXHAUST SYSTEM**

    Muffler: Inspect for leaks at seams, inlet and outlet connections or holes in muffler body.

    Exhaust pipe: Inspect for exhaust gas leak at all connections and for holes in tubing.

    Exhaust system gaskets: Inspect for gasket leaks between manifold and block and manifold to exhaust pipe.

    Exhaust system: Inspect for tightness.

    Exhaust system mounting: Inspect condition of exhaust system supports.
17. **COOLING SYSTEM**

    Fan: Inspect blades.

    Fan shroud: Inspect for attachment or tears.

    Radiator: Inspect for cleanliness.

18. **ENGINE COOLANT** – Replace engine coolant every 32,500 miles (52,000 kilometers) or 12 months.
19. **FUEL SYSTEM** – Visually inspect all fuel line connections on the fuel injection pump and injector every 26,000 miles (41,600 kilometers) or 12 months.
20. **CLUTCH PEDAL FREE PLAY** – Inspect clutch pedal free play and adjust as necessary.
21. • **TRANSMISSION OIL: AUTOMATIC** – Check oil level every 6,500 miles (10,400 kilometers) or every month.

    • **TRANSMISSION OIL: AUTOMATIC** – Replace automatic transmission fluid at every 50,000 miles (80,000 kilometers) or 24 months.

    • **TRANSMISSION OIL: MANUAL** – Check oil level every 6,500 miles (10,400 kilometers) or every 3 months.

    • **TRANSMISSION OIL: MANUAL** – Replace lubricant every 39,000 miles (62,400 kilometers) or 12 months.
22. **AUTOMATIC T/M OIL FILTER** – Replace the automatic T/M oil filter on the first 5,000 miles (8,000 kilometers) and every 50,000 miles (80,000 kilometers) or 24 months.
23. **TRANSMISSION CONTROL FUNCTION** – Inspect abnormal noise, signs of wear or other abnormal condition every 26,000 miles (41,600 kilometers) or 6 months.
24. **BRAKE VALVE** – Overhaul the brake valve every 52,000 miles (83,200 kilometers) or 12 months.
25. **BRAKE LINING FOR WEAR** – Check brake linings for wear, cracks, other surface condition every 6,500 miles (10,400 kilometers) or 3 months.
26. **BRAKE DRUM FOR WEAR AND DAMAGE** – Check the brake drum for wear and damage every 6,500 miles (10,400 kilometers) or 6 months.
27. **BRAKE HOSE** – Check for cracks, damage or other abnormal condition.
28. **BRAKE HOSE** – Replace hose every 52,000 miles (83,200 kilometers) or 12 months.
29. • **BRAKE FLUID LEVEL** – Check fluid level every 6,500 miles (10,400 kilometers) or 3 months.

    • **BRAKE FLUID** – Replace fluid every 32,500 miles (52,000 kilometers) or 12 months.

    • **BRAKE AIR MASTER** – Overhaul the brake air master every 52,000 miles (83,200 kilometers) or 12 months.

    • **BRAKE WHEEL CYLINDER** – Overhaul the brake wheel cylinder every 52,000 miles (83,200 kilometers) or 12 months.
30. **QUICK RELEASE VALVE** – Check the quick release valve every 52,000 miles (83,200 kilometers) or 12 months.
31. **PARKING BRAKE FUNCTION** – Park on a fairly steep hill and check that the vehicle can be held using only the parking brake.
32. **PARKING BRAKE LINING FOR WEAR** – Check brake lining for wear, cracks, other surface condition every 26,000 miles (41,600 kilometers) or 6 months.
33. **POWER STEERING CONTROL** – Be alert for any changes in steering action. An inspection or service is needed when the steering wheel is harder to turn or has too much free play, or if there are strange sounds when turning or parking.
34. **STEERING GEAR BOX BOLT TORQUE** – Attaching bolts should be tightened to specified torque at first 6,500 miles (10,400 kilometers) and every 26,000 miles (41,600 kilometers) or 6 months.
35. **POWER STEERING FLUID** – Check the fluid level every 6,500 miles (10,400 kilometers) or every 3 months.
36. **POWER STEERING FLUID** – Replace power steering fluid every 39,000 miles (62,400 kilometers) or 12 months.
37. **POWER STEERING HOSE** – Check for cracks or other abnormal condition. Replace the power steering hose every 104,000 miles (166,400 kilometers) or 24 months.
38. **FRONT AXLE DAMAGE AND DISTORTION** – Inspect the front axle for damage and distortion every 104,000 miles (166,400 kilometers) or 24 months.
39. **WHEEL ALIGNMENT** – Check the wheel alignment every 26,000 miles (41,600 kilometers) or 12 months.
40. **WHEEL TURNING RADIUS** - Check the wheel turning radius every 26,000 miles (41,600 kilometers) or 12 months.
41. **DIFFERENTIAL GEAR OIL** – Check oil level every 6,500 miles (10,400 kilometers) or 3 months.
42. **DIFFERENTIAL GEAR OIL** – Replace gear oil every 39,000 miles (62,400 kilometers) or 12 months.
43. **SUSPENSION BOLT FOR LOOSENESS** – Inspect the suspension bolts for looseness every 26,000 miles (41,600 kilometers) or 6 months.
44. **LEAF SPRING U-BOLT TORQUE** – Retighten to specified torque at first 650 miles (1,050 kilometers), and next 6,500 miles (10,400 kilometers) and every 26,000 miles (41,600 kilometers) or 6 months.
45. **SPRING FOR DAMAGE** – Check the leaf spring visually for damage every 6,500 miles (10,400 kilometers) or every month.
46. **SHOCK ABSORBER FOR LEAKAGE** – Inspect the shock absorber for leakage every 6,500 miles (10,400 kilometers) or 3 months.

47. **PROPELLER SHAFT FOR LOOSENESS** - Retighten to specified torque every 13,000 miles (20,800 kilometers) or 3 months.
48. **UNIVERSAL JOINT AND SPLINE FOR WEAR** - Inspect the universal joint and spline for wear every 26,000 miles (41, 600 kilometers) or 12 months.
49. **WHEEL NUT TORQUE** - Tighten to specified torque at first 650 miles (1,050 kilometers) and every 6,500 miles (10,400 kilometers) or 1 month.
50. **TIRE AND DISK WHEEL FOR DAMAGE** - Inspect the tire and disk wheel for damage every 6,500 miles (10,400 kilometers) or 1 month.
51. **ROTATE TIRES** - To equalize wear, rotate tires at every 6,500 miles (10,400 kilometers).
52. **HUB FOR LOOSENESS** - Inspect the hub for looseness every 13,000 miles (20,800 kilometers) or 6 months.
53. **WHEEL HUB BEARING OIL (REAR AXLE)** - Check oil level. Also, inspect the oil seal for leakage every 6,500 miles (10,400 kilometers) or 3 months.
54. **WHEEL HUB BEARING OIL (REAR AXLE)** - Replace oil every 39,000 miles (62,400 kilometers) or 12 months.
55. **STARTER: BRUSHES FOR WEAR** - Check the starter brushes for wear every 26,000 miles (41,600 kilometers) or 12 months.
56. **GENERATOR: BRUSHES FOR WEAR** - Check the generator brushes for wear every 26,000 miles (41,600 kilometers) or 12 months.

GREASING POINTS FOR FRR/WT5500 MODEL

1. **WATER PUMP** - Replace lubricant every 6,500 miles (10,400 kilometers) or 3 months.
2. **STEERING SHAFT** - Replace lubricant every 6,500 miles (10,400 kilometers) or 3 months.
3. **KINGPIN** - Replace lubricant every 6,500 miles (10,400 kilometers) or 3 months.
4. **SPRING PIN AND SHACKLE PIN** - Replace lubricant every 6,500 miles (10,400 kilometers) or 3 months.
5. **WHEEL HUB BEARING (FRONT AXLE ONLY)** - Replace lubricant every 26,000 miles (41,600 kilometers) or 12 months.
6. **CLUTCH SHIFT BLOCK** - Replace lubricant every 3,250 miles (5,200 kilometers) or 1 month.
7. **PROPELLER SHAFT** - Replace lubricant every 3,250 miles (5,200 kilometers) or 1 month.

OWNER SAFETY AND ROUTINE MAINTENANCE

Listed below are vehicle checks which should be made periodically by either the owner or a qualified technician to ensure proper performance and safety of your vehicle. Take any problems promptly to a technician for service advice.

FOR YOUR SAFETY AND THAT OF OTHERS, ANY OF THE SAFETY RELATED COMPONENTS THAT MAY HAVE BEEN DAMAGED IN AN ACCIDENT SHOULD BE CHECKED AND NEEDED REPAIRS PERFORMED BEFORE OPERATING YOUR VEHICLE.

At the minimum, these routine checks should be made every 6 months or 6,000 miles (10,000 km), whichever comes first. Whenever repairs are necessary, have them completed before operating the vehicle.

A **PARKING BRAKE** - Park on a fairly steep hill and hold the vehicle with the parking brake only.
This checks holding ability.

CAUTION: BEFORE CHECK ITEM (B), BE SURE TO HAVE ENOUGH ROOM AROUND THE VEHICLE. THEN FIRMLY APPLY BOTH THE PARKING BRAKE (REFER TO "PARKING BRAKE" IN SECTION 2 FOR PROCEDURE) AND THE REGULAR BRAKE. DO NOT USE THE ACCELERATOR PEDAL. IF THE ENGINE START, BE READY TO TURN OFF THE IGNITION/ENGINE CONTROL SWITCH AT ONCE. TAKE THESE PRECAUTIONS BECAUSE THE VEHICLE COULD MOVE WITHOUT WARNING AND POSSIBLY CAUSE PERSONAL INJURY OR PROPERTY DAMAGE.

B **STARTER SAFETY SWITCH (AUTOMATIC TRANSMISSION)** - Check by trying to start the engine in each gear. The starter should crank only in "Neutral."

C **TRANSMISSION SHIFT INDICATOR (AUTOMATIC TRANSMISSION)** - Check that the indicator points to the gear chosen.

D **STEERING** - Be alert for any changes in steering action. An inspection or service is needed when the steering wheel is harder to turn or has too much free play, or if there are strange sounds when turning or parking.

E **WHEEL ALIGNMENT, BALANCE, AND TIRES** – Check tires for abnormal wear or damage.
Also, check for damaged wheels. A pull right or left on a straight and level road may show the need for a wheel alignment. A vibration of the steering wheel or seat at normal highway speeds may mean a wheel balancing is needed. Check tire pressure when the tires are "cold", at least monthly, and whenever the vehicle is serviced (include the spare, if equipped).
Check the pressure more often if daily check shows it's needed (refer to Driver Daily Checklist in Section 1). Change tire pressure as needed when changing loads.

F **BRAKES** – Be alert to illumination of the "BRAKE AIR" low pressure warning light or for the alarm buzzer, or changes in braking action, such as repeated pulling to one side, unusual sounds when braking or increased brake pedal travel. Make sure air brake system reservoirs are drained daily with full system air pressure, and check system for leaks. Any of these conditions could indicate the need for brake system inspection and/or service.

G **EXHAUST SYSTEM** – Be alert for any changes in the sound of the exhaust system or any smell of fumes. These are signs the system may be leaking. Have it checked and/or repaired at once. Refer to "Engine Exhaust Gas Caution (Carbon Monoxide)" in Section 2.

H **WINDSHIELD WIPERS AND WASHERS** – Check operation and condition of the wiper blades. Check the flow and aim of the washer spray.

I **DEFROSTERS** – Turn the control lever to "the defrost position" and the blower fan knob to "4". Then check the air flow from the ducts at the inside base of the windshield.

J **REARVIEW MIRRORS AND SUN VISORS** – Check that friction joints hold mirrors and sun visors in place.

K **HORN** – Sound the horn now and then to be sure it works

L **SAFETY BELTS** – Check belt system, including: webbing, buckles, latch plates, retractors and anchors for proper operation, and for damage.

M **SEAT ADJUSTERS** – When adjusting a manual seat, be sure seat adjusters latch by pushing the seat forward and backward.

N **LIGHTS** – Check panel lighting, warning lamps, indicator lamps, and interior lamps. On the outside, check: license plate lamps, side marker lamps, reflectors on outside mirrors, headlamps, parking lamps, identification and clearance lamps, taillamps, brake lamps, turn signals, backup lamps, and hazard warning flashers. Have headlamp aim checked at once if beams seem improperly aimed.

O **GLASS, Mirrors, Lights and/or Reflectors Condition** – Look for broken, scratched, dirty or damaged glass, mirrors, lamps or reflectors that could reduce the view or visibility or cause injury. Replace, clean or repair promptly.

P **DOOR LATCHES** – Check that doors close, latch, and lock tightly. Check for broken, damaged or missing parts that might prevent tight latching.

Q **TILT CAB** – Be sure the tilt lever is raised and the lock pin is inserted in the lever bracket. (except crew cab model)

R **FLUID LEAKS** – Check for fuel, water, oil, or other fluid leaks by looking at the surface beneath the vehicle after it has been parked for a while. If you notice fumes or fluid at any time, have the cause found and corrected at once.

S **SPARE AND JACK** – Check that spare tire assembly and jack equipment (if equipped) are securely stowed at all times.

T **UNDERBODY** – Corrosive materials used for ice, snow removal, and dust control can collect on the underbody. If these materials are not removed, accelerated corrosion (rust) can occur on underbody parts such as fuel lines, frame, floor pan, and exhaust system. At least every spring, flush these materials from the underbody with plain water. Take care to clean well any areas where mud and other debris can collect. Sediment packed in closed areas of the frame should be loosened before being flushed.

NOISE EMISSION CONTROL

NOISE CONTROL SYSTEM

The following information relates to compliance with Federal noise emission standards for vehicles with a Gross Vehicle Weight Rating (GVWR) of more than 4,536 kilograms (10,000 pounds). The Maintenance Schedule provides information on maintaining the noise control system to minimize degradation of the noise emission control system during the life of your vehicle. The noise control system warranty is given in your Warranty folder.

These standards apply only to vehicles sold in the United States.

TAMPERING WITH NOISE CONTROL SYSTEM PROHIBITED

Federal law prohibits the following acts or the causing thereof:

1. The removal or rendering inoperative by any person other than for purposes of maintenance, repair or replacement of any device or element of design incorporated into any new vehicle for the purpose of noise control, prior to its sale or delivery to the ultimate purchaser or while it is in use, or;
2. The use of the vehicle after such device or element of design has been removed or rendered inoperative by any person.

Among those acts presumed to constitute tampering are the following acts.

Insulation

- Removal of noise shields or underhood insulation.

Engine

- Removal or rendering engine speed governor, if so equipped, inoperative so as to allow engine speed to exceed manufacturer specifications.

Fan and Drive

- Removal of fan clutch or rendering clutch inoperative.
- Removal of fan shroud.

Air Intake

- Removal of air cleaner silencer.
- Reversing air cleaner cover.

Exhaust

- Removal of catalytic converter, muffler and/or resonator.
- Removal of exhaust pipes and exhaust pipe clamps.

RECOMMENDED FLUIDS AND LUBRICANTS

USAGE	FLUIDS/LUBRICANTS
Engine Oil	Use API CD, SF/CD or SG/CE
Manual Transmission and Rear Axle	Multi-purpose gear oil SAE 90 GL5 (SAE 80 GL5 in Canada)
Wheel Hub Bearing (Oil Lubricating Type)	Multi-purpose gear oil SAE 90 GL5 (SAE 80 GL5 in Canada)
Automatic Transmission	ATF DEXRON®-III
Chassis Lubricant	Multi-purpose grease with high temperature, good quality, lithium soap, extreme-pressure grease
Battery Terminals	Petroleum jelly
Clutch and Brake Fluid	Brake Fluid DOT 3 or equivalent
Cab-Door Hinges and Latches	A semi-fluid grease having extreme pressure properties and containing zinc oxide (Lubriplate or equivalent)
Power Steering Fluid	ATF DEXRON®-IIE or III
Engine Coolant	Mixture of water and high-quality ethylene glycol base type anti-freeze conforming to GM Spec. 6277-M or equivalent
• Front Axle • Suspension • Steering Shaft • Clutch Shift Block	NLGI #1 or #2 multi-purpose type grease
• Propeller Shaft (Universal Joints and Sliding Sleeve)	NLGIEP #1 or #2 lubricating grease
• Wheel Hub Bearing (Except Oil Lubricating Type) • Water Pump	NLGI #2 or #3
Accelerator Pivot Assembly	SAE 30 or 10W-30 engine oil

LUBRICATION CHART

GREASE POINTS	REMARKS
1. Water Pump Bearings	— 1 fitting
2. Clutch Shift Block	— 1 fitting
3. Steering Shaft Universal Joints and Slip Shaft	— 3 fittings
4. Kingpins	— 2 fittings ea. side
5. Propeller Shaft Universal Joints and Sliding Sleeve	— 4 fittings
6. Front Spring Pins and Shackle Pins	— 1 fitting ea. side-front — 2 fittings ea. side-rear
7. Rear Spring Pins and Shackle Pins	— 1 fitting ea. side-front — 2 fittings ea. side-rear

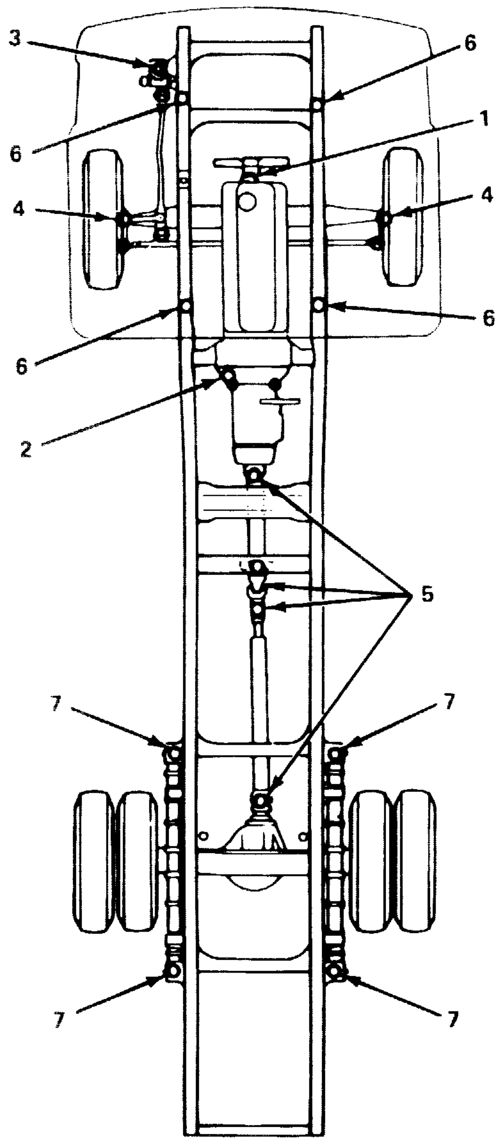


Figure 4 – Lubrication Chart

SPECIFICATIONS

CAPACITIES

Engine Crankcase

Capacities are for normal refill. Capacity given may be approximate – keep level as close as possible to the full mark without overfilling. Do not operate with the level below the low mark.

6HK1-TC...................... 14.0 L (14.79 qts)

This figure includes the full flow main oil filter, which should be changed at each oil change.

It also includes the bypass filter. The bypass filter should be changed at each oil change.

Transmission

The transmission capacities as stated are approximate. For manual and auxiliary transmission, the correct oil level is to the bottom of the fill plug opening. The oil capacity will vary due to the angle of the transmission with the vehicle. For automatic transmission, refer to the "Allison Automatic Transmissions" Operator's Manual for oil level check and maintenance information.

Manual	W/O PTO	W/PTO
ISUZU MLD 6-speed	6.5L (13.74 pints)	7.2L (15.22 pints)

Automatic		Initial Fill*		Refill*	
Transmission	Sump	Liters	Quarts	Liters	Quarts
S1000	Shallow	12	12.7	7	7.4

*Approximate quantities, do not include external lines and cooler hose.

Fuel Tank

The fuel tank capacity is stated on a metal plate attached to the fuel tank body. Only fill the tank to 95 percent of its capacity. This allows room for the expansion of the fuel.

COOLING SYSTEM

8 gallons (30.3 liters)
THERMOSTAT (Start to Open)
82°C (180°F)
RADIATOR PRESSURE CAP
49 kPa (7.1 psi)

REAR AXLE

AXLE TYPE	CAPACITY	
Single Speed	Liters	Pints
R065 13.5" Differential	5.5	12

AIR CLEANER ELEMENT

1 stage type	ISUZU No. 1-14215-181-0 GM No. 94058234

OIL FILTER ELEMENT

ISUZU No. 8-94392-475-0 GM No. 94392475

FUEL FILTER ELEMENT

Fuel (Engine mounted)	ISUZU No. 8-94392-474-0 GM No. 94392474
Pre Fuel Filter (Water separator)	ISUZU No. 8-94392-485-0 GM No. 94392485

*For this special filter consult your dealer for filter replacement.

ESSENTIAL SERVICE TOOLS

Essential service tools that are shown in this service manual that have tool product numbers beginning with "J" are available for worldwide distribution from:

Kent-Moore
SPX Corporation
29784 Little Mack
Roseville, M1 48066-2298
1-800-328-6651
Mon.–Fri. 8:00 p.m. EST
Telex: 244040 KMTR VR
FAX: 313-578-7375

MEMO

SECTION 1

HEATING AND AIR CONDITIONING

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FRAME

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SECTION 3

STEERING, SUSPENSION, WHEELS AND TIRES

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REAR AXLE AND PROPELLER SHAFT

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SECTION 5

BRAKES
(Air Over Hydraulic Brakes)

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SECTION 5C

PARKING BRAKE

CONTENTS

DESCRIPTION

The parking brake used on this vehicle is a mechanically operated internal-expanding type drum brake mounted on the rear of the transmission case. A control cable is routed into the cab and is connected to a lever located on the floor between the drive and passenger seat (figure 1).

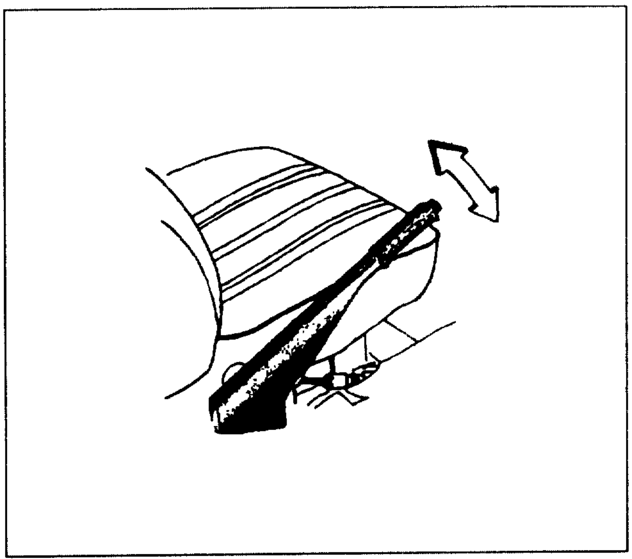


Figure 1 - Parking Brake Lever

ON-VEHICLE SERVICE

Before doing any service on the parking brake, park the vehicle on a level surface, block the wheels, and place the brake lever in the release or off position, fully down.

BRAKE SHOE ADJUSTMENT

- Block the wheels of the vehicle.
- Release the parking brake.
- Raise the rear axle so that the tires are off the floor.

Remove or Disconnect (Figure 2)

1. Cable at the lever (3).
- Rotate the drum (22) to align an access hole with the adjuster (29).
2. Bolt (24) and cover (25).
- Move the lever (3) side to side several times to center the shoes (14).

Adjust

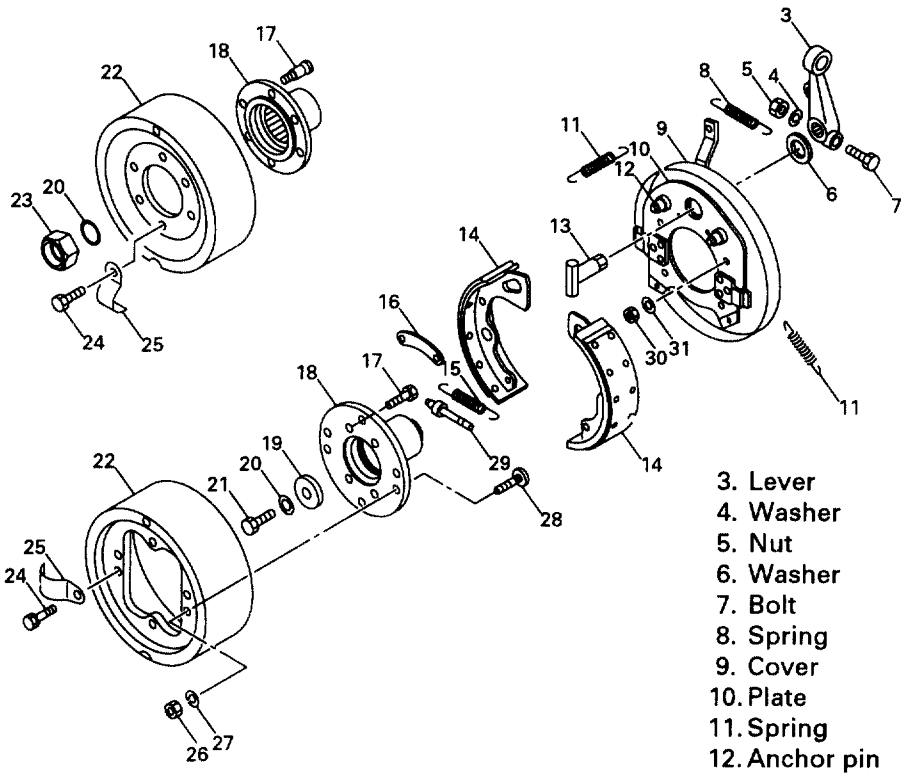
- Insert a screwdriver in the access hole and rotate the adjuster (29) upward until the shoes (14) drag on the drum (figure 3).
- Back off the adjuster (29) as specified.
  13 notches

Measure

- Gap at the middle of the shoe lining figure 4.
  - 10 in. Parking Brake 0.23 mm (0.009 in.)

Install or Connect (Figure 2)

- Cover (25) and bolt (24).
  - Check the brake for positive action.



3. Lever
4. Washer
5. Nut
6. Washer
7. Bolt
8. Spring
9. Cover
10. Plate
11. Spring
12. Anchor pin
13. Camshaft
14. Shoe
15. Spring
16. Plate
17. Bolt
18. Flange
19. Plate
20. O-Ring seal
21. Bolt
22. Drum
23. Nut
24. Bolt
25. Cover
26. Nut
27. Washer
28. Bolt
29. Adjuster
30. Nut
31. Washer

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Figure 2 – Parking Brake

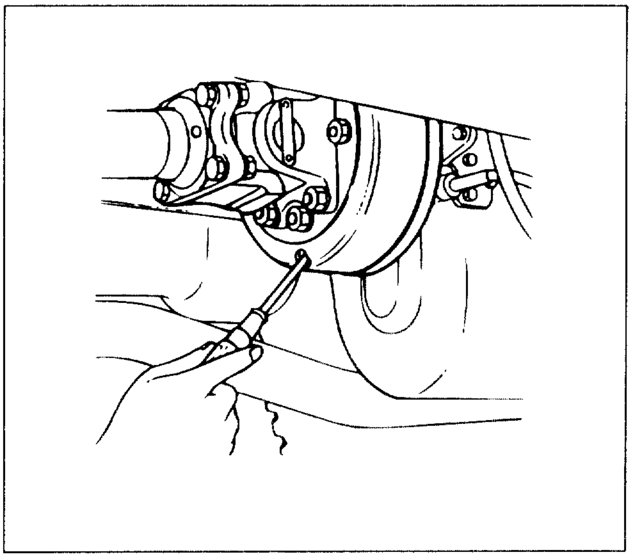

Figure 3 - Adjusting the Brake Shoes

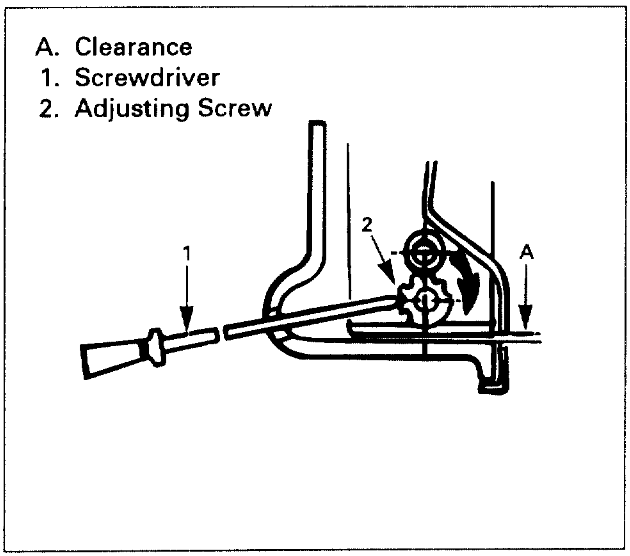

Figure 4 - Brake Shoe Adjustment and Clearance

SHOE REPLACEMENT

- Block the vehicle wheels.
- Release the parking brake.

Remove or Disconnect (Figure 2)

1. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
2. Nut (23).
3. Drum (22) and flange (18).
    - O-ring seal (20) in the flange (18) bore.
4. Spring (11) two places (figure 5).
5. Spring (15).
6. Adjuster (29).
7. Shoes (14).

Inspect

- Return spring (11). Free length should be specified length (figure 6).
    - 10" Parking Brake 68 mm (2.68 in.)
- Shoes (14). Replace the shoes if the web at the point of cam (13) contact is severely worn.
- Lining. Replace if riveted lining is 0.2 mm (0.008 in.) from the rivet heads. Replace bonded lining when worn to 2.0 mm (0.08 in.).

Install or Connect (Figure 2)

1. Shoes (14).
2. Adjuster (29).
3. Spring (15).
4. Spring (11).
    - Install springs (11) to the anchor pins (13) (figure 5).
5. Drum (22) and flange (18).
6. Nut (23).
    - MLD Nut (23) to 784 N·m (579 ft. lbs.).
    - Stake the nut (23) in 2 places, 180 degrees apart. (MBG and MLD)
    - S1000 Bolt to 147 N·m (108 ft. lbs.).
7. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).

Adjust

- Brake and check operation.

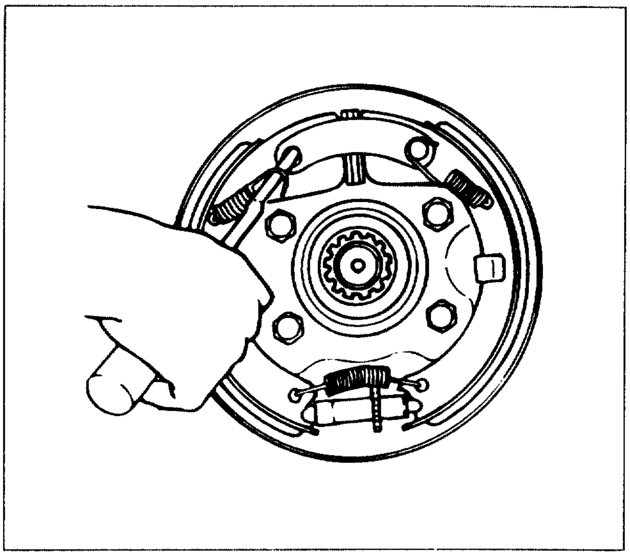

Figure 5 - Installing or Removing the Springs

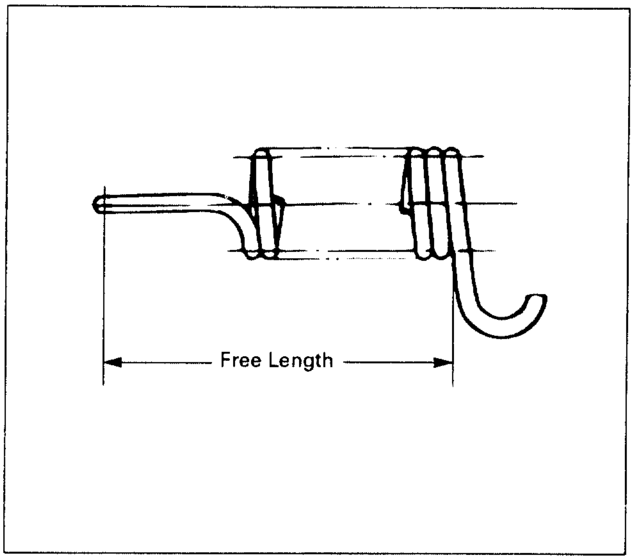

Figure 6 – Return Spring Free Length

DRUM REPLACEMENT

- Block the vehicle wheels.
- Release the parking brake.

Remove or Disconnect (Figure 2)

1. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
2. Bolts (24) and washers.
3. Cover (25).
4. Drum (22).

Measure

- Diameter. Replace if the drum (22) ID is greater than maximum limit. See specifications.
- Run-out. Replace if the run-out varies more than 0.05 mm (0.002 in.).

Install or Connect (Figure 2)

1. Drum (22).
2. Cover (25).
3. Bolts (24) and washers. Align the drum holes with the flange holes.
4. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
   — Adjust the brake and check operation.

COVER REPLACEMENT

- Block the vehicle wheels.
- Release the parking brake.

Remove or Disconnect (Figure 2)

1. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
2. Nut (23).
   - Open the staking. Be careful of the shaft threads.
3. Drum (22) and flange (18).
4. Cable from the lever (3).
5. Lever from the camshaft (13).
   - Leave the shoes (14) and camshaft (13) in place.
6. Spring (8).
7. Cover (10).
   - Replace parts as necessary.

Install or Connect (Figure 2)

1. Cover (9).
2. Spring (8) to the cover (9) bracket.
3. Washer (6) on the camshaft (13).
4. Camshaft (13) into the lever (3).
   - Align the holes.
5. Bolt (1) into the lever (3) tighten with nut (5) and washer (4).
6. Cable to the lever (3).
   - Attach the spring (8) to levers eye (3).
7. Drum (22) and the flange (18).
   - Be sure O-ring seal (20) is in the flange (18).
8. Nut (23).

   Tighten
   - MLD Nut (23) to 784 N·m (579 ft. lbs.).
   - Stake the nut (23) in 2 places, 180 degrees apart. (MBG and MLD)
   - S1000 Bolt to 147 N·m (108 ft. lbs.).

9. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
   — Check for propeller brake operation and adjust if necessary.

LEVER ADJUSTMENT

1. Block the vehicle wheels.
2. Release the parking brake.
3. Loosen e jam nut and adjusting nut (figure 7).

Adjust

When connecting cable with cam shaft lever, use adjust nut in order to make the clearance 0mm (0 in.) between cam and shoe, then lock adjust nut with lock nut.

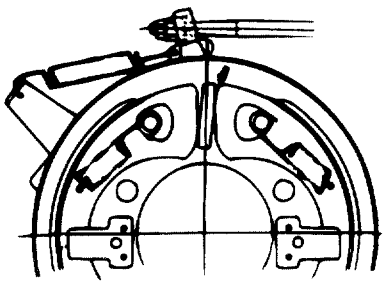

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Figure 7 – Adjusting the Cable

BRAKE LEVER REPLACEMENT

- Block the vehicle wheels.
- Release the parking brake.

Remove or Disconnect (Figure 8)

1. Driver seat. Refer to CAB (SEC. 10).
2. Safety belt buckle assembly. Refer to CAB (SEC. 10).
3. Utility tray and handle assembly. Refer to CAB (SEC. 10).
4. Parking brake switch.
5. Bolt (50< two places.
6. Cover (43).
7. Cotter pin (48).
8. Flat washer (47) from the pin (42).
9. Wave washer (46).
10. Cable connector (45).
11. Wave washer (44).
12. Bolt (41), three places.
13. Brake lever (40).

Remove or Disconnect (Figure 8)

1. Brake lever (40).
2. Bolt (41), three places.
3. Wave washer (44) to the pin (42).
4. Cable connector (45).
5. Wave washer (46).
6. Flat washer (47).
7. Cotter pin (48).
8. Cover (43).
9. Bolt (50), two places.

Adjust

- Pull the brake lever with 200 N (45) lbs.) and check for 3 to 9 notches.

35. Cable
40. Parking Brake Lever Assembly
41. Bolt
42. Pin
43. Cover
44. Wave Washer
45. Cable Connector
46. Wave Washer
47. Flat Washer
48. Cotter Pin
49. Bolt

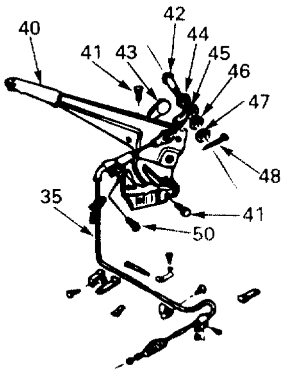

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Figure 8 – Brake Lever and Cable Detail

SPECIFICATIONS

TORQUE SPECIFICATIONS

Air Cylinder Retaining Bolts	26 N.m (20 lb·ft)
Lever to Link Bolt	26 N.m (20 lb·ft)
Exhaust Brake Valve Retaining Bolts	26 N.m (20 lb·ft)
Lever Retaining Nut	14 N.m(122 lb·in)
Cover Retaining Bolts	26 N.m (20 lb·ft)
Valve Stop Bolt Lock Nut	19 N.m (14 lb·ft)
Piston Retaining Nut	14 N.m(122 lb·in)
Cylinder Cover Retaining Bolts	14 N.m(122 lb·in)
Joint Lock Nut	23 N.m (17 lb·ft)

SECTION 5E

EXHAUST BRAKE

The following "Notice" applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology: "NOTICE: See 'Notice' on page 5E-1 of this section."

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

DESCRIPTION

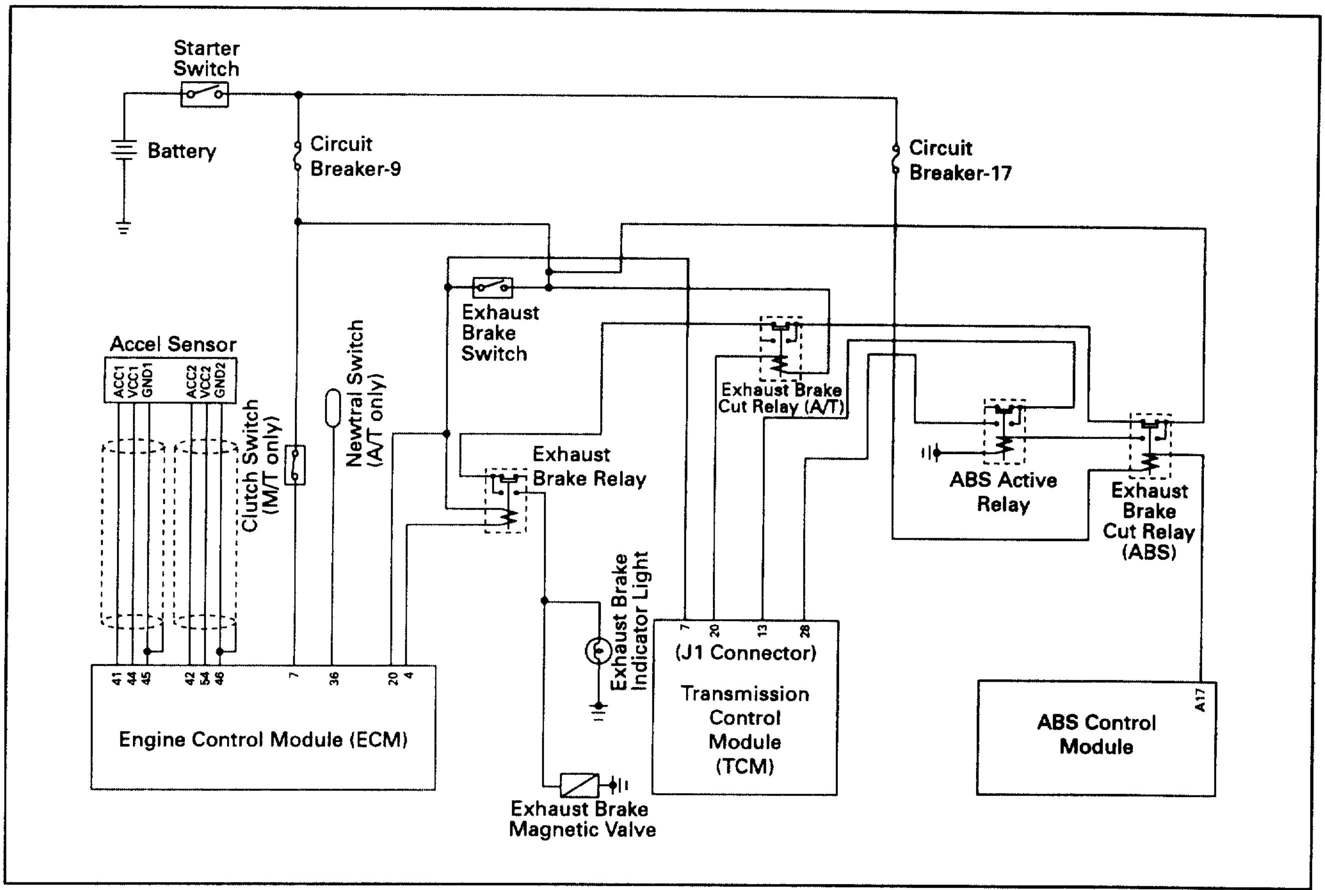


Figure 1 – Exhaust Brake Circuit Diagram

OPERATION

The exhaust brake system operates under the following conditions.

Manual Transmission Model:
The exhaust brake will operate when the exhaust brake switch is in the "ON" position and both clutch and accelerator pedals are not engaged. At this point the indicator light comes on.

Automatic Transmission Model:
The exhaust brake will operate when the exhaust brake switch is in the "ON" position, the A/T select lever is in any gear except "P" or "N", and the accelerator pedal is not engaged. At this point the indicator light comes on.

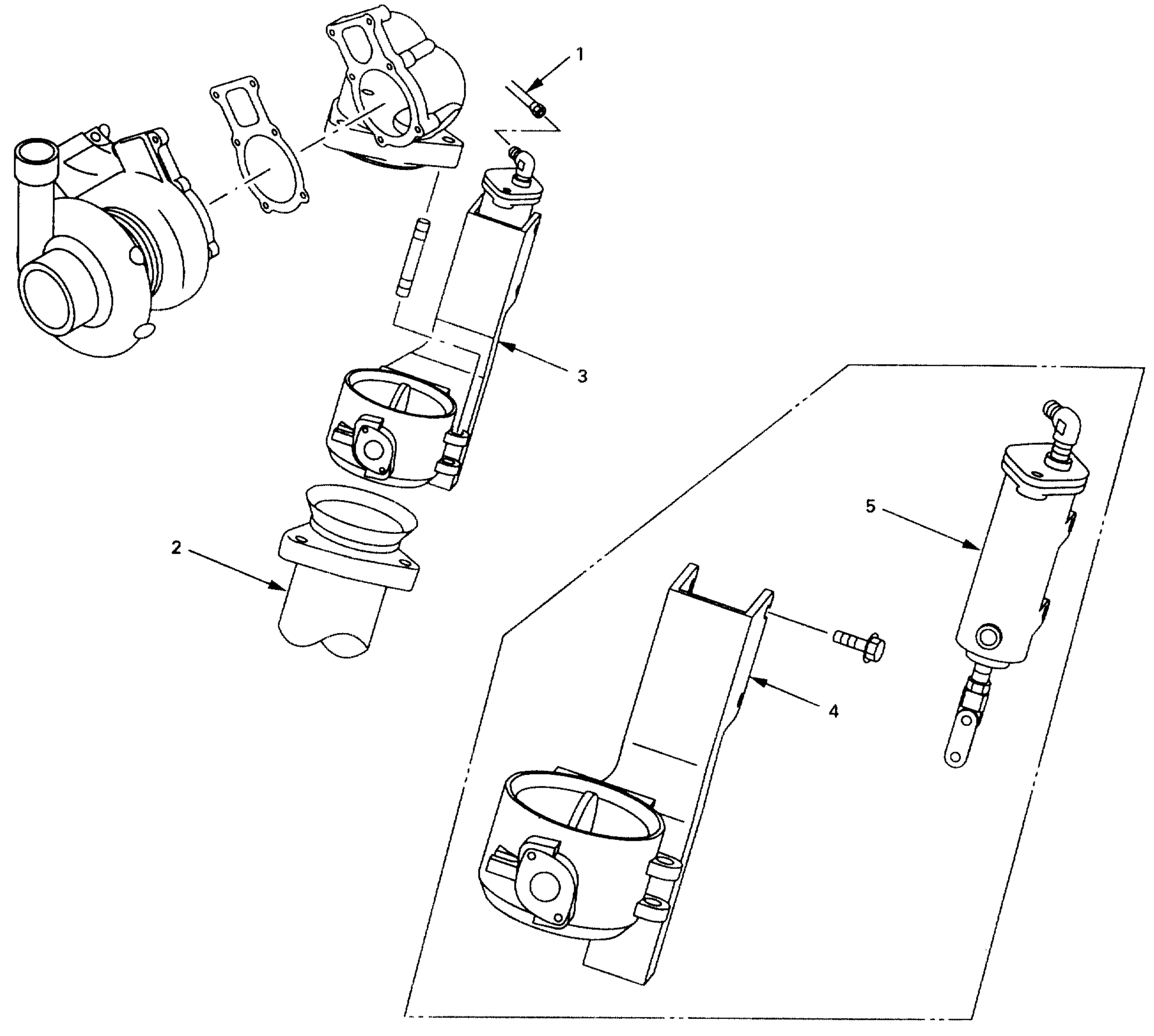
NOTE: The exhaust brake system will cancel if the Anti-lock Brake System is activated.

DIAGNOSIS OF EXHAUST BRAKE

PROBLEM	POSSIBLE CAUSE	CORRECTION
Exhaust Brake Does Not Operate	1. Blown fuse. 2. Improperly adjusted or faulty clutch pedal switch. 3. Poor connections or corroded terminals at switches or control valve. 4. Improperly adjusted or seized exhaust manifold valve. 5. Air lines kinked, restricted, or plugged with ice. 6. Air cylinder or control valve jammed with ice. 7. Faulty control valve. Valve should open when 12 volts is applied to terminals. 8. Faulty air cylinder. 9. Broken wire in wiring harness.	1. Replace. 2. Adjust or replace. 3. Clean or replace. 4. Adjust or repair. 5. Repair. In freezing weather keep air tanks drained. 6. Melt ice. Drain water lines. Keep air tanks drained in freezing weather. 7. Replace. 8. Replace. 9. Repair.
Exhaust Brake Slow to Operate	1. Tight exhaust manifold valve or lever. 2. Improperly adjusted clutch pedal switch.	1. Free up and lubricate. 2. Adjust.
Weak Braking Action	1. Improperly adjusted or tight exhaust manifold valve. 2. Tight lever. 3. Air lines kinked or partially plugged with ice. 4. Leaking fittings at air lines. 5. Leaky air cylinder.	1. Free up and/or adjust. Lubricate as needed. 2. Free up and lubricate. 3. Repair. In freezing weather, keep air tanks drained. 4. Tighten. 5. Replace.
Exhaust Brake Will Not Shut Off (Brake Control Switch "OFF")	1. Seized exhaust manifold valve. 2. Control valve or air cylinder jammed with ice. 3. Short in wiring harness (12-volts at control solenoid regardless of control switch position). 4. Faulty control switch.	1. Free up and lubricate. 2. Melt ice and drain lines. Keep air tanks drained in freezing weather. 3. Repair. 4. Replace.
Exhaust Brake "ON" Continuously When Control Switch Is"ON" (Not Controlled by Clutch Pedal Switch)	1. Improperly adjusted clutch pedal switch. 2. Switches improperly wired. 3. Short in wiring harness.	1. Adjust. 2. Check wiring against wiring diagram. Repair as needed. 3. Repair.
Engine Overheats or Loses Power	1. Exhaust manifold valve stuck partially closed. 2. Exhaust manifold valve adjusted so that it is partially closed.	1. Free up and lubricate or replace. 2. Adjust.

EXHAUST BRAKE ON-VEHICLE SERVICE

EXHAUST BRAKE ASSEMBLY REPLACEMENT



1. Air Pipe
2. Exhaust Pipe
3. Exhaust Brake Assembly
4. Exhaust Brake Valve
5. Air Cylinder

Figure 2 – Exhaust Brake

↔ Remove or Disconnect (Figure 2)

- Release compressed air from the supply reservoir.

1. Air pipe (1).
2. Exhaust pipe (2).
3. Exhaust brake assembly (3).
4. Exhaust brake valve (4).
5. Air cylinder (5).

→← Install or Connect (Figure 2)

1. Assemble air cylinder (5) on exhaust brake valve (4).

Tighten

Bolts to 26 N·m (20 lb·ft)

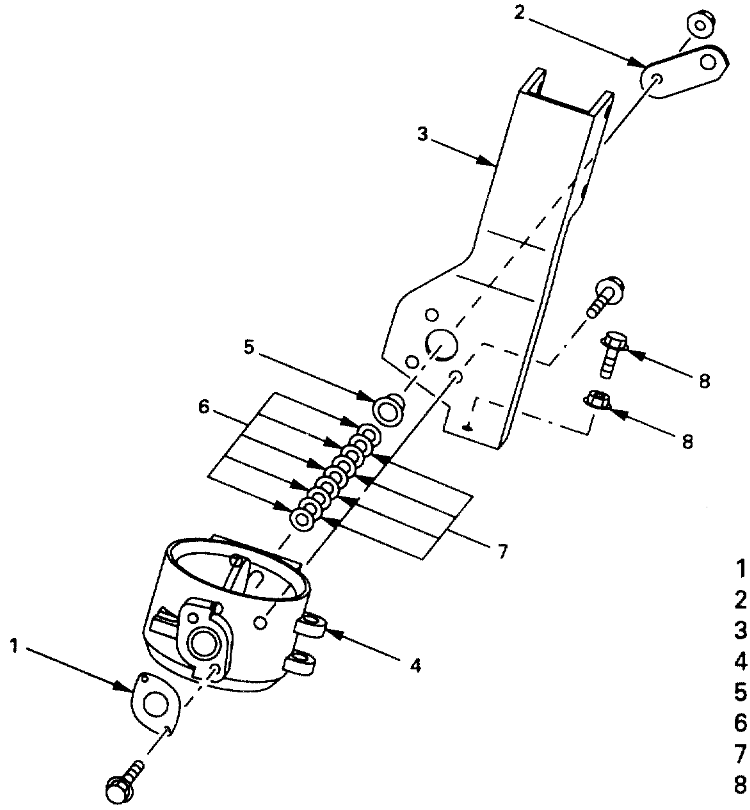
2. Connect link to lever so that air cylinder shaft should be pulled out more than 2 mm (0.08 in).

Tighten

Nut to 26 N·m (20 lb·ft)

3. Install exhaust brake assembly (3) and exhaust pipe (2) to the engine.
4. Connect air pipe (1).

EXHAUST BRAKE VALVE UNIT REPAIR



1. Cover
2. Lever
3. Bracket
4. Exhaust Brake Valve
5. Cover
6. Seal Ring: Shaft
7. Seal Ring: Hole
8. Bolt and Nut

Figure 3 – Exhaust Brake Valve Components

Disassemble (Figure 3)

1. Cover (1).
2. Lever (2).
3. Bracket (3).
4. Exhaust brake valve (4).
5. Cover (5).
6. Seal ring : shaft (6).
7. Seal ring : hole (7).
8. Bolt and nut (8).

Clean (Figure 3)

— Parts as needed in solvent.

Inspect (Figure 3)

— Shaft and bushing for galling or wear. Check the fit of the bushings on the shaft. If excessively worn or tight, replace the valve body assembly.
— Valve plate for damage.
— Valve body for cracks or damage.

Assemble (Figure 3)

1. Insert seal ring: shaft (6) and seal ring: hole (7) alternately in exhaust brake valve (4).
2. Install cover (5) on exhaust brake valve (4).
3. Install exhaust brake valve (4) on bracket (3).

Tighten

Bolts to 26 N·m (20 lb·ft)

4. Install lever (2) to exhaust brake valve (4).

Tighten

Nut to 14 N·m (122 lb·in)

5. Install cover (1)

Tighten

Bolts to 26 N·m (20 lb·ft)

6. Install bolt and nut (8) temporarily.

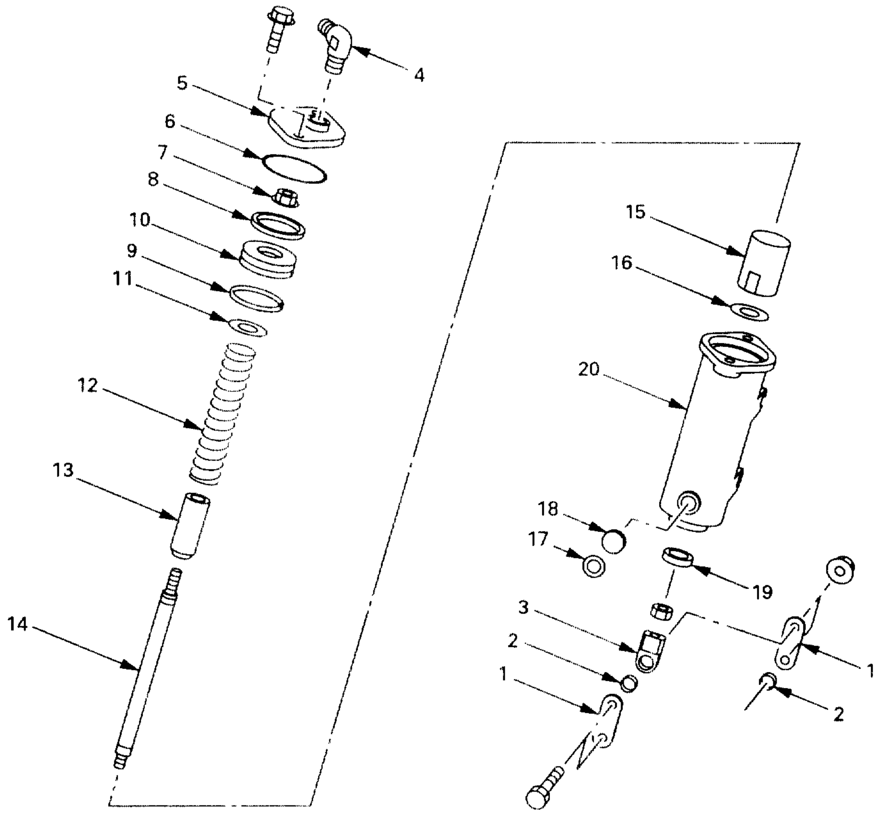
Adjust

- Adjust the valve stop bolt (8) so that the clearance between the valve and body in the exhaust brake valve (4) is between 0.2 – 0.4 mm (0.008 – 0.016 in).

Tighten

Nut (8) to 19 N·m (14 lb·ft).

AIR CYLINDER PARTS UNIT REPAIR



1. Link
2. Collar
3. Joint
4. Connector
5. Cover
6. O-ring
7. Nut
8. Gasket
9. Wear Ring
10. Piston
11. Washer
12. Spring
13. Cylinder Protector
14. Shaft
15. Guide
16. Washer
17. Retaining Ring
18. Filter
19. Dust Seal
20. Cylinder

155MY001

Figure 4 – Air Cylinder Components

Disassemble (Figure 4)

1. Links (1).
2. Collars (2).
3. Joint and nut (3).
4. Connector (4).
5. Cover (5).
6. O-ring (6).
7. Nut (7).
8. Gasket (8).
9. Wear ring (9).
10. Piston (10).
11. Washer (11)
12. Spring (12).
13. Cylinder protector (13).
14. Shaft (14).
15. Guide (15).
16. Washer (16)
17. Retaining ring (17).
18. Filter (18).
19. Dust seal (19).
20. Cylinder (20).

Clean (Figure 4)

— Parts as needed in solvent.

Inspect (Figure 4)

— Visually inspect all the parts for excessive wear and damage. If excessive wear or damage is discovered during inspection, the part(s) must be replaced.

Assemble (Figure 4)

1. Cylinder (20).
   - Apply a coat of fluoride grease to the entire inside surface of the cylinder body.
   - Apply a coat of liquid gasket to the dust seal installation position of the cylinder body.
2. Filter (18) and retaining ring (17).
3. Dust seal (19).
   - Apply grease to the dust seal lip.
   - Apply a coat of liquid gasket to the dust seal outer circumference.
   - Stake cylinder (20) at three spots.
4. Set washer (16) and guide (15) in cylinder (20), aligning guide hole with cylinder breather hole.
5. Shaft (14).
   - Apply a coat of fluoride grease to the entire surface of the shaft assembly.
6. Insert shaft (14) into cylinder protector (13).
7. Set spring (12) in cylinder (20).
8. Set washer (11) and piston (10) to shaft (14).
9. Nut (7).

Tighten

Nut to 14 N·m (122 lb·in)

10. Install gasket (8) and wear ring (9) on piston (10).
11. Set O-ring (6) and piston assembly in cylinder (20).
12. Cover (5).

Tighten

Cover fixing bolts to 14 N·m (122 lb·in)

13. Connector.
14. Drive nut and joint fully into shaft (14).

Tighten

Nut to 23 N·m (17 lb·ft)

15. Install collar (2) and link (1).

Tighten

Nut to 26 N·m (20 lb·ft)

CLUTCH PEDAL SWITCH REPLACEMENT (Manual Transmission Only)

Remove or Disconnect (Figure 5)

1. Battery negative cable.
2. Wires (1).
3. Nut (2).
4. Clutch pedal switch (4).

Install or Connect (Figure 5)

1. Clutch pedal switch (4).
2. Nut (2). Do not tighten.

Adjust

- Clutch pedal switch to obtain dimension "A" (figure 5).

3. Wires (1).
4. Battery negative cable.

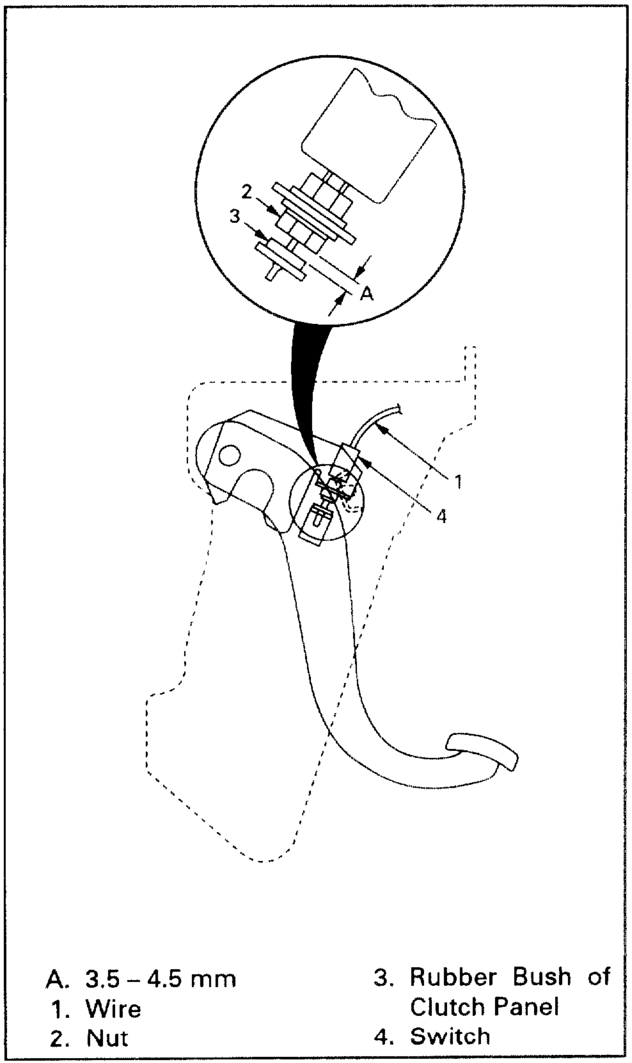


Figure 5 – Clutch Pedal Switch

CONTROL VALVE REPLACEMENT

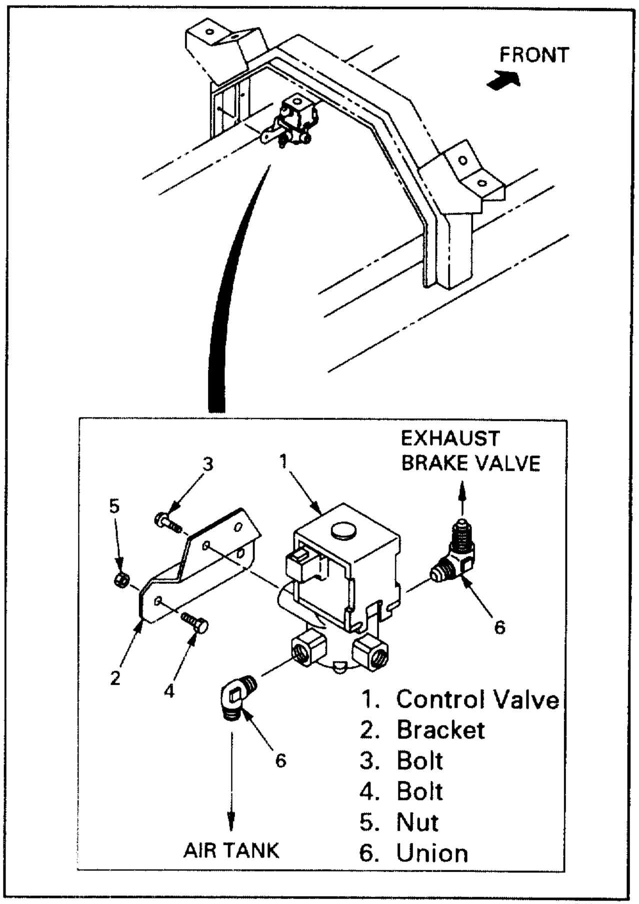


Figure 6 – Control Valve

CONTROL VALVE REPLACEMENT

- The control valve (1) is located inside the rear cab member (Figure 6).

Remove or Disconnect (Figure 6)

- Release all compressed air from the air tanks.

1. Control valve wires.
2. Air lines.
3. Bolts (4), nuts (5).
4. Bracket (2).
5. Control valve (1).

Install or Connect (Figure 6)

1. Bracket (2).
2. Control valve (1) to rear cab member.
3. Bolts (4) and nuts (2).
4. Air lines.
5. Control valve wires.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Air Cylinder Retaining Bolts	26 N.m (20 lb·ft)
Lever to Link Bolt	26 N.m (20 lb·ft)
Exhaust Brake Valve Retaining Bolts	26 N.m (20 lb·ft)
Lever Retaining Nut	14 N.m(122 lb·in)
Cover Retaining Bolts	26 N.m (20 lb·ft)
Valve Stop Bolt Lock Nut	19 N.m (14 lb·ft)
Piston Retaining Nut	14 N.m(122 lb·in)
Cylinder Cover Retaining Bolts	14 N.m(122 lb·in)
Joint Lock Nut	23 N.m (17 lb·ft)

SECTION 6

ENGINE

CONTENTS

MEMO

SECTION 6C2

DIESEL FUEL INJECTION

NOTICE: *Always use the correct fastener in the correct location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.*

CONTENTS

GENERAL DESCRIPTION

COMMON RAIL SYSTEM

This section covers the electronically controlled fuel injection system for 6HK1 diesel engine.

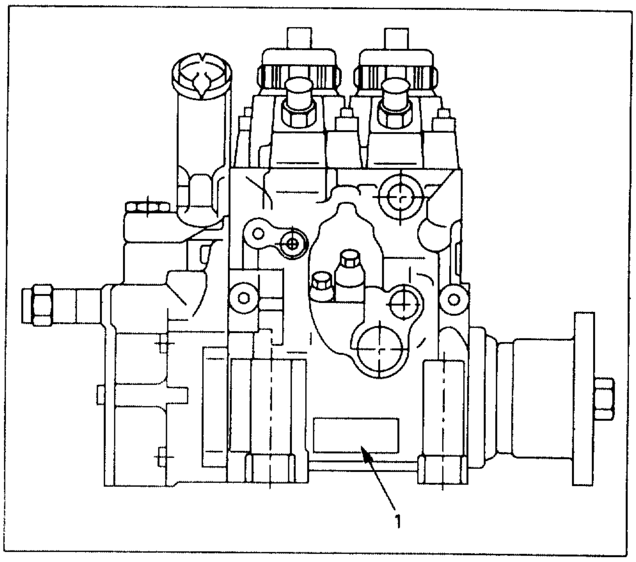
The 6HK1 (7.8L) diesel engine fuel system consists of the following.

- Fuel tank
- Fuel hoses and lines
- Water separator
- Fuel filter
- Fuel feed pump
- Fuel supply pump
- Fuel common rail
- Steel lines
- Six fuel injectors with solenoid valve

The fuel supply pump, fuel common rail and the fuel injectors are made by DENSO.

If an internal problem occurs in the fuel supply pump, the fuel supply pump must be removed from the engine and serviced by an authorized DENSO dealer. Do not open the fuel supply pump and injector assembly, or the warranty is void.

The fuel supply pump has an identification tag (1) attached to the fuel supply pump body (Figure 1).



Legend

(1) Identification Tag

Figure 1 – Identification Tag Location

SYSTEM OUTLINE

The COMMON RAIL SYSTEM detects engine conditions (engine speed, accelerator pedal angle, coolant temperature, etc.) by means of its sensors and generally control fuel injection amount, timing, and pressure by means of its microcomputer, thereby making the engine run in the best condition.

Further, the system performs the self-diagnosis/lighting function to diagnose main components and, if abnormality found, worn the driver, the failsafe function to stop the engine depending on the parts to which trouble has occurred, and the backup function to switch over the control method to enable the vehicle to run continuously.

SYSTEM COMPOSITION

The system can be functionally divided into two systems, fuel and control.

(1) Fuel System

The high pressure fuel generated by supply pump is distributed to each cylinder. The solenoid valve in the injector opens and closes the nozzle needle valve, thereby controlling the start and end of fuel injection.

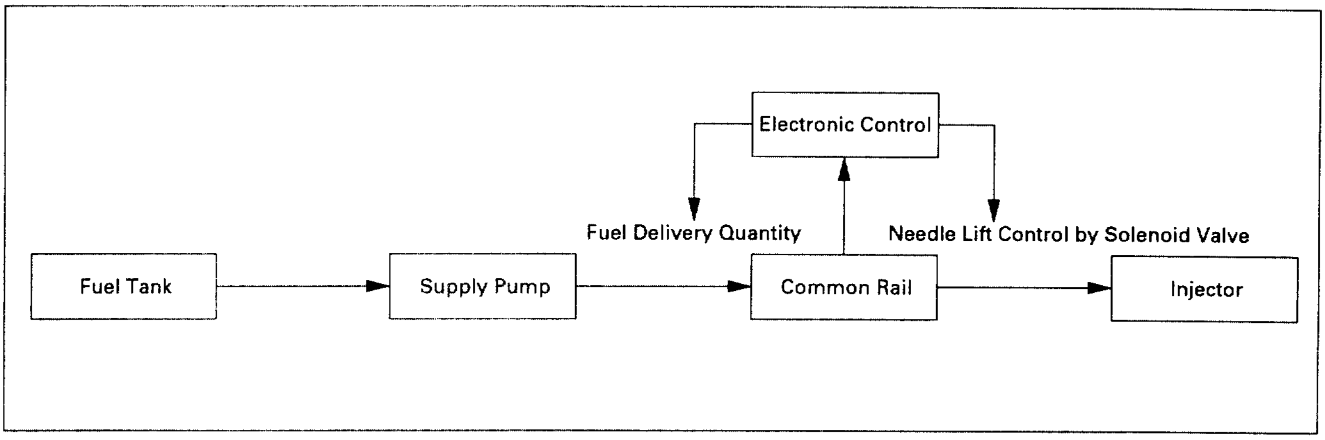


Figure 2 – Fuel System Composition

(2) Control System

ECM is used to compute and control from the signals received from the sensors installed to the engine and vehicle the timing and time for passing current to the injector so that the optimum quantity of fuel can be injected at the optimum timing.

The control system mainly comprises sensors, computer, and actuator.

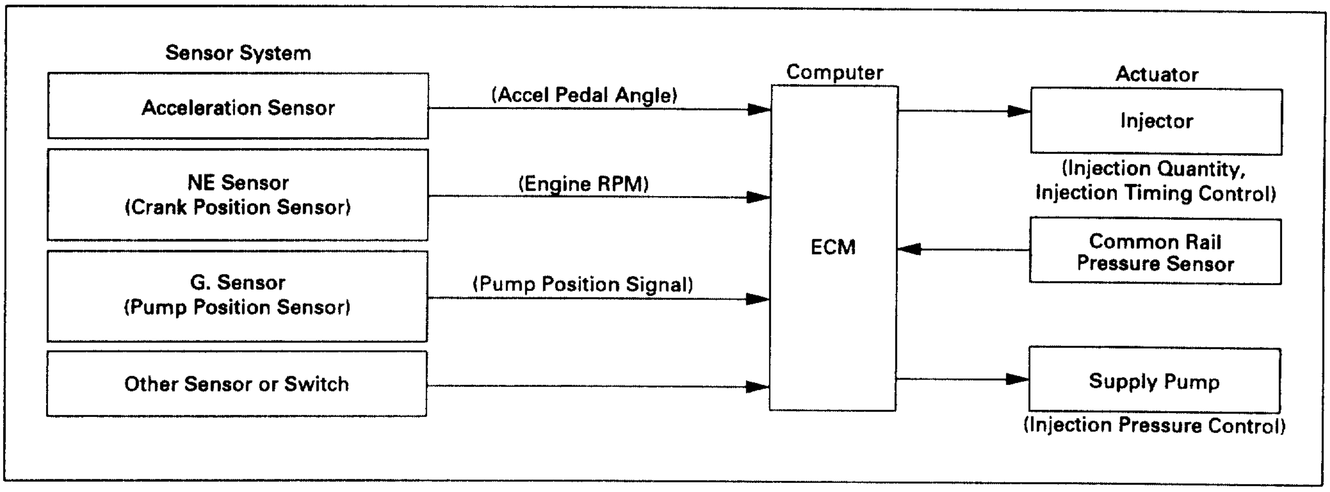


Figure 3 – Control System

(2) System Construction

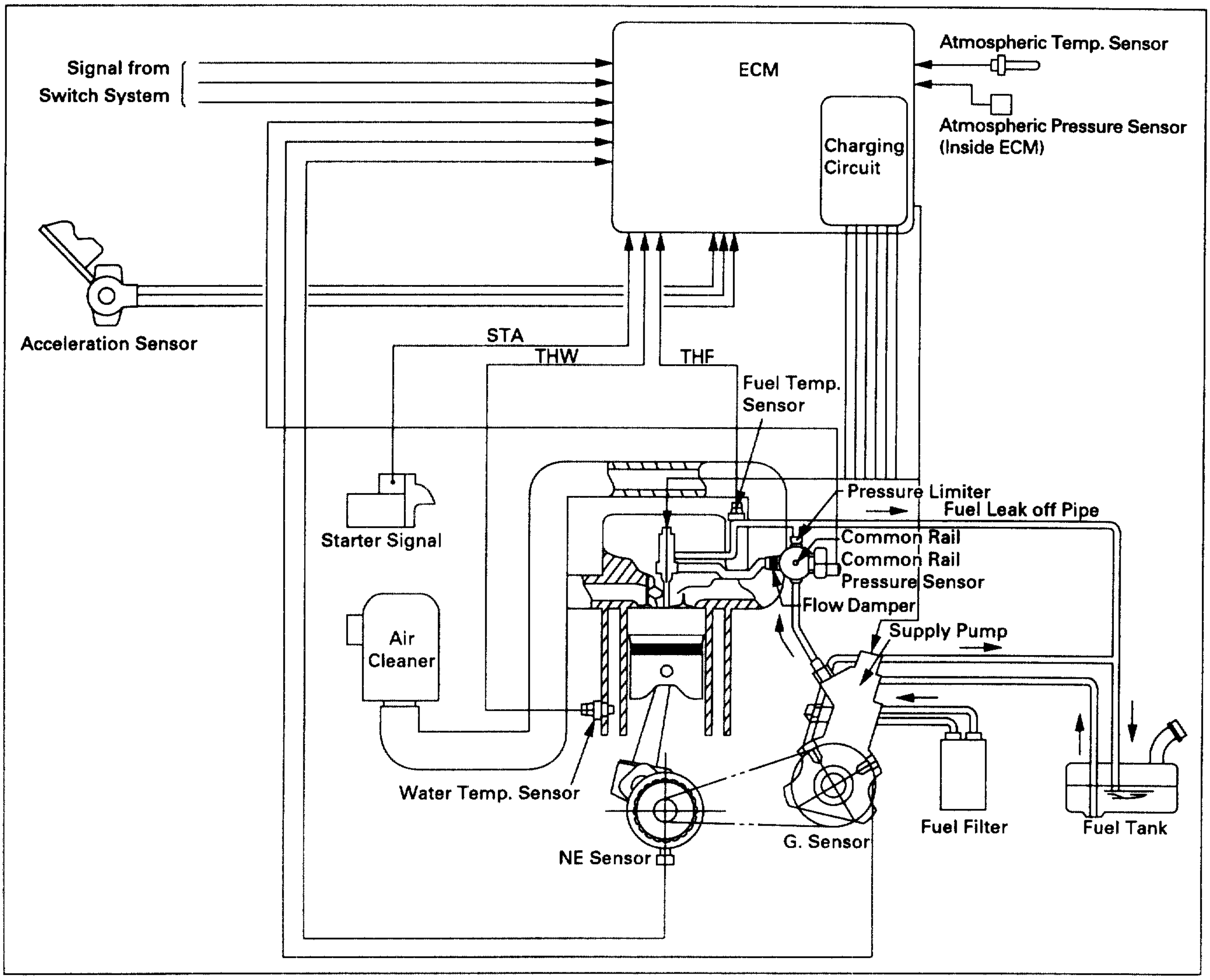


Figure 4 – System Construction

SYSTEM DESCRIPTION AND OPERATION

The COMMON RAIL SYSTEM consists of an supply pump, common rail, injector, ECM and sensors.

The supply pump generates the fuel pressure in the common rail. Fuel pressure is controlled depending on the fuel amount discharged from the supply pump. The fuel discharge amount is controlled by means of PCV provided in the supply pump which is opened/closed in response to electric signals from ECM.

The common rail receives and distributes the fuel pressure made by the supply pump to each cylinder. Fuel pressure is detected by means of a common rail pressure sensor installed to the common rail and is feedback controlled so that the instructed pressure value set according to engine speed and load can agree with an actual pressure value.

The fuel pressure in the common rail is applied through the injection pipe of each cylinder to the nozzle side and control chamber of the injector.

The injector controls injection amount and time by switching on and off a TWV (Two Way Valve). When the TWV is switched on (to carry current), the fuel circuit is changed over to such a status that the high pressure fuel in the control chamber may flow out through and outlet orifice. Owing to nozzle valve opening force caused by the nozzle side of high pressure fuel, the needle valve is lifted to start fuel injection. When the TWV is switched off (to cut current), the fuel circuit is changed over to such a status that the high pressure fuel is flowed back through the inlet orifice into the control chamber.

Therefore, the needle valve comes down to stop fuel injection.

Thus, fuel injection time can be electronically controlled by TWV switching on and fuel injecting amount, by TWV switching off.

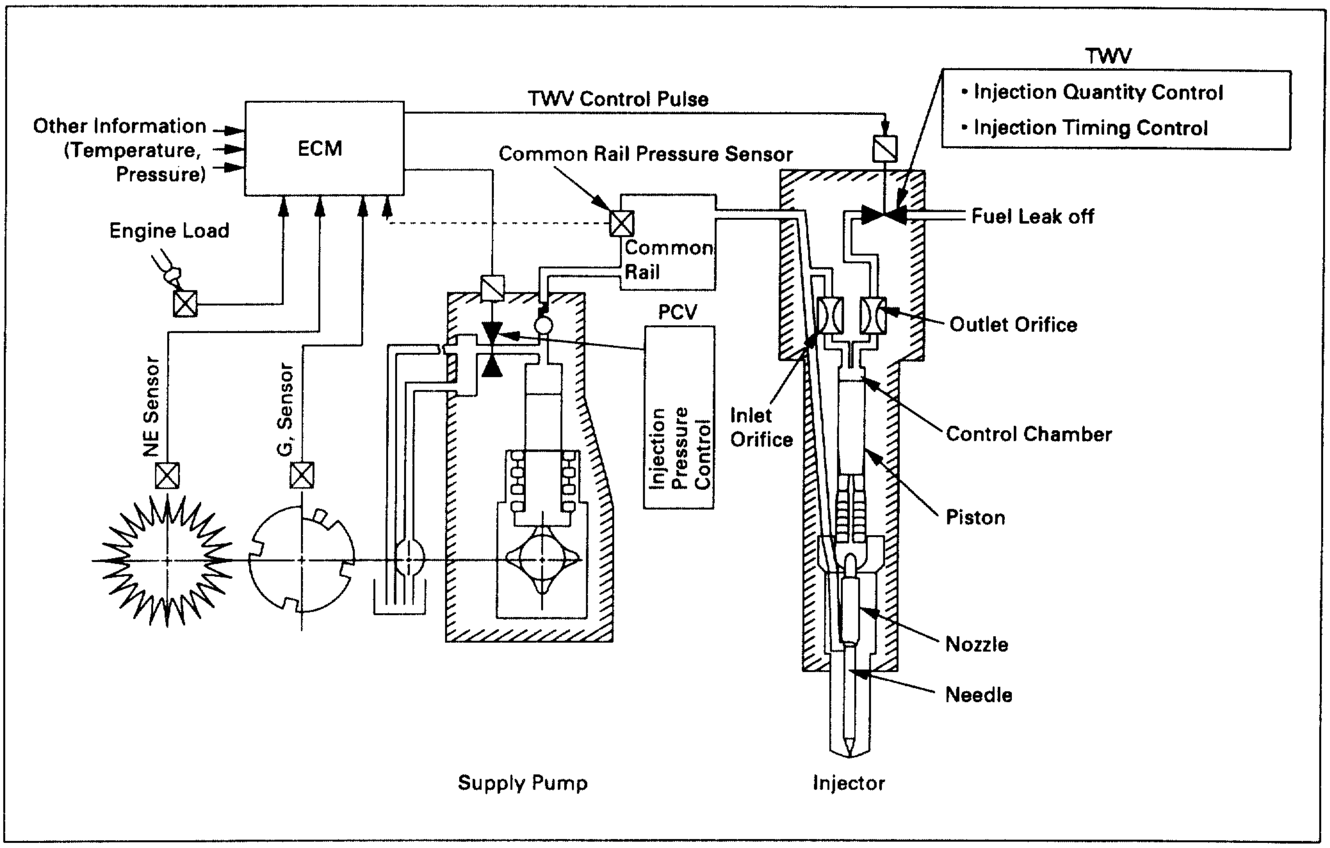


Figure 5 – System Description and Operation

VARIOUS CONTROLS

In comparison with the mechanical governor or timer used in the conventional type supply pump, fuel injection amount/timing can be controlled further properly.

ECM computes from signals coming from the sensors installed to engine and vehicle and controls the time point and length for carrying current to the injector so that the optimum injection can be performed at the optimum timing.

(1) Fuel Pilot Injection Control Function

This is a function to control either fuel pilot injection or not.

(2) Fuel Injection Amount Control Function

This is a function to control fuel injection based on signals from engine speed and accelerator opening sensors so that the optimum injection amount can be obtained. A substitute for the conventional mechanical governor.

(3) Fuel Injection Timing Control Function

This is a function to obtain the optimum injection timing from engine speed and fuel injection amount. A substitute for the conventional timer.

(4) Fuel Injection Pressure Control Function (Common Rail Pressure Control Function)

This is a function to measure fuel pressure with the common rail sensor and feed back the measurement to ECM thereby to control the discharge amount of the pump.

Pressure feedback control is carried out so that the optimum value (instructed value) set according to engine speed and fuel injection amount can be reached

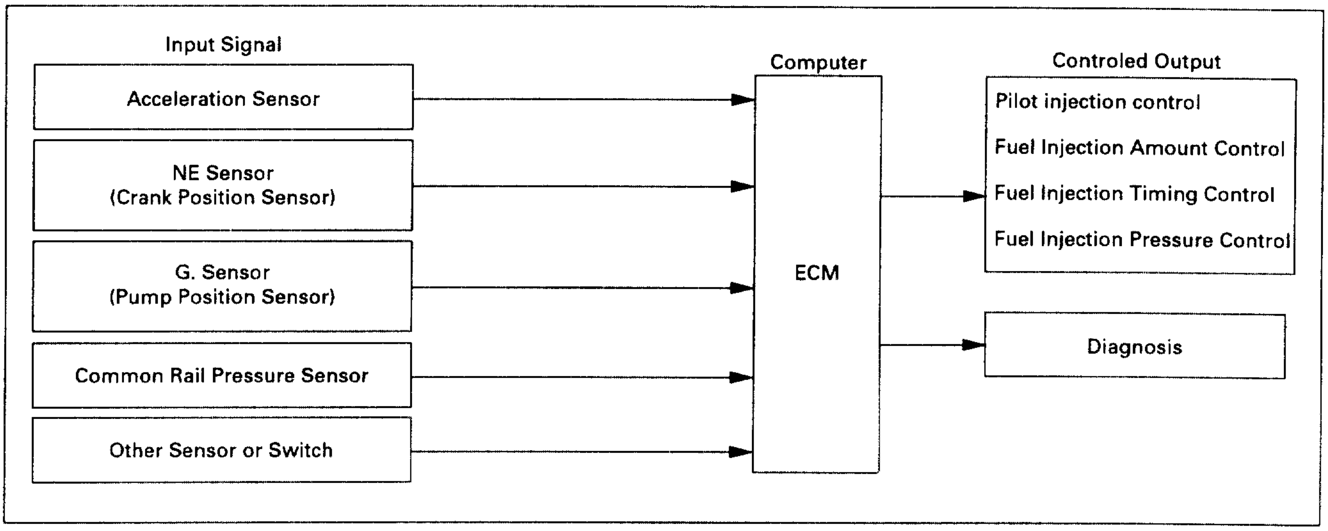


Figure 6 – Control System

FUEL INJECTION RATE CONTROL

(1) Main Injection

Same as the conventional system.

(2) Pilot Injection

This is a small amount of injection conducted prior to the conventional fuel injection (main injection).
Injection rate is increased as there is a rising tide of high pressure injection. But a time lag from fuel injection to combustion start (ignition delay) cannot be shortened over a certain value. As a result the fuel injected could be increased till ignition to cause instantaneous explosive combustion which would in turn increase NOx and noise. Pilot injection puts down an initial injection rate to the irreducible minimum to lessen the explosive combustion so that NOx and noise can be reduced.

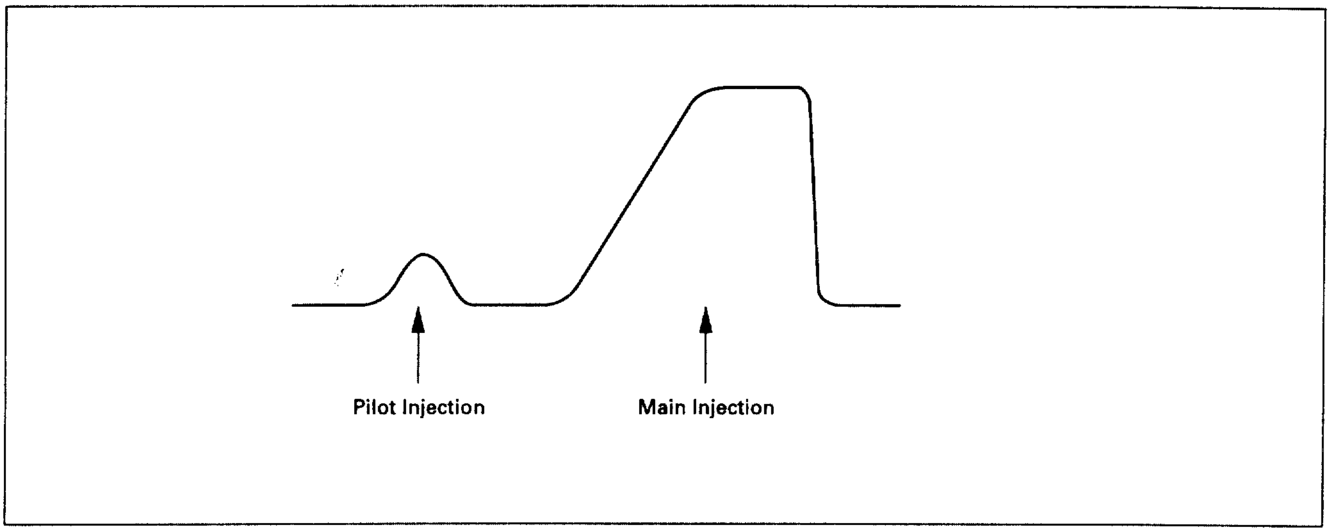


Figure 7 – Pilot Injection

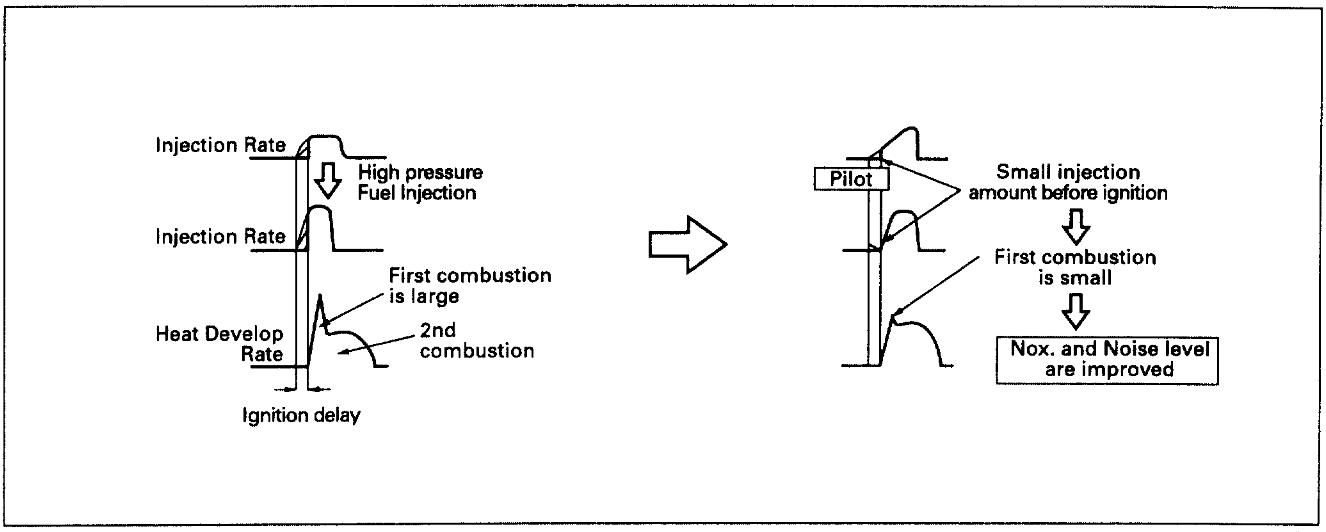


Figure 8 – Combustion Situation Under High Fuel Pressure

(3) Split Injection

This means two or more small amount fuel injections to be conducted prior to the conventional fuel injection (main injection) for increase engine start under cold weather.

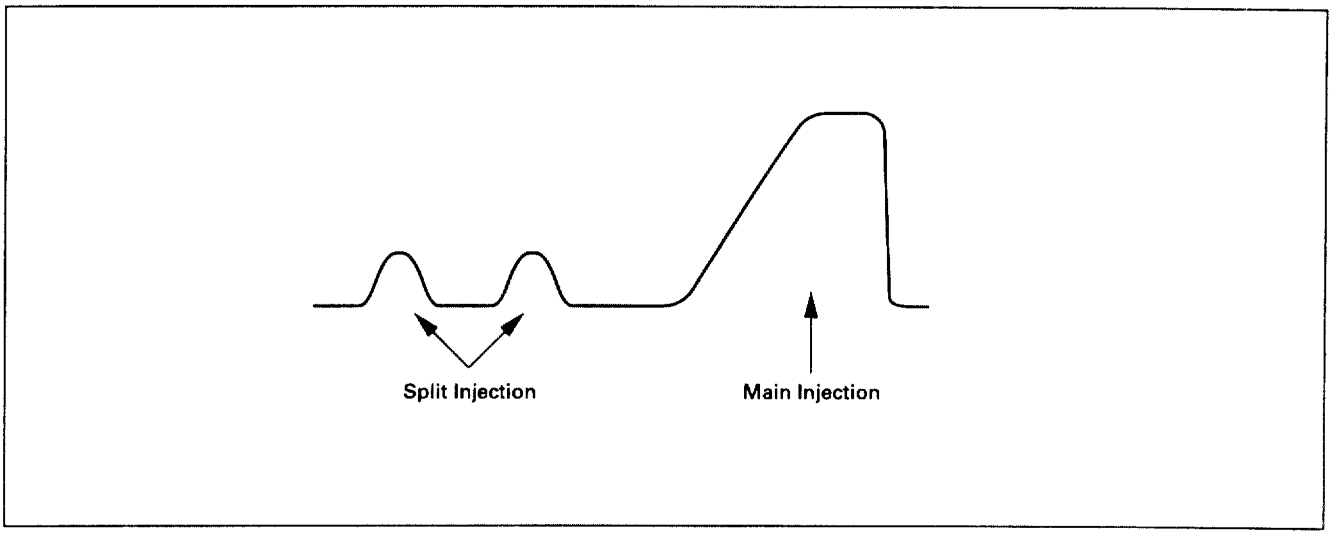


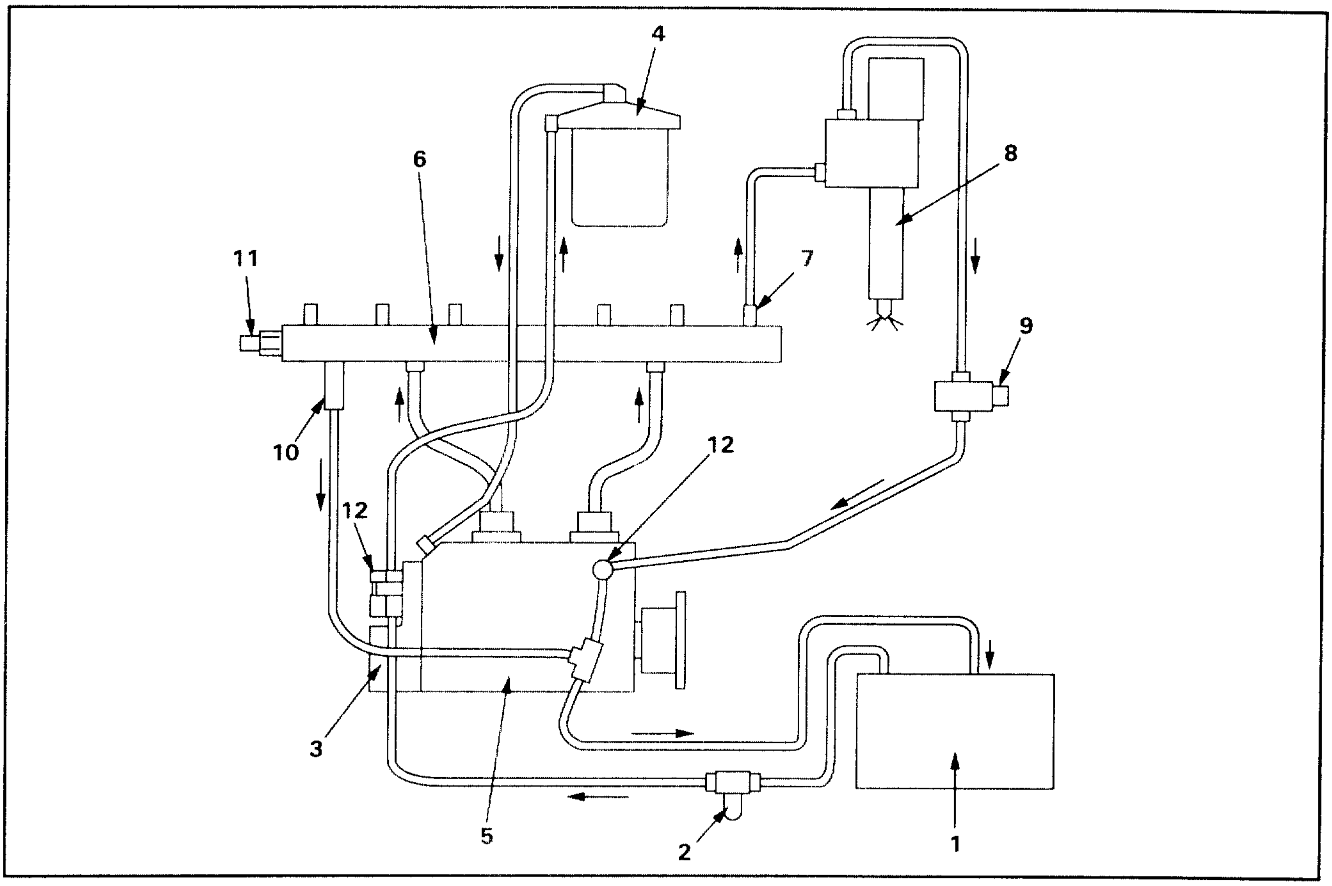
Figure 9 – Split Injection

FUEL INJECTION SYSTEM

SYSTEM OPERATION

Fuel is drawn through the fuel pre-filter (2) by the fuel feed feed pump (3), refer to (Figure 10). The fuel feed pumps the fuel into the fuel filter (4) and then into the fuel supply pump (5). The fuel supply pump then pressurizes and supplies the fuel to fuel common rail.

The pressured fuel distributes through the fuel injectors line to the fuel injectors (8). The high pressure fuel enters the fuel injector and forces the needle off its seat, same time the fuel enters the control room of fuel injectors. The fuel injection timing is controlled by ECM. The ECM command to open the fuel return line of solenoid valve on top of the injector, then the fuel is forced out of the fuel injector into the cylinder.

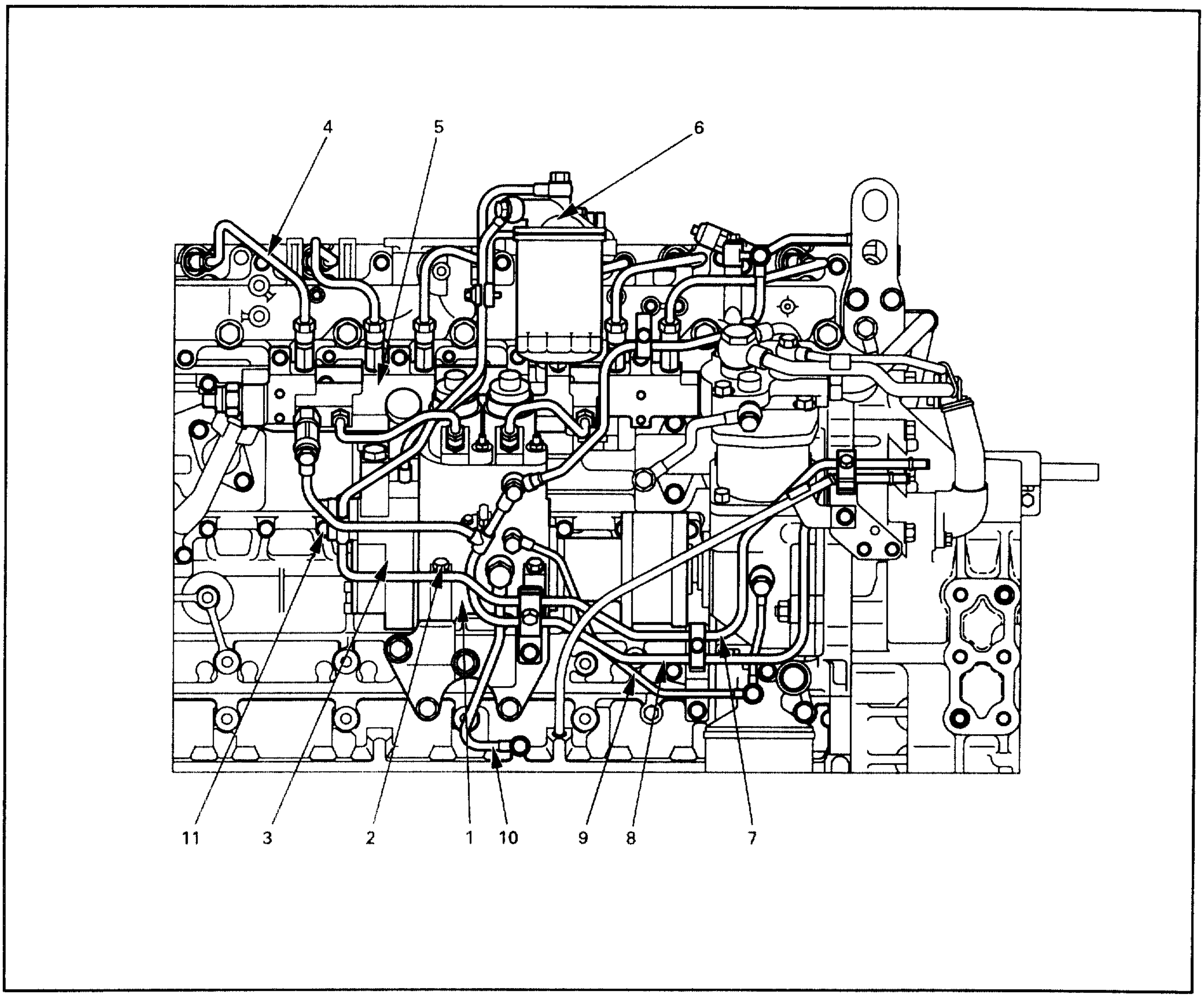


Legend

(1) Fuel Tank	(7) Fuel Flow Dumper
(2) Fuel Pre-Filter	(8) Injector Assembly
(3) Fuel Feed Pump	(9) Fuel Temperature Sensor
(4) Fuel Filter	(10) Fuel Pressure Limiter
(5) Supply Pump	(11) Fuel Pressure Sensor
(6) Fuel Common Rail	(12) Overflow Valve

Figure 10 — Fuel System Schematic

ON VEHICLE SERVICE



Legend

- (1) Fuel Supply Pump
- (2) Bolt
- (3) Fuel Transfer Pump
- (4) Injection Pipe
- (5) Common Rail
- (6) Fuel Filter
- (7) Fuel Feed Pipe
- (8) Fuel Return Pipe
- (9) Oil Feed Pipe
- (10) Oil Return Pipe
- (11) Fuel Return Overflow Pipe

Figure 11 — Location of Fuel System

FUEL SUPPLY PUMP

⟷ Removal

1. Tilt the cab.
2. Disconnect the negative battery cable.
3. Disconnect PCV harness connector.
4. Disconnect G sensor harness connector.
5. Remove clamp bolts from the fuel feed pipe (7), fuel return pipe (8) and fuel supply pipe to fuel filter.
6. Remove fuel feed pipe (7).
7. Remove fuel return pipe (8).
8. Remove oil feed pipe.
9. Remove oil return pipe.
10. Remove two fuel supply pipes between supply pump and common rail.
11. Disconnect coupling fixing bolts.
12. Remove fuel supply pump fixing bolts.
13. Remove fuel supply pump assembly.

Installation

1. Turn crankshaft until the TDC mark is aligned with the pointer. Make sure the No. 1 cylinder is at TDC on the compression stroke.

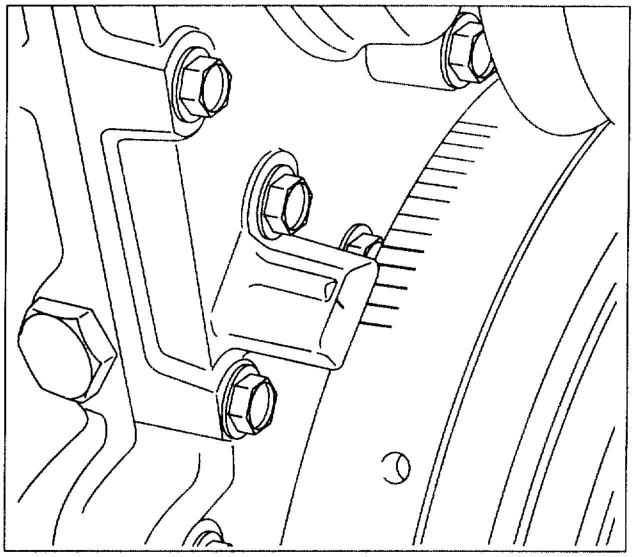


Figure 12 – TDC Mark

2. Confirm that the "S" on the air compressor coupler is aligned with the pointer on the air compressor body. If not, the crankshaft is not on No. 1 compression stroke and must be rotated one turn.
3. Align alignment mark between supply pump coupler and supply pump housing.

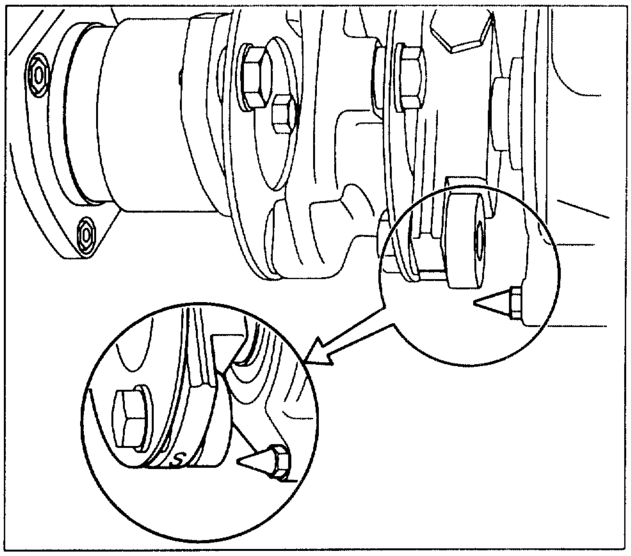
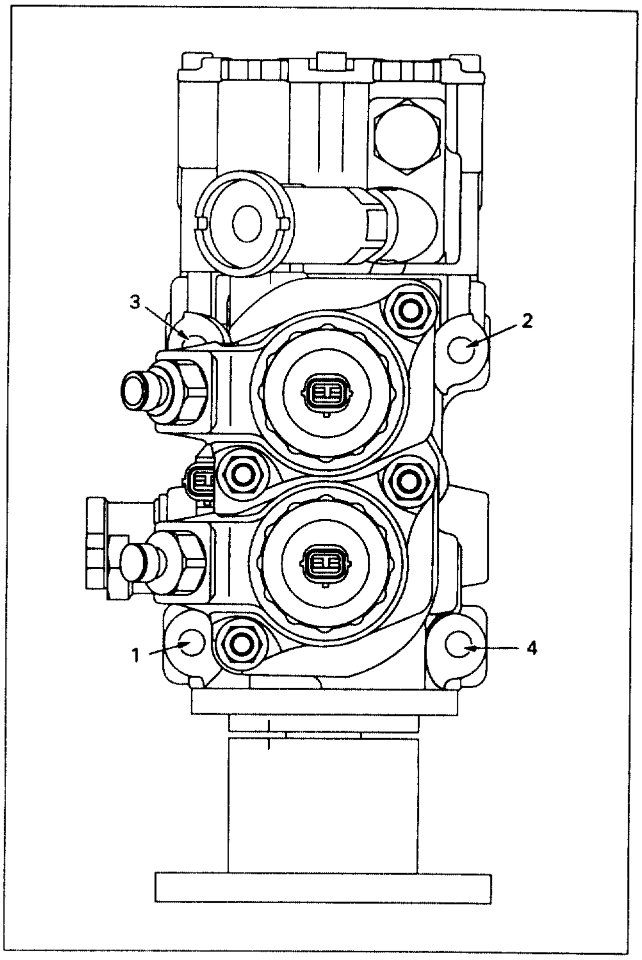


Figure 13 – Supply Pump Pointer

4. Install supply pump assembly onto the pump bracket.
5. Tighten supply pump fixing bolts to the specified torque.
   Torque : 25 N·m (18 lb·ft)



Legend

The number indicate to tighten order.

Figure 14 – Supply Pump Fixing Sequence

6. Tighten coupling bolts to the specified torque.
   Bolt 1: 91 N·m (66 lb·ft)
   Bolt 2: 61 N·m (46 lb·ft)
   Bolt 3: 60 N·m (45 lb·ft)

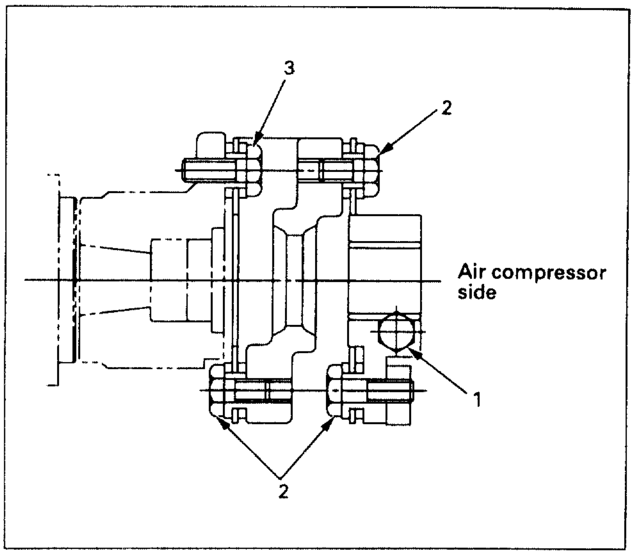


Figure 15 – Coupling Bolts

7. Install two fuel supply pipes between supply pump and commonrail.
8 Install oil return pipe.
9. Install oil feed pipe.
10. Install fuel return pipe.
11. Install fuel feed pipe.

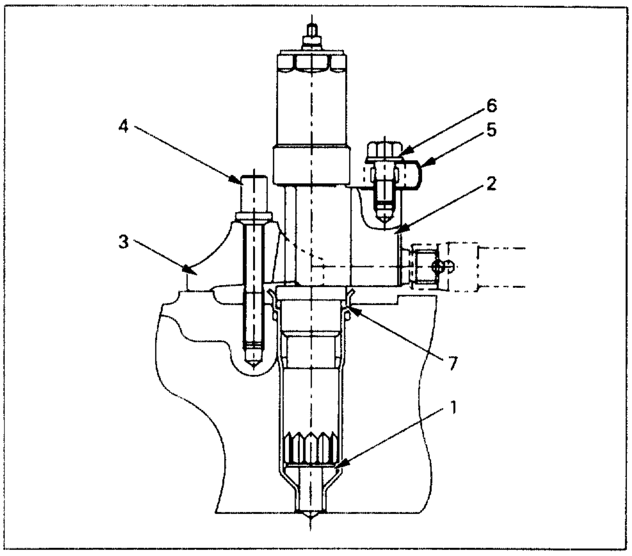
Caution: When install fuel feed pipe on the fuel feed pump, must use special gasket between feed pipe eye (on the relief valve) and return pipe eye (short return pipe). If use other gasket it will cause not start engine.

12. Tighten clamp bolts with clamp.
    Torque : 6 N·m (52 lb·in)
13. Reconnect G sensor harness connector.
14. Reconnect PCV harness connector.
15. Reconnect negative battery cable.
16. Down cab and lock.

FUEL INJECTOR

Removal

1. Tilt cab.
2. Disconnect the negative battery cable.
3. Disconnect two TWV harness connector at outside of lower case (Under the valve rocker arm cover).
4. Remove injection pipes between injector and supply pump.
5. Remove valve rocker arm cover.
6. Disconnect TWV harness connector from inside of lower case joint connector.
7. Loosen terminal nuts for TWV harness on the top of injector and remove TWV harness.
8. Remove TWV harness assembly from top of rocker arm assembly.
9. Loosen injector clamp bolt then remove injector assembly.



Legend

(1) Injector Gasket
(2) Injector Assembly
(3) Injector Clamp
(4) Clamp Bolt
(5) Gasket for Return Pipe
(6) Eye Bolt
(7) Injector Sleeve

Figure 16 – Fuel Injector

Installation

1. Standing put injector clamp on the valve spring seat as shown in the illustration.

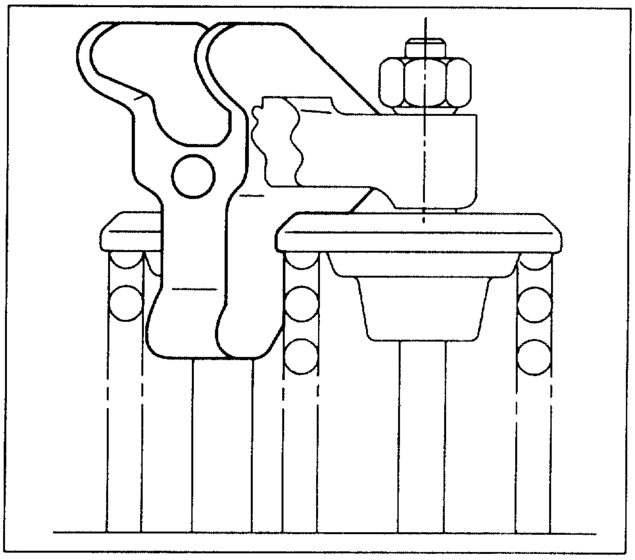


Figure 17 – Fuel Injector Clamp

2. When injector assembly comes installation portion, the injector clamp putting on the injector then install the injector assembly together with clamp into injector sleeve hole.
3. Temporary tighten injection pipe to injector.
4. Apply molybdenum disulfide grease to clamp bolt, tighten injector clamp bolt to specified torque.
   Torque : 31 N·m (22 lb·ft)
5. Tighten injection pipe to the specified torque.
   Torque : 44 N·m (33 lb·ft)
6. Install fuel return pipe, tighten eye bolt to the specified torque.
   Torque : 12 N·m (106 lb·in)

Note:

1. ***Be confirm that tightening torque of injection pipe (Item 5 above) and fuel return pipe eye bolt (Item 6 above) after tighten them for prevent to dilute of engine oil.***
2. ***Make sure that the gasket for return pipe (5) not ride on the injector body when tighten eye bolt. (The correct direction shown in the Figure 16).***

7. Install TWV harness assembly, tighten fixing bolt to specified torque.
   Torque : 22 N·m (16 lb·ft)
8. Install TWV harness to TWV terminals, tighten fixing nut to the specified torque.
   Torque : 2 N·m (17.7 lb·in)

Note: Do not over tight TWV terminal nuts.

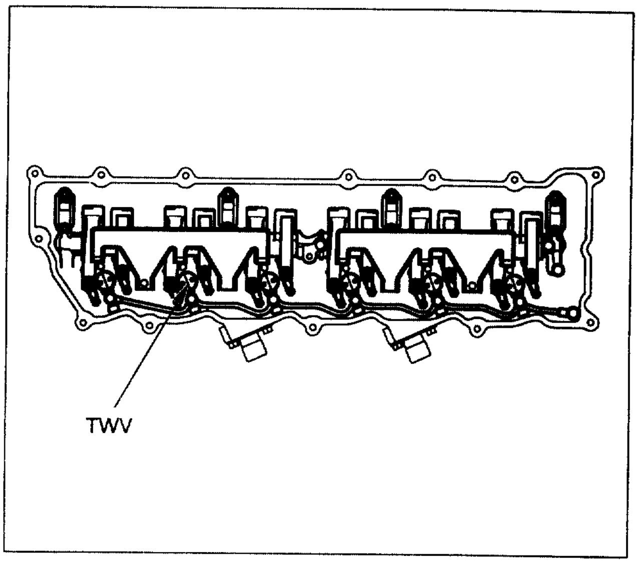


Figure 18 – TWV

9. Reconnect TWV harness to lower case joint connector.
10. Install valve rocker arm cover to tighten to the specified torque.
    Torque : 13 N·m (113 lb·in)
11. Reconnect two TWV harness connector at outside of lower case.
12. Reconnect the negative battery cable.
13. Down cab.

Bleeding Fuel System

Note: The injector assembly must be replaced only assembly.
When the fuel system is opened to the atmosphere, it must be bleed to remove all the air. Air in the fuel system will cause a no start or poor engine performance.

1. Loosen the primer pump knob (1, Figure 19) on the fuel supply pump.

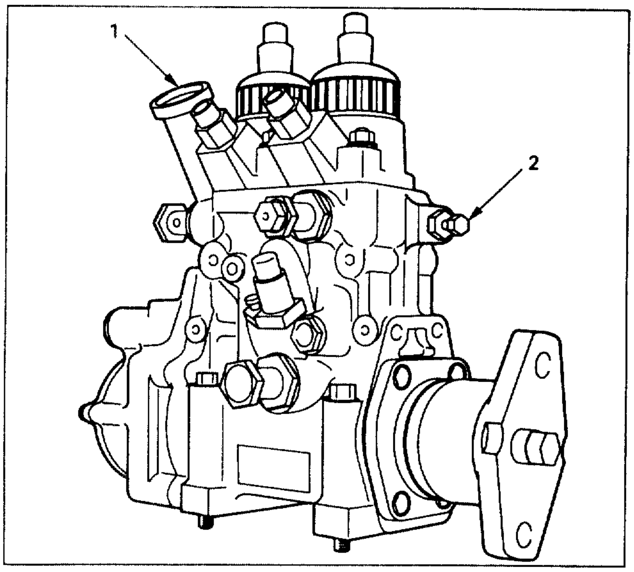


Figure 19 – Supply Pump

2. Loosen the fuel feed line eye bolt (1, Figure 20) on the fuel filter.

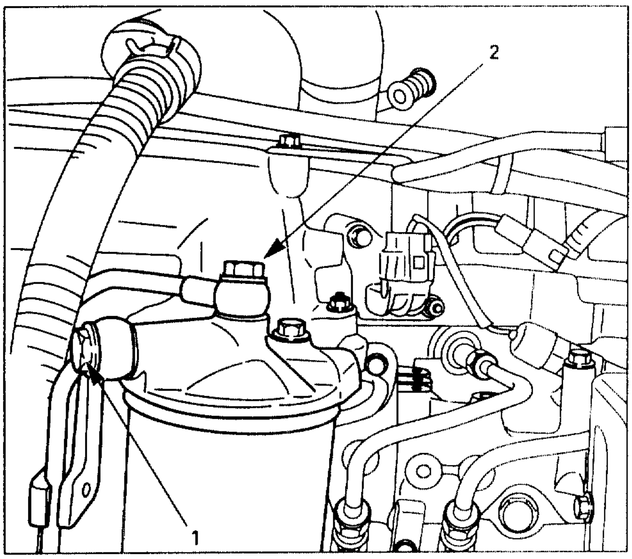


Figure 20 – Fuel Filter

3. Pump the primer pump (1, Figure 19), until a solid stream of fuel comes from the fuel filter feed line eye bolt (1, Figure 20).
4. Tighten the fuel filter eye bolt.
   Torque : 41 N·m (30 lb·ft)
5. Loosen the fuel feed line eye bolt (2, Figure 20) on the fuel filter.
6. Pump the primer pump (1, Figure 19), until a solid stream of fuel comes from the fuel feed line eye bolt (2, Figure 20).
7. Tighten the fuel filter eye bolt (2, Figure 20).
   Torque : 41 N·m (30 lb·ft)
8. Loosen the air bleeding plug (2, Figure 19) on the supply pump.
9. Pump the primer pump (1, Figure 19), until a solid stream of fuel comes from the air bleeding plug (2, Figure 19).
10. Tighten the air bleeding plug.
    Torque : 6 N·m (52 lb·in)
11. Pump the primer pump 60 times.
12. Starter switch "ON" but do not be started engine, turn on the engine idling adjust switch to idling downward until 5 minutes.
13. Pump the primer pump 60 times during step 12.
14. Engine start.
    If the engine does not start, repeat air bleeding procedure form step 1.

Important tightening torque for fuel injection system

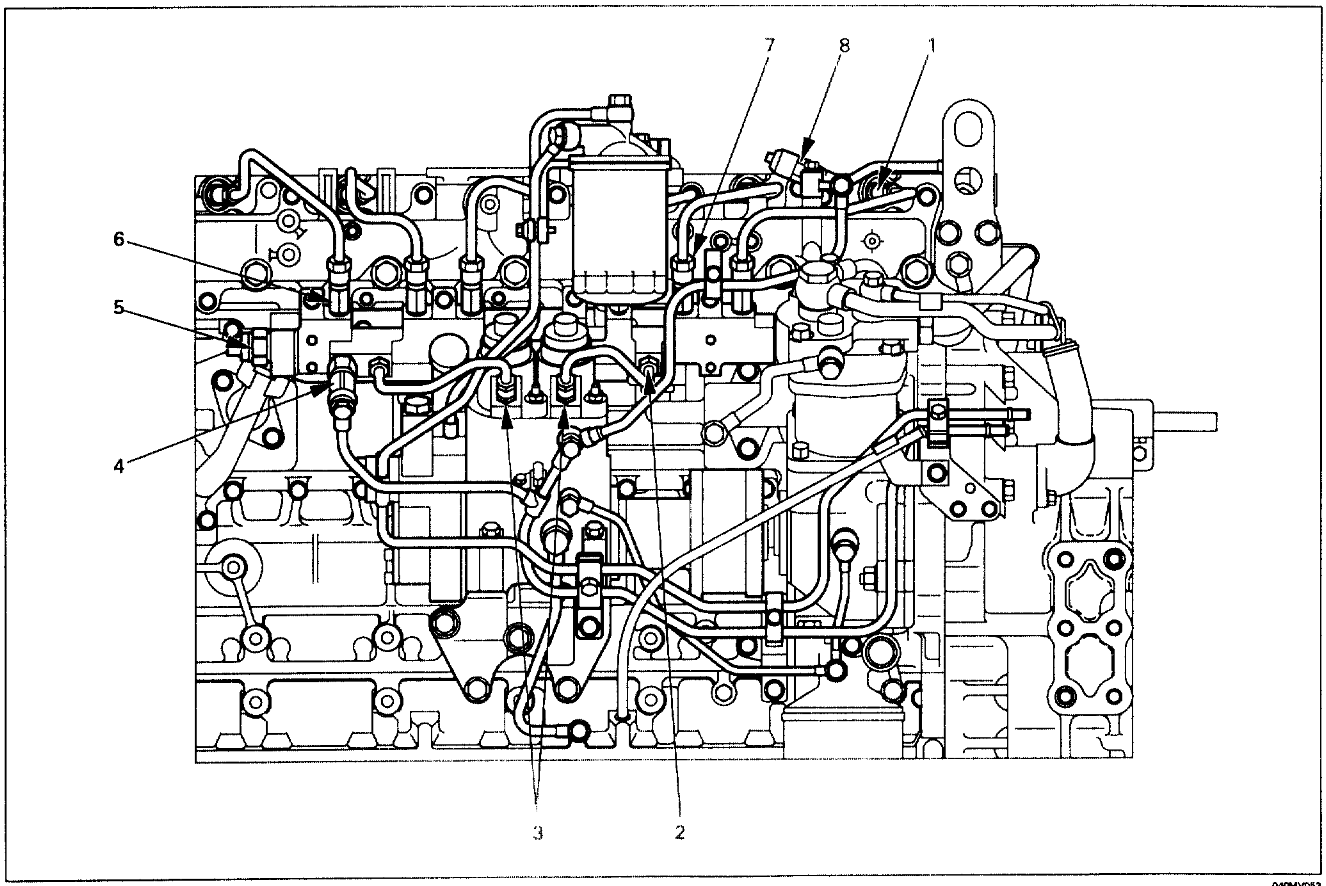
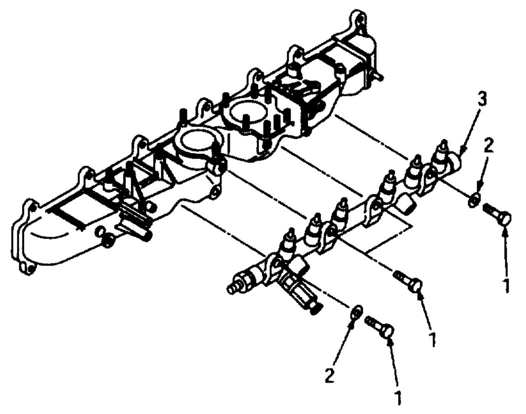


Figure 21 – Important Tightening Torque

COMMON RAIL ASSEMBLY



1. Bolt
2. Washer
3. Common Rail Assembly

Figure 1 – Common Rail Assembly

Remove or Disconnect (Figure 1)

1. Tilt the cab.
2. Negative battery cable.
3. Air inlet pipes and brackets.
4. Fuel lines.

   Important

   Do not bend the fuel lines in any shape or form to ease the removal of the common rail assembly.
5. Fuel filter and the bracket from the intake manifold.
6. Common rail assembly.

Install or Connect (Figure 1)

NOTICE: Before installation, wash the common rail assembly carefully.

1. Common rail assembly.

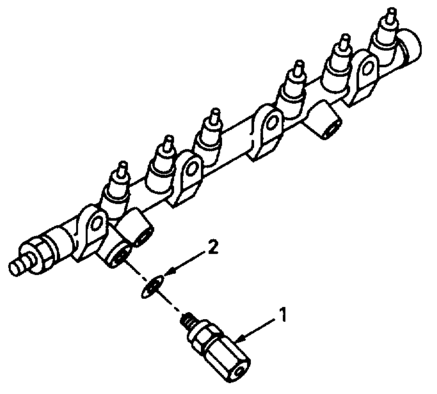
   Tighten

   Common rail bolts to 21N·m (16lb.ft)
2. Fuel filter and the bracket to the intake manifold.
3. Fuel lines.
4. Air inlet pipes and brackets.
5. Negative battery cable.
6. Lower the cab.

FUEL PRESSURE SENSOR

Refer to section 6E.

FUEL PRESSURE LIMITER



1. Pressure Limiter
2. Gasket

Figure 2 – Pressure Limiter Removal

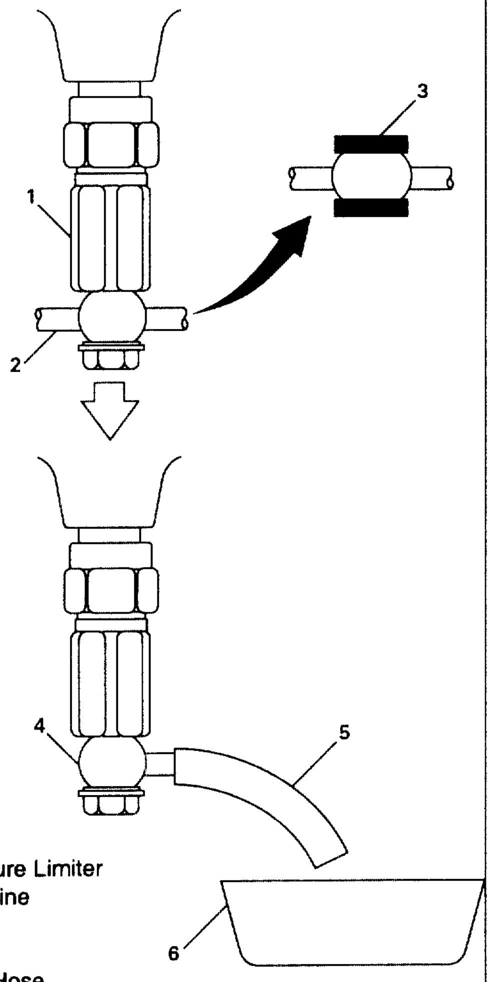
Remove or Disconnect (Figure 2)

1. Fuel lines.
2. Using 24mm hex. wrench, remove pressure limiter.
3. Remove gasket using tweezers.

NOTICE: Be careful not to damage sealing surface.

Inspect (Figure 3)

If the fuel pressure sensor is not failed, check the pressure limiter.



1. Pressure Limiter
2. Fuel Line
3. Plug
4. Union
5. Vinyl Hose
6. Drain Tank

Figure 3 – Pressure Limiter Inspection

CAUTION: IF THE PRESSURE LIMITER ACTIVATES, HIGH PRESSURE / HIGH TEMPERATURE FUEL FLOWS OUT.

1. Remove fuel line from pressure limiter.
2. Plug the removed fuel line.
3. Install the union to pressure limiter.
4. Connect the vinyl hose to union. Prepare drain tank to catch the fuel.
5. Start the engine. If the fuel flows out continuously from pressure limiter, replace the pressure limiter.

NOTICE: At the same time, check the fuel contamination in the fuel filter and the fuel tank.

Install or Connect (Figure 2)

1. Install gasket.
2. Install pressure limiter and tighten it using 24mm hex. wrench.

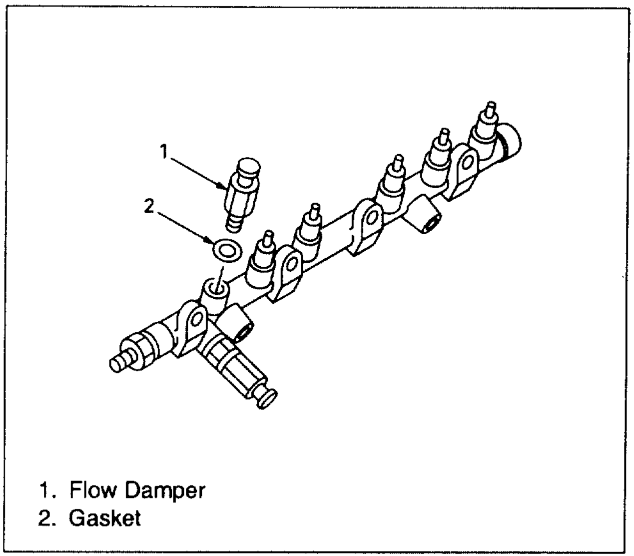
   Tighten

   Pressure limiter to 172N·m (127lb.ft)
3. Fuel lines.

   Tighten

   Bolt to 20N·m (15lb.ft)

FUEL FLOW DAMPER



1. Flow Damper
2. Gasket

Figure 4 – Flow Damper Removal

Remove or Disconnect (Figure 4)

1. Remove flow damper.
2. Remove gasket using tweezers.

Inspect (Figure 5)

- Check the flow damper operation by using scan tool. Refer to section 6E.
- With engine running, depress accelerator pedal to WOT (Wide Open Throttle). Then check the DTC (Diagnostic Trouble Code) of flow damper. If the DTC is set, check the fuel leakage. Fuel leakage is not found, fuel injector trouble or fuel contamination is suspected.

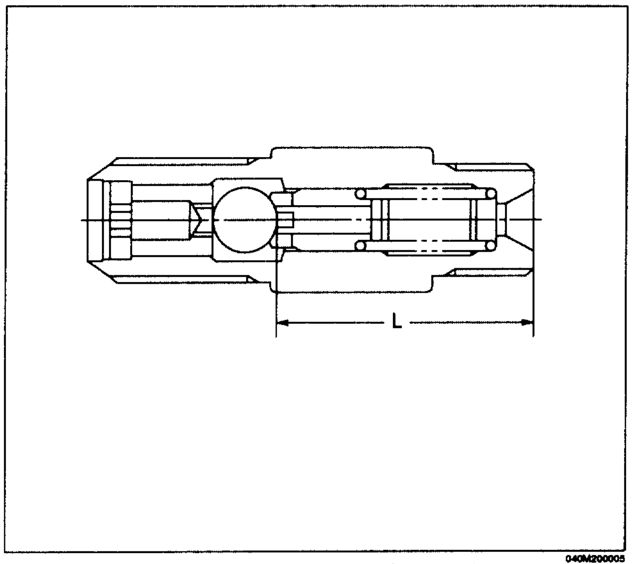


Figure 5 – Flow Damper Inspection

- Insert a pin (3mm diameter) to flow damper. If the "L" length is greater than 33mm (1.29in.), replace flow damper.

Install or Connect (Figure 4)

1. Install gasket.
2. Install flow damper.

Tighten

Flow damper to 172N·m (127lb.ft)

SPECIFICATIONS

Fastener Tightening Specifications

Application	N·m	lb·ft	lb·in
Fuel supply pump bracket to cylinder block	50	37	
Fuel supply pump to pump bracket	25	18	
Fuel supply pump coupling bolt 1	91	66	
Fuel supply pump coupling bolt 2	61	46	
Fuel supply pump coupling bolt 3	60	45	
Fuel pipe clamp bolt	6		52
Fuel injector fixing bolt	31	22	
Fuel injection pipe sleeve nut (Injector/Supply pump)	44	33	
Fuel injection pipe sleeve nut (Common rail)	54	40	
Fuel return pipe eye bolt	12		106
TWV harness assembly fixing bolt	22	16	
TWV harness terminal nut	2		17
Flow damper	172	127	
Pressure limiter	172	127	
Common rail pressure sensor	98	72	
Fuel filter eye bolt	14	10	
Air bleeding plug on supply pump	6		52
Fuel temperature sensor	20	14.5	

BLANK

SECTION 6D

ENGINE ELECTRICAL

CONTENTS

CHARGING SYSTEM

DESCRIPTION

The generator is a 12-volt, 110-ampere model.

The regulator is an IC integral type and it is mounted along with the brush holder assembly inside the generator installed in the rear end cover.

The generator does not require particular maintenance such as voltage adjustment.

The rectifier connected to the stator coil has eight diodes to transform AC voltage into DC voltage.

This DC voltage is connected to the output terminal of generator.

DIAGNOSIS OF CHARGING SYSTEM

Look for any of the conditions below for any related charging system problems:

1. Slow cranking at normal temperatures. This usually means an undercharged battery.
2. Dim lamps. Undercharged battery or the generator is not charging.
3. Very bright lamps, a very warm battery, and a high pitched whine coming from the generator indicates an overcharge condition.

UNDERCHARGED BATTERIES

1. Check that the undercharged condition has not been caused by accessories having been left on for extended periods.
2. Turn all electrical systems off. Disconnect the negative cable clamp from the negative terminal post of the battery. Connect a 12-volt test lamp in series between the negative battery cable clamp and the negative battery post. If the test lamp glows, remove the fuses one at a time until the test light goes out.
   When the circuit causing the discharge has been located, find and repair the problem.
   Recheck for battery drain after making the repair. Reconnect the battery cable clamp.
3. Check the drive belt for proper tension.
4. Inspect the wiring for insulation breaks, corrosion, and damaged wires. Check all circuit connections, cable clamps and battery terminals for tightness and cleanliness.
5. Using a battery charger, charge the batteries. Then with the engine running at fast idle, check the generator voltage and amperage with a voltmeter and inductive ammeter. The voltage with fully charged batteries should be about 13.5 volts. The amperage should be near zero after the batteries have been recharged from starting the engine.

OVERCHARGED CONDITION

With the engine running at fast idle, and all electrical systems turned off, measure the voltage at the generator.

The voltage should be from13.5 to 14.8 volts. If the voltage is higher than 15 volts, test the generator as described under "Generator Output Test" later in this section.

NOISY GENERATOR

Noise from a generator may be caused by a loose drive pulley, loose mounting bolts, worn or dirty bearings, overcharged condition, and defective diodes.

CHARGING SYSTEM TEST

REGULATED VOLTAGE CHECK

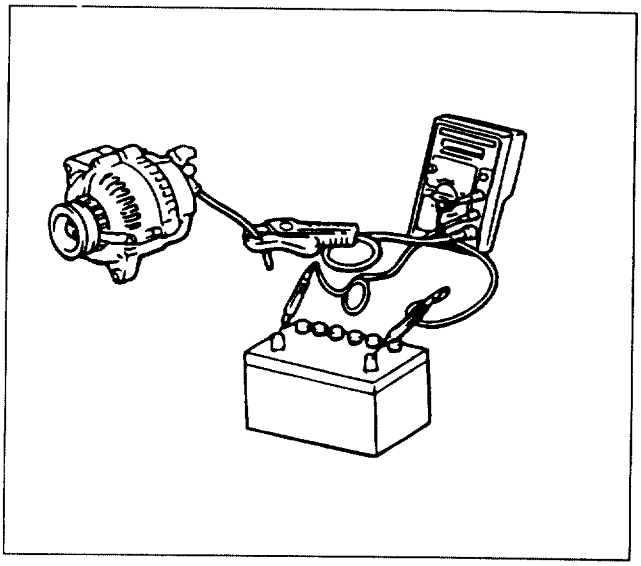


Figure 1 – On-Vehicle Test

1. Connect the voltmeter and ammeter as shown in the figure 1. Turn the ignition switch to "ON" position. The generator indicator lamp should light.
2. Start the engine. The generator indicator lamp should turn off.
3. Run the engine at 2000rpm. Check the voltage at the "B" terminal when the output current is 10 ampere. This regulated voltage should be from 14.2 to 14.8 volts.

NOTICE: The regulator setting voltage changes depending on temperature. This test should be done promptly.

OUTPUT CURRENT CHECK

1. Run the engine at 2000rpm, turn on the headlamps (high-beam) and heater fan ("HI" position).
2. Check the output current. Characteristics of generator are shown in figure 2.

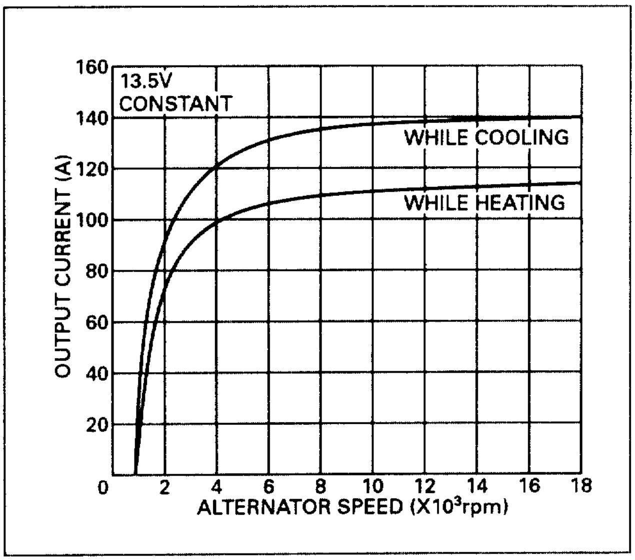


Figure 2 – Standard Characteristics

NOTICE: When the battery is fully charged, the output current becomes low. Turn on the windshield wiper etc., try above check again.

ON-VEHICLE SERVICE

GENERATOR REPLACEMENT

Remove or Disconnect (Figure 3)

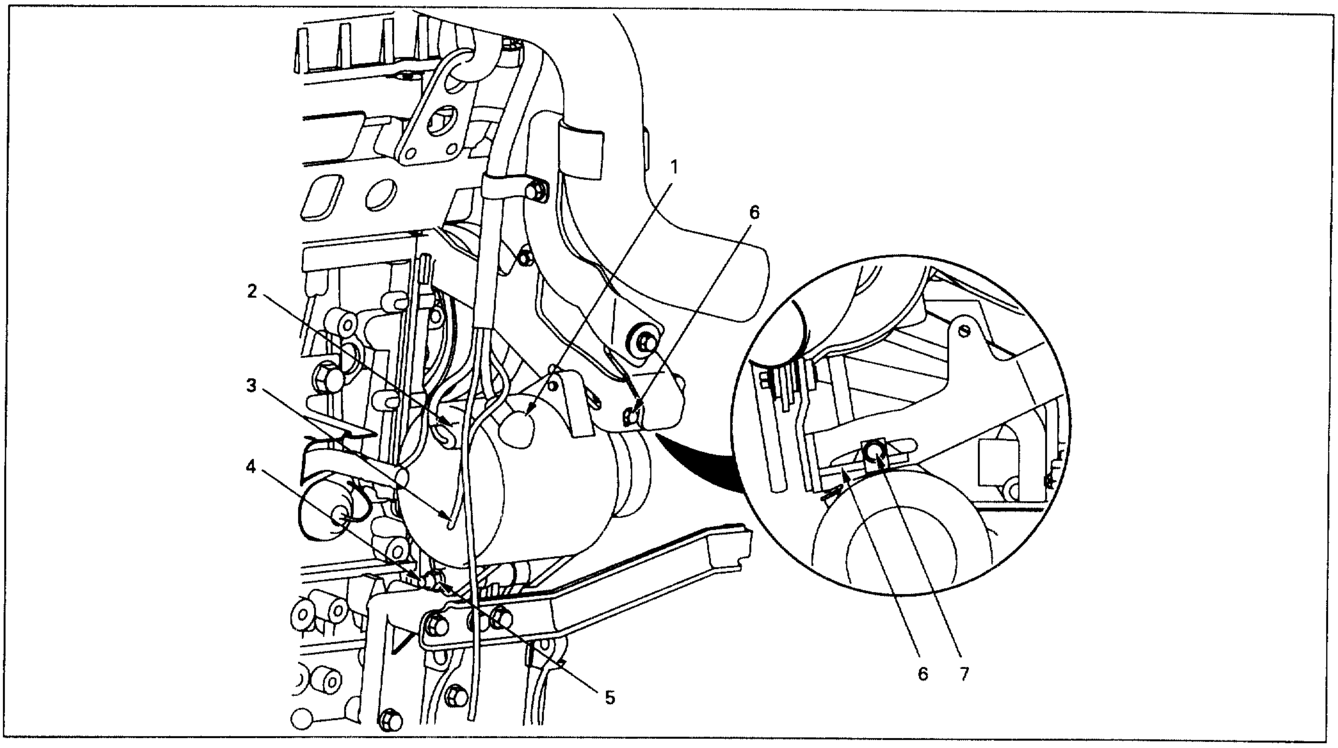


Figure 3 – Generator Replacement

1. Negative battery cable at the battery.
2. Black connector at generator (2)
3. Battery lead "B" at the generator (1).
4. Ground wire "E" at the generator (3).
5. Losenlower mounting nut (5).
6. Loosen upper mounting bolt (7).
7. Loosen adjusting bolt (6).
8. Drive belts.
9. Lower mounting bolt (4).
10. Generator.

Inspect

1. Mount brackets for damage.
2. Drive belts for wear or damage.

Install or Connect (Figure 3)

1. Generator.
2. Lower mounting bolt (4).
3. Lower mounting nut (5).
4. Drive belts.
5. Adjusting bolts (6).
6. Electrical connectors and harness.
7. Battery cable to negative terminal.

Tighten

- New drivebelts so that the belts deflect 10 to 15 mm (0.39 to 0.59 in.) when a 10 kg (22 lb.) test load is applied between the fan pulley and generator.

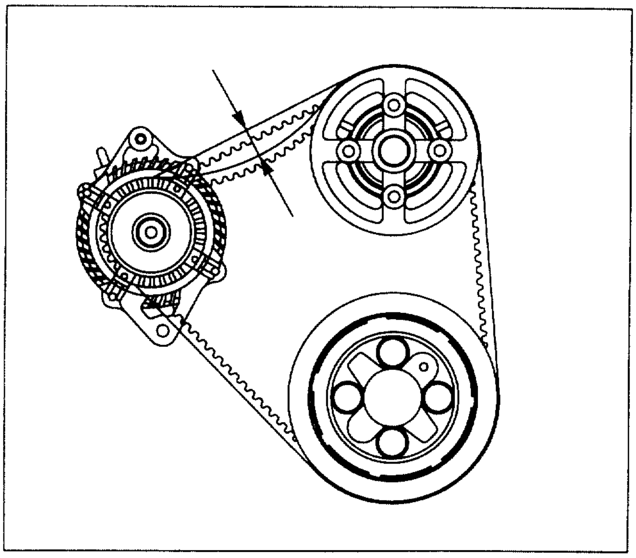


Figure 4 – Drivebelt Tension

- Upper mounting bolt to 31 N·m (23 ft.lb).
- Lower mounting nut (13) to 68 N·m (50 ft.lb).

UNIT REPAIR

BENCH TEST

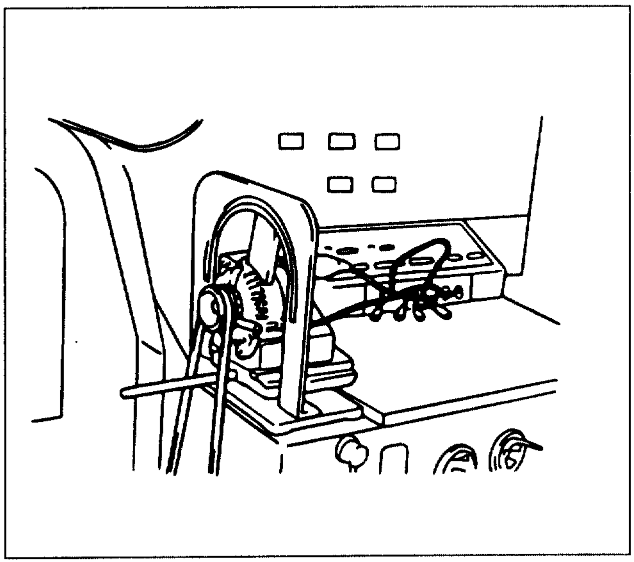


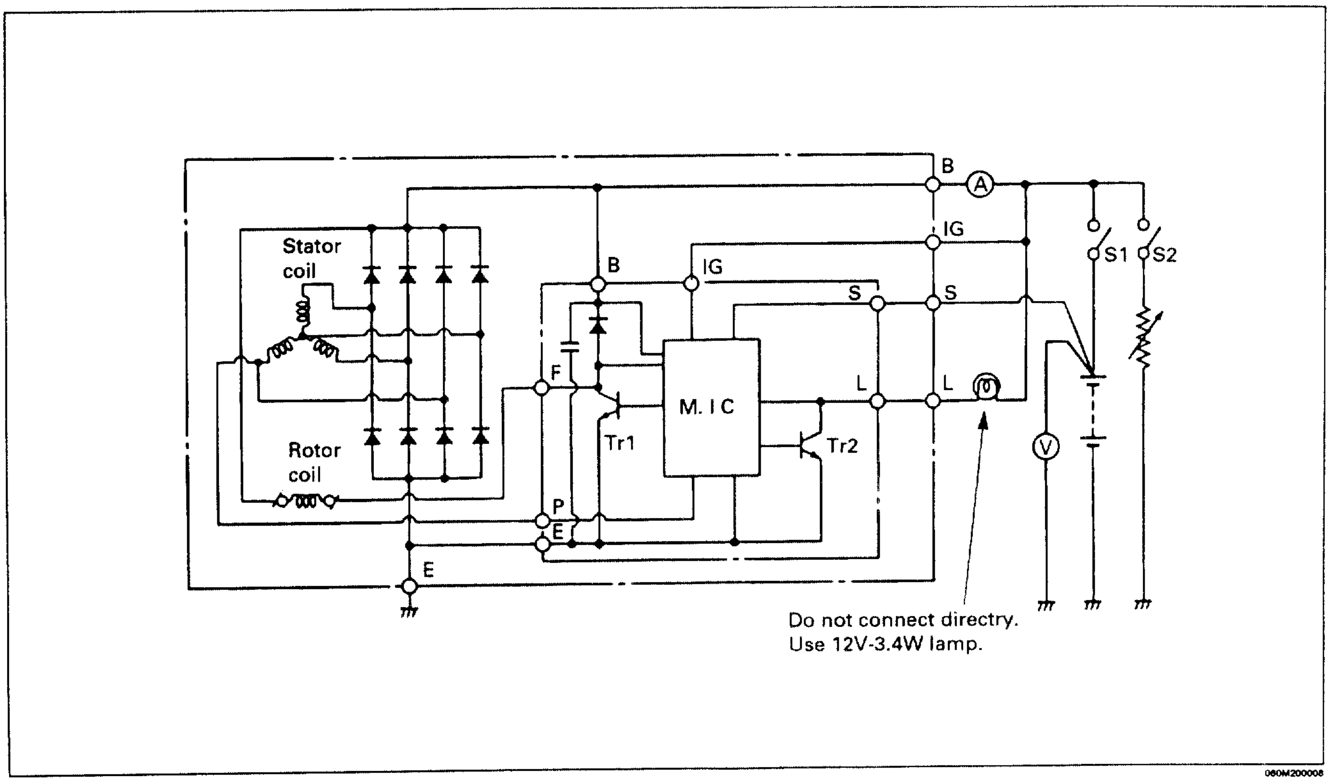
Figure 5 – Bench Test

Set the generator in a test stand, make connection as shown in the figure 6.

1. Regulated voltage.
   Turn on the battery switch S1. Run the generator at 5000rpm, turn on the load switch S2, and adjust the load resistance so that the ammeter reading becomes 10A. In this condition, the voltage should be from 14.2 to 14.8 volts at 25°C (77°F).
2. No load test.
   Turn on the battery switch S1. Run the generator, turn off the switch S1 when the ammeter reading becomes 0 ampere or more. Adjust the rotating speed so that the voltmeter reading becomes 14 volts. In this condition, the rotating speed should be 1000 rpm or less.
3. Output test.
   Turn on the battery switch S1 and load switch S2. Run the generator, adjust the voltage and rotating speed (13.5V/5000rpm). In this condition, the output current should be 110A or more. Decrease the rotating speed and check the output current becomes nearly 0A, open the battery switch S1 and load switch S2.

NOTICE:

1. ***Do not connect terminal "L" and "B" directly. Always use 3.4W lamp.***
2. ***The battery should be fully charged.***
3. ***Never make battery connections with polarities reversed.***
4. ***Do not remove the battery while generator is rotating.***
5. ***The regulator setting voltage changes depending on temperature. This test should be done promptly.***



Do not connect directry.
Use 12V-3.4W lamp.

Figure 6 – Connection for Bench Test

DISASSEMBLY

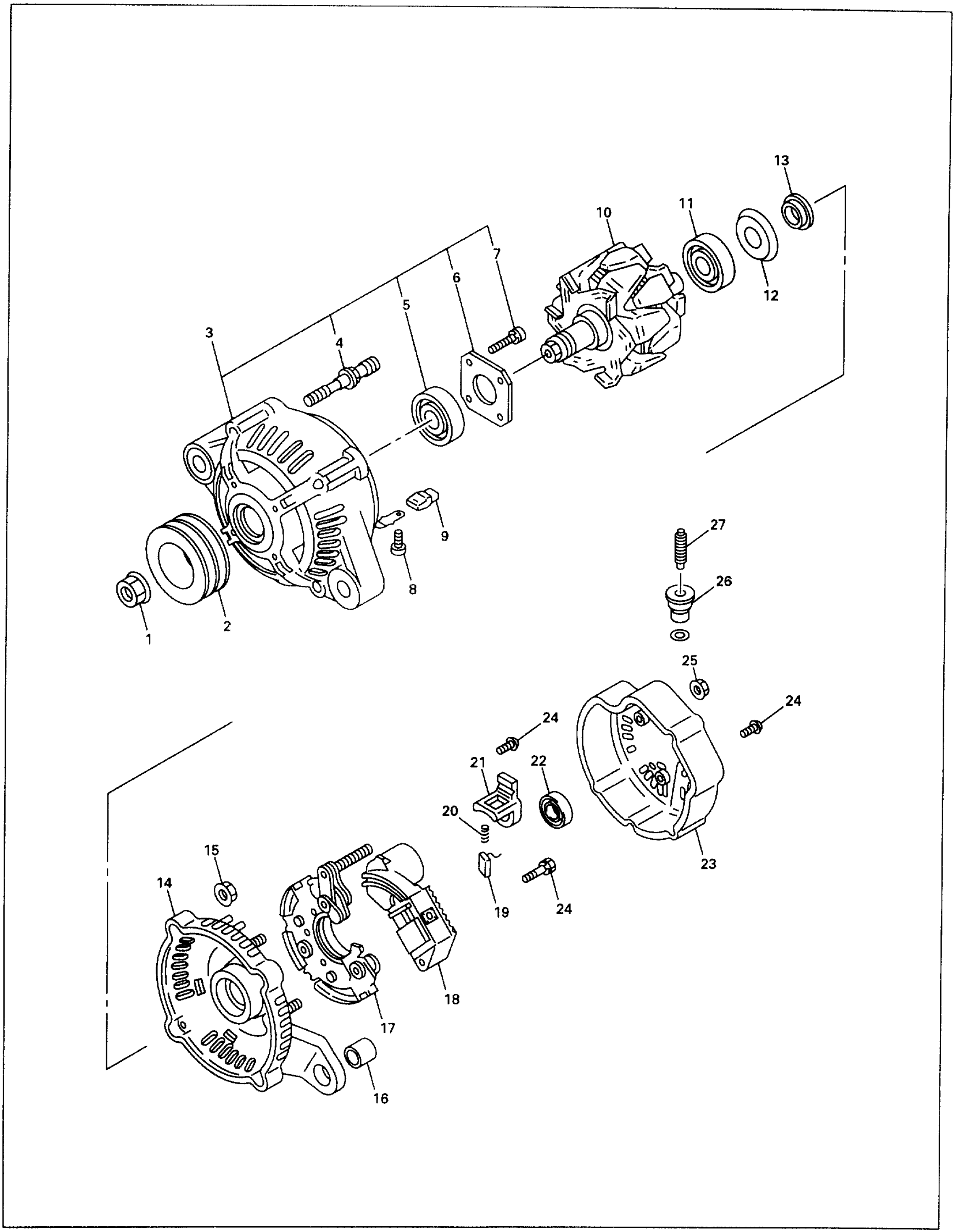


Figure 7 – Generator Components

Disassemble (Figures 7 through 18)

1. Secure the pulley directly in the vice between two copper plates, loosen the nut and remove the pulley.

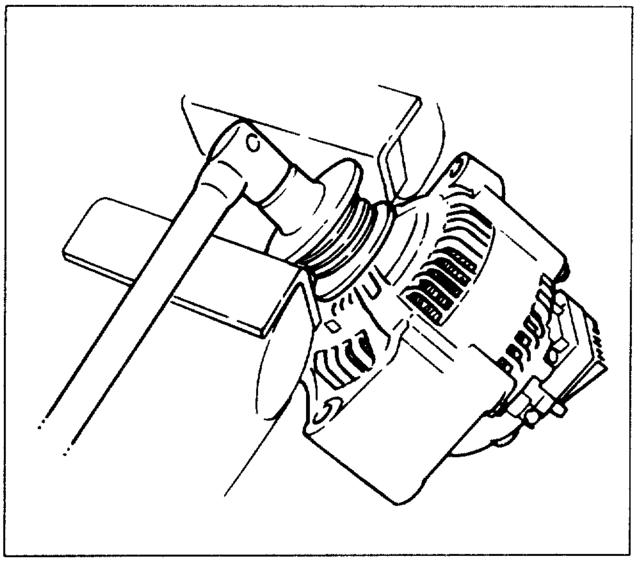


Figure 8 – Pulley Removal

2. Remove three nuts holding the rear end cover and a nut at "B" terminal, remove rear end cover.

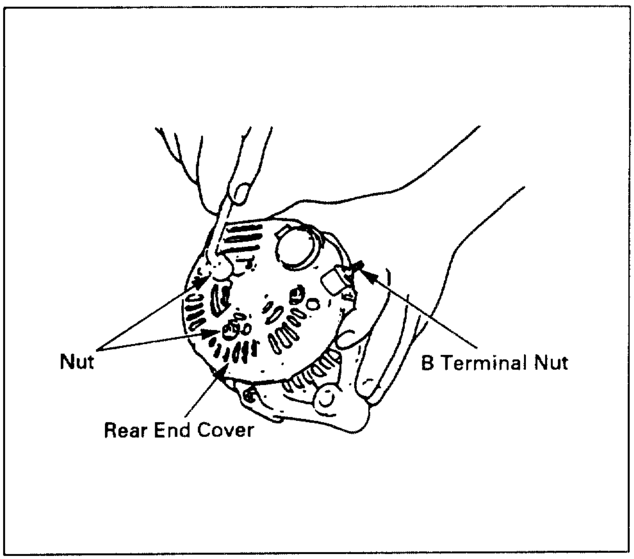


Figure 9 – Removal of Rear End Cover

3. Remove two screws fastening brush holder to rectifier and remove holder.

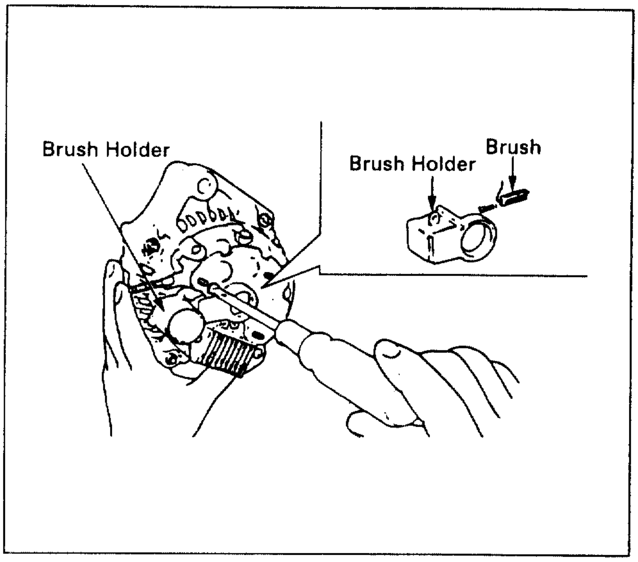


Figure 10 – Removal of Brush Holder

4. Remove three screws holding IC regulator and remove regulator.

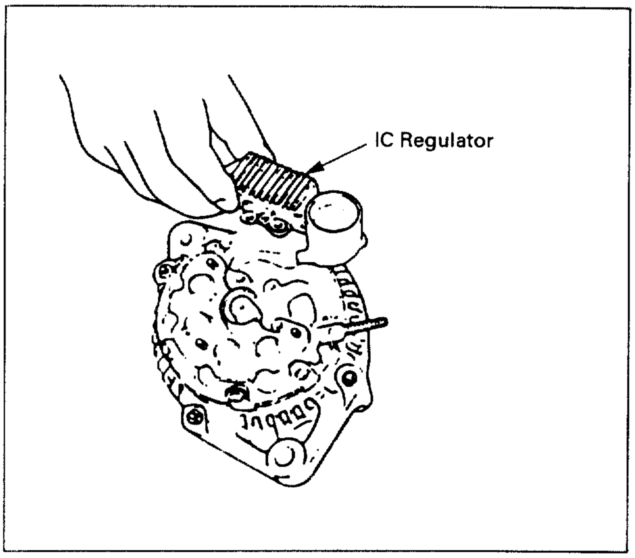


Figure 11 – Removal of IC Regulator

NOTICE: The lengths of the screws are different, please remember to install the correct screw length in each location. Battery overcharging may occur, if the incorrect screw is installed.

5. Remove four screws holding rectifier and lead wire from stator.

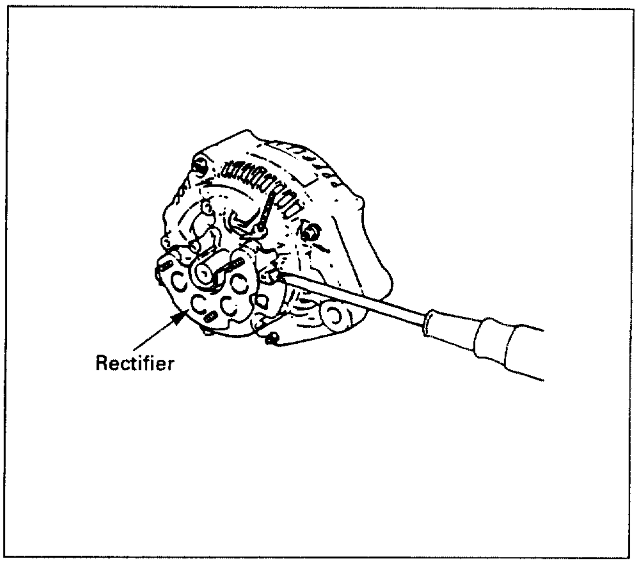


Figure 12 – Rectifier Removal

060M200012

6. Remove bushing and four bolts, which are holding the drive end and rear frames together.

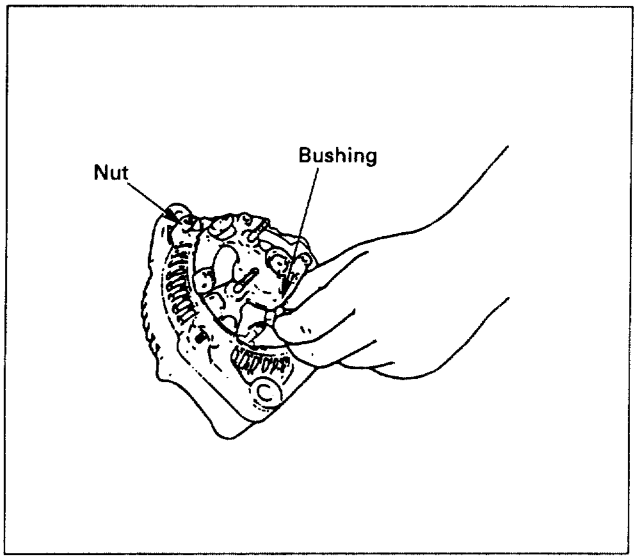


Figure 13 – Bushing Removal

060M200013

NOTICE: Do not stretch the stator wire when the bushing is removed.

7. Remove rear end cover using puller.

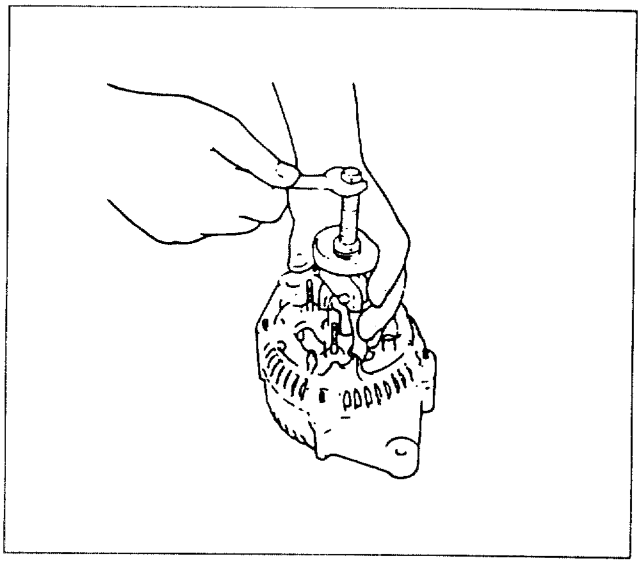


Figure 14 – Removal of Rear End Frame

060M200014

8. Support drive end frame horizontally using two blocks and remove the rotor with a bench press.

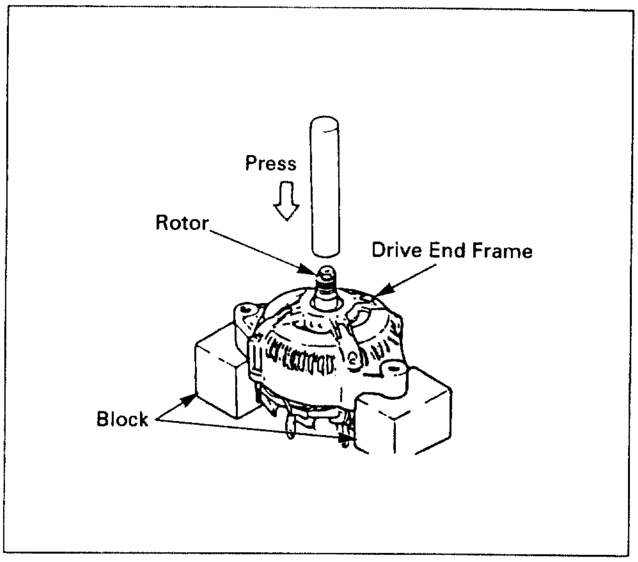


Figure 15 – Removal of Rotor

060M200015

NOTICE: Do not drop the rotor as this can damage the slip ring, fan, etc.

9. Remove four screws holding retainer plate and remove the plate.

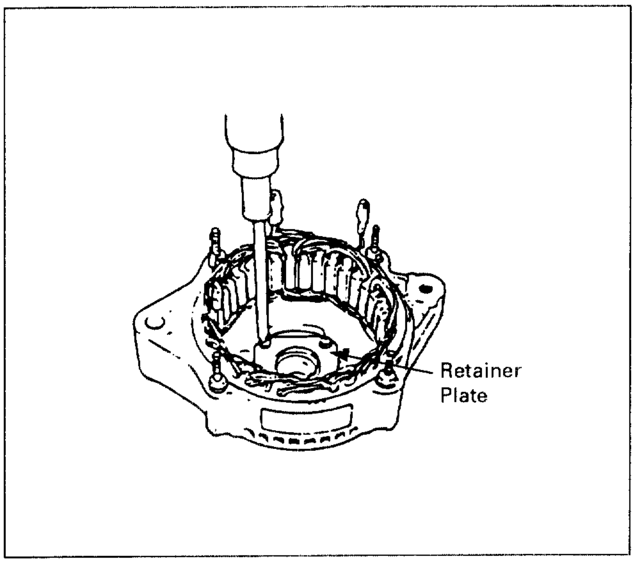


Figure 16 – Removal of Retainer Plate

10. Support drive end frame horizontally using two blocks, put a suitable sleeve on the bearing and remove the bearing with a press.

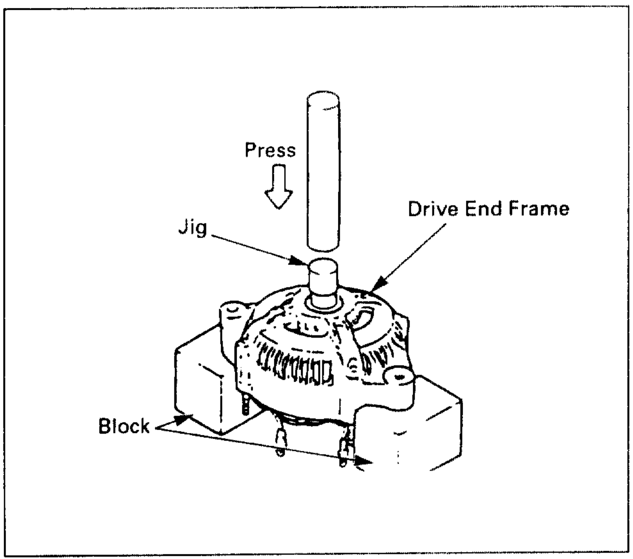


Figure 17 – Bearing Removal

NOTICE: The two bearings for this alternator are for high-speed revolution; whenever they are replaced, a genuine part should always be used. Do not subject the bearing to a shock.

11. Remove bearing using puller (Slip ring side).

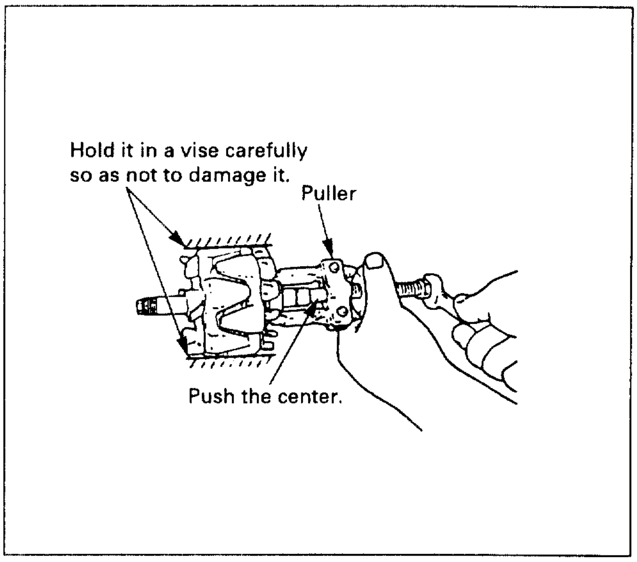


Figure 18 – Bearing Removal

INSPECTION AND REPAIR

Inspect (Figures 19 through 22)

1. Rotor.
   - Resistance between slip rings. The resistance should read approx. 2.9 ohms.

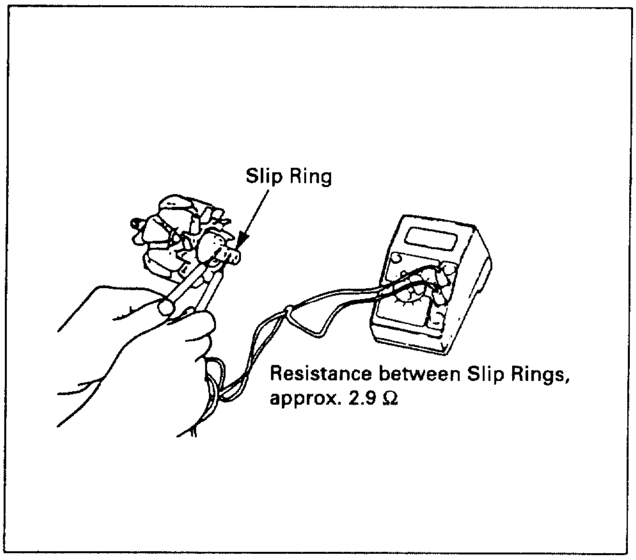


Figure 19 – Resistance between Slip Rings

   - Insulation resistance between slip ring and core pole. The resistance should read more than 0.1M ohms when measured with a 500V megger.
   - Slip ring diameter. Standard slip ring diameter is 14.4mm (0.57-inch). If the diameter measures less than 14.0mm (0.55-inch), replace the rotor.

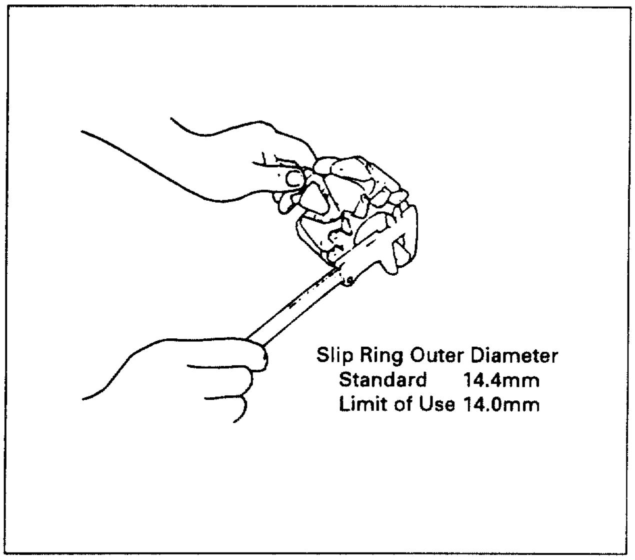


Figure 20 – Slip Ring Outer Diameter

   - Check for stained or rough surfaces and remove any found with fine sandpaper (#300 to 500).

2. Rectifier.
   Use the K-ohms range of the circuit tester and check for continuity (figure 21).

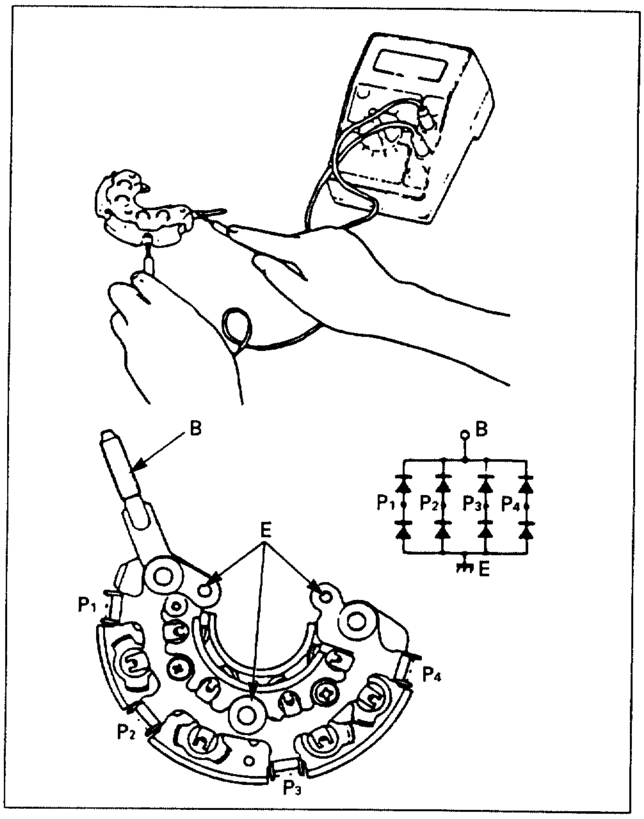


Figure 21 – Rectifier Check

The rectifier is good if continuity is measured in one direction through the diode but not in the other.

NOTICE: The condition of the rectifier cannot be determined by measurement of resistance in the right direction. Diode characteristics bring forth a great difference in current in the right direction, according to the source voltage and, therefore, measurement is different depending on the type of tester and its range of resistance. This is the reason why the rectifier is judged good when the difference in resistances measured in the right and in the reverse directions is big.

Do not use a 500V megger for measuring because it will destroy the rectifier.

3. Brush
   Measure length of brush protruding from the brush holder. If the brush is shorter than 4.5mm (0.18-inch), replace it.

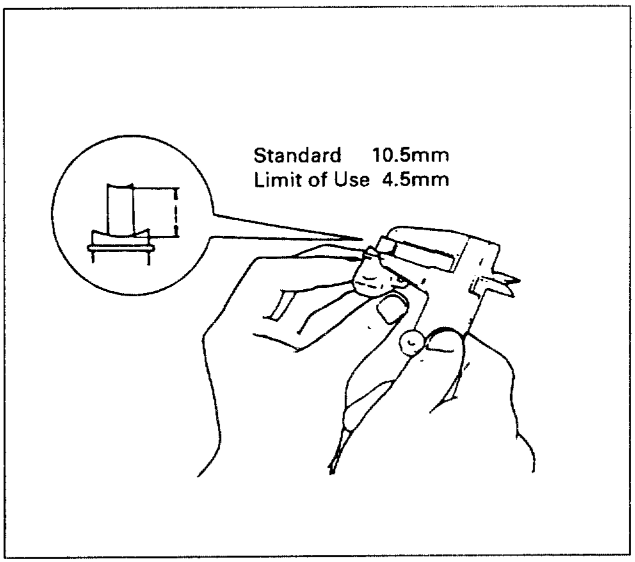


Figure 22 – Brush Check

080M200038

REASSEMBLY

Assemble (Figures 23 through 25)

To reassemble, follow the disassembly steps in the reverse order, noting the following points.

1. Bearing.
   Press the bearing into the frame.

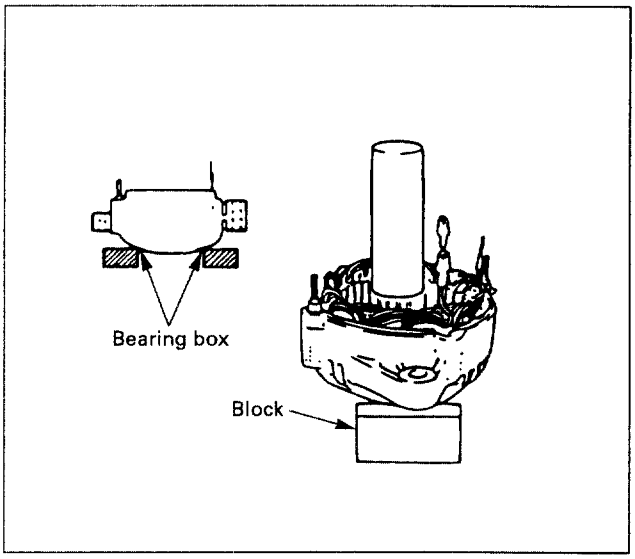


Figure 23 – Bearing Installation

080M200023

NOTICE:

- ***Uniformly heat the frame to a temperature which will permit installation. Do not exceed 100°C (212°F).***
- ***Push the outer race of the bearing while pressing.***
- ***Support the bearing box using blocks, not the stay.***

2. Brush.
   If install the new brush, adjust the length of brush protruding from the brush holder.

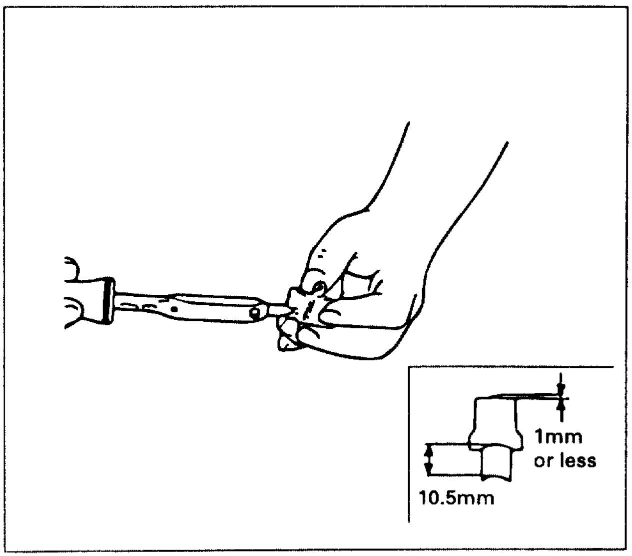


Figure 24 – Brush Installation

080M200024

NOTICE: The thickness of solder must be 1mm (0.04-inch) or less. After soldering, apply the insulation varnish.

3. Brush holder.
   Install the brush holder with the IC regulator.

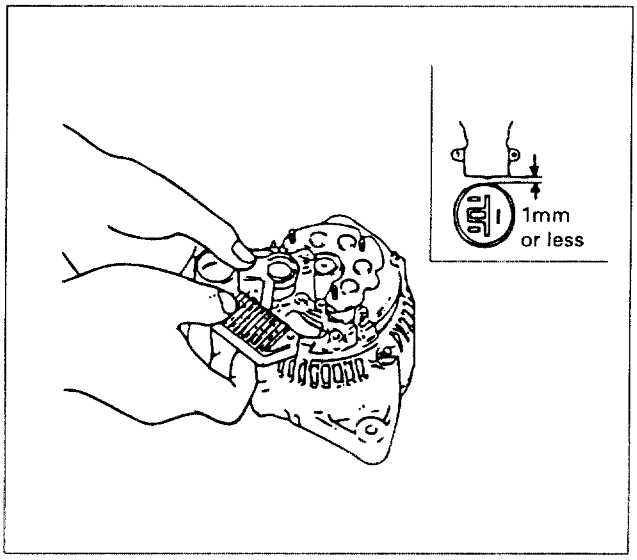


Figure 25 – Brush Holder Installation

NOTICE:

- ***Be careful not to install the brush holder in the reverse direction.***
- ***The clearance between the brush holder and connector must be at least 1mm (0.04in) or more. Do not attempt to increase the clearance using a screwdriver.***
- ***Be careful not to deform the rubber seal of the brush holder while installation.***
- ***The lengths of the screws are different, please remember to install the correct screw length in each location.***

4. Pulley

Tighten

- Nut to 110 N·m (82ft.lb).

SECTION 6E

ENGINE EMISSION AND ELECTRICAL DIAGNOSIS

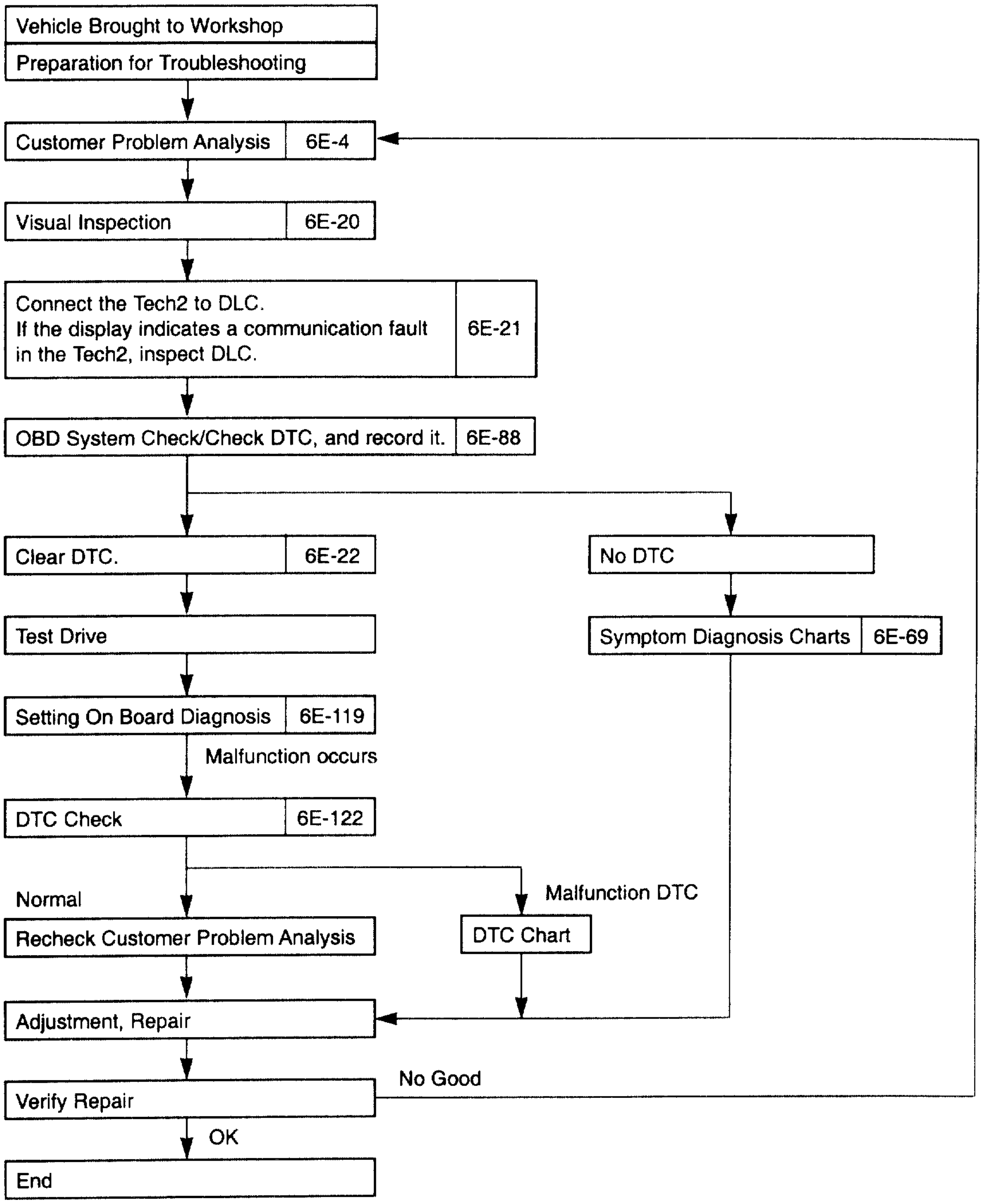
NOTICE: *Always use the correct fastener in the correct location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.*

CONTENTS

GENERAL DESCRIPTION

HOW TO PROCEED WITH TROUBLESHOOTING

Troubleshoot in accordance with the procedure on the following page.
Title side numbers are titles of pages in this manual with the page number indicated in the bottom portion. See the indicated pages for detailed explanations.



CUSTOMER PROBLEM ANALYSIS CHECK

ENGINE CONTROL SYSTEM Check Sheet

Inspector's Name ______________________

Customer's Name		Model and Model Year	
Driver's Name		Frame No	
Date Vehicle Brought in		Engine Model	
License No.		Odometer Reading	km miles

Problem symptoms	☐ Engine does not Start	☐ Engine does not crank ☐ No initial combustion ☐ No complete combustion
	☐ Difficult to Start	☐ Engine cranks slowly ☐ Other ______
	☐ Poor Idling	☐ Idling rpm is abnormal ☐ High (rpm) ☐ Low (rpm) ☐ Rough idling ☐ Other ______
	☐ Poor Driveability	☐ Hesitation ☐ Surging ☐ Other ______
	☐ Engine Stall	☐ Soon after starting ☐ After accelerator pedal depressed ☐ After accelerator pedal released ☐ During A/C operation ☐ Shifting from N to D ☐ Other ______
	☐ Others	

Dates Problem Occurred		
Problem Frequency		☐ Constant ☐ Sometimes (times per day/month) ☐ Once only ☐ Other ______
Condition When Problem Occurs	Weather	☐ Fine ☐ Cloudy ☐ Rainy ☐ Snowly ☐ Various/Other ______
	Outdoor Temperature	☐ Hot ☐ Warm ☐ Cool ☐ Cold (approx.______ °F/ ______ °C)
	Place	☐ Highway ☐ Suburbs ☐ Inner city ☐ Uphill ☐ Downhill ☐ Rough road ☐ Other ______
	Engine Temperature	☐ Cold ☐ Warming up ☐ After warming up ☐ Any temperature ☐ Other ______
	Engine Operation	☐ Starting ☐ Just after starting (min.) ☐ Idling ☐ Racing ☐ Driving ☐ Constant speed ☐ Acceleration ☐ Deceleration ☐ A/C switch ON/OFF ☐ Other ______

Condition of MIL		☐ Remains on ☐ Sometimes light up ☐ Does not light up
DTC Inspection	Normal Mode (Precheck)	☐ Normal ☐ Malfunction code(s) (code)
	Check Mode	☐ Normal ☐ Malfunction code(s) (code)

FUEL SYSTEM OUTLINE

SYSTEM OUTLINE

This system also provides the following functions:

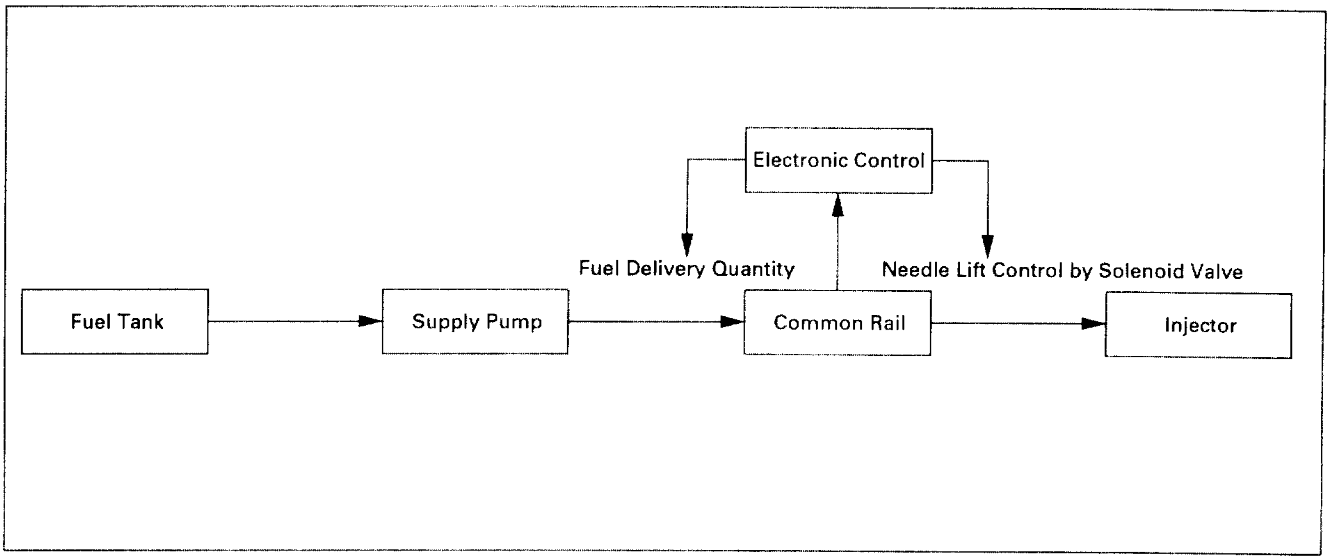
- A self-diagnosis and alarm function that uses a computer to diagnose the system's major components and to alert the driver in case of a problem.
- A fail-safe function to stop the engine, depending upon the location of the problem.
- A backup function to change the fuel regulation method, thus enabling the vehicle to continue operating.

SYSTEM CONFIGURATION

Divided by function, the system can be classified according to the fuel system and the control system.

1. Fuel System

The high-pressure fuel that is generated by the supply pump is distributed to the cylinders by way of a common rail. Then, the electromagnetic valves in the injectors open and close the nozzle needle valve to control the starting and ending of the injection of fuel.

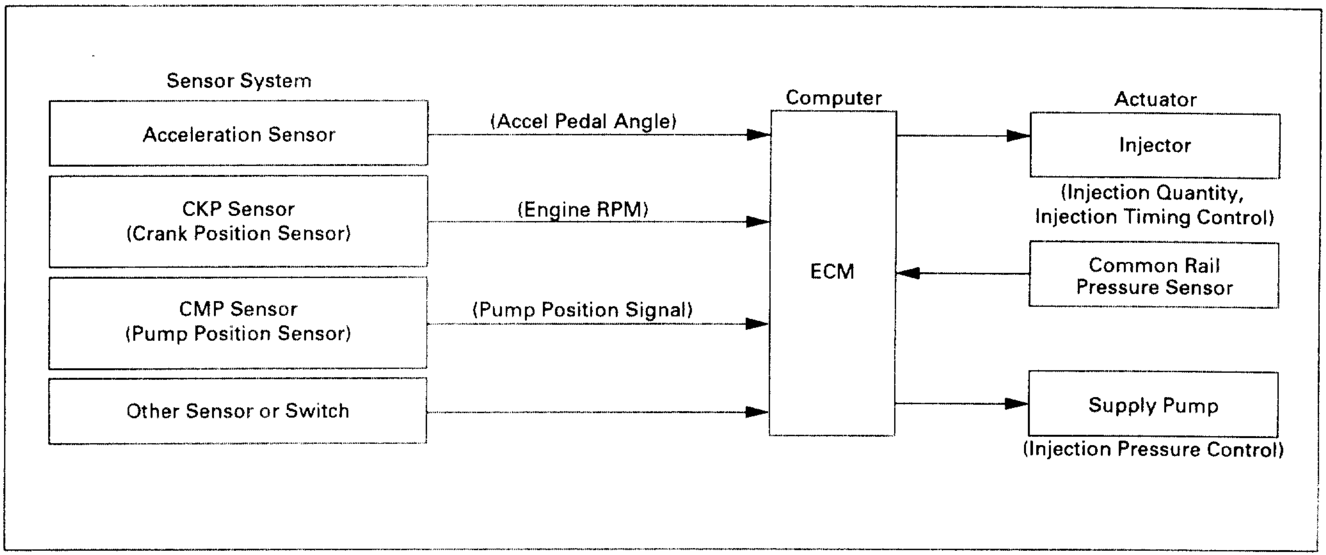


056MX003

2. Control System

Based on the signals received from various sensors that are mounted on the enigne and on the vehicle, the ECM controls the timing of the current and the length of time that the current is applied to the injectors, thus ensuring that an optimal amount of fuel is injected at an optimal time.

The control system can be broadly classified according to the following electronic components: sensors, computers, and actuators.



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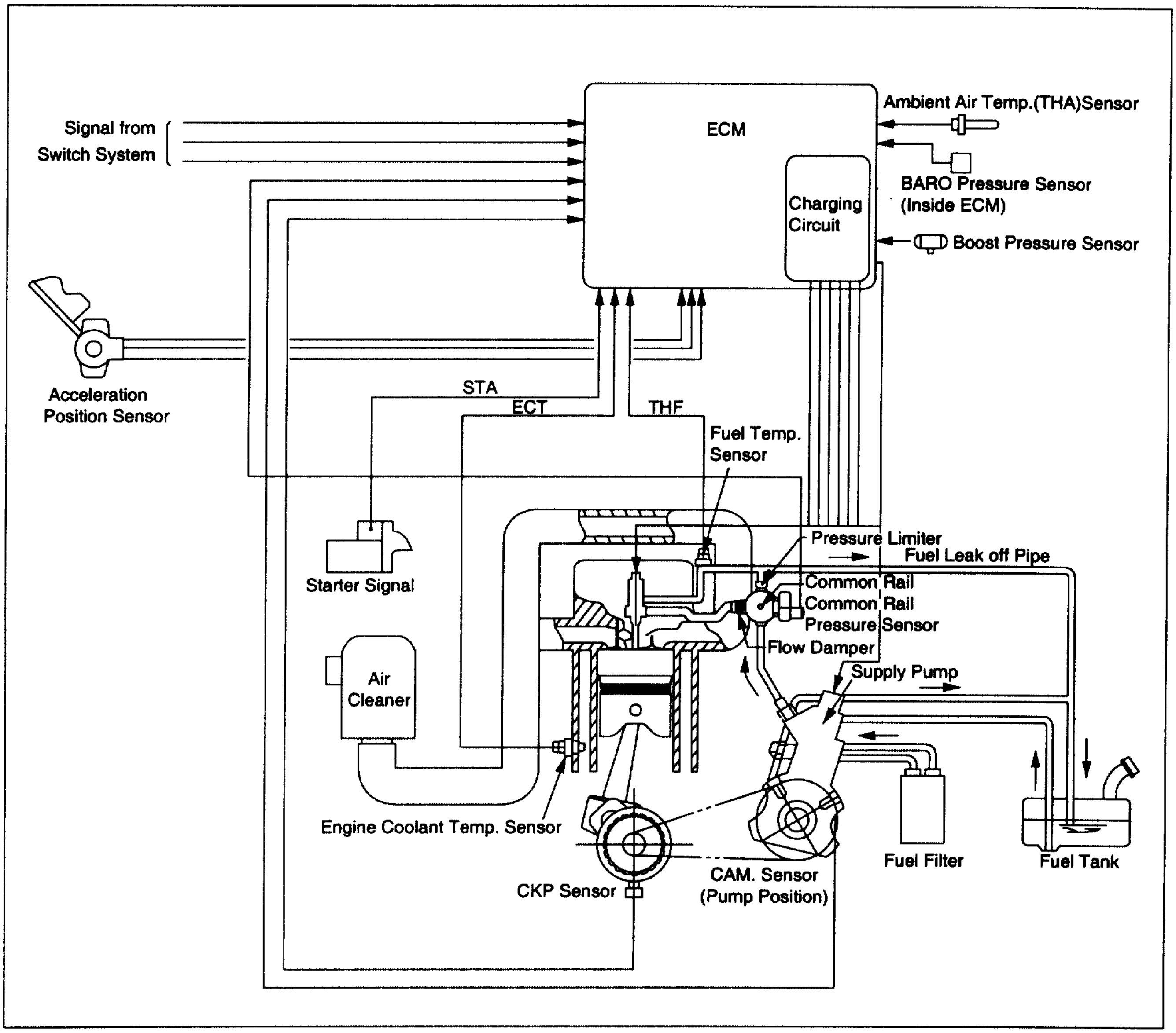
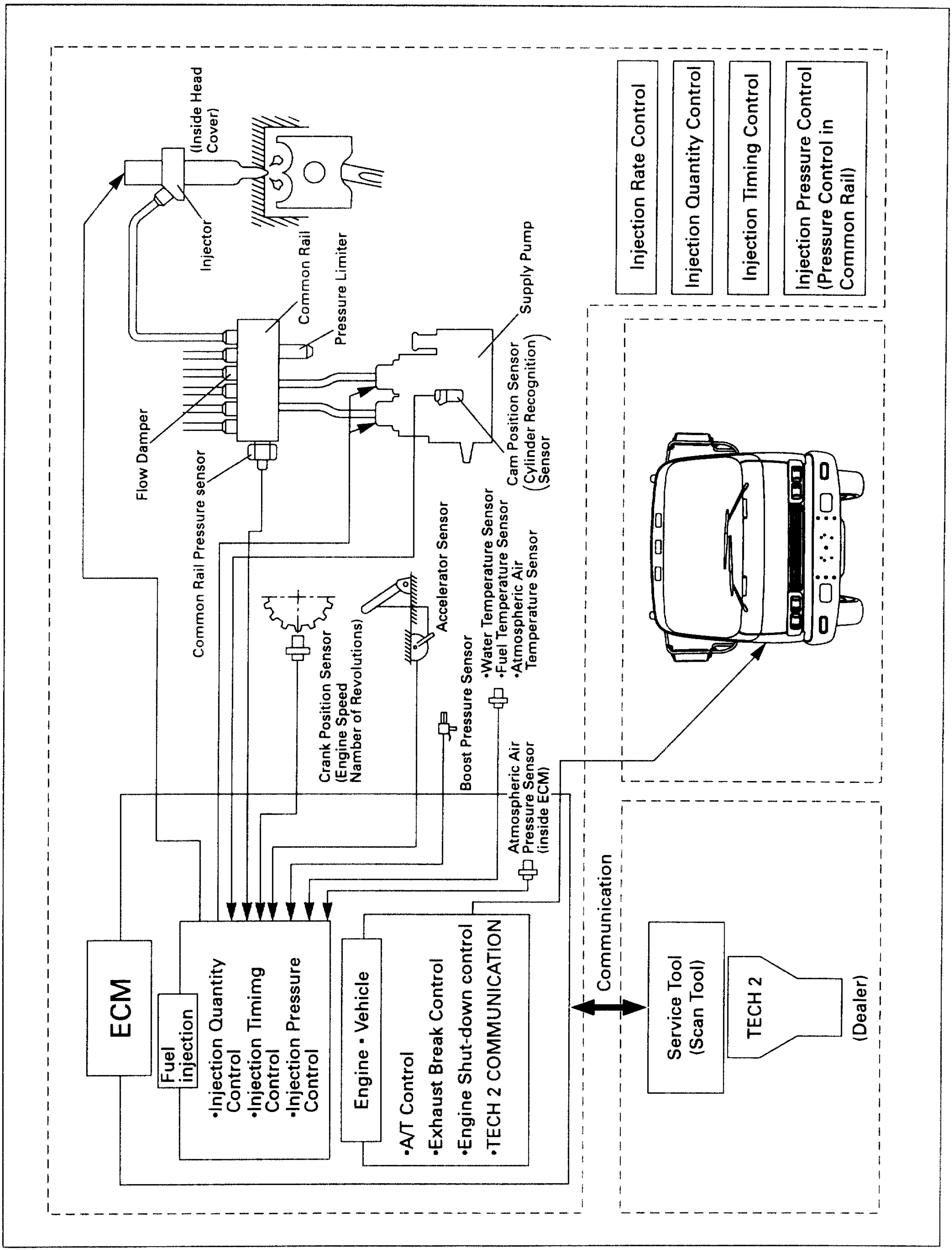
3. System Configuration [1]



4. System Configuration [2]



CONSTRUCTION AND OPERATION OF THE SYSTEM

The COMMON RAIL SYSTEM consists of a supply pump, common rail, injector, ECM and sensors.

The supply pump generates the fuel pressure in the common rail. Fuel pressure is controlled depending on the fuel amount discharged from the supply pump. The fuel discharge amount is controlled by means of PCV provided in the supply pump which is opened/closed in response to electric signals from ECM.

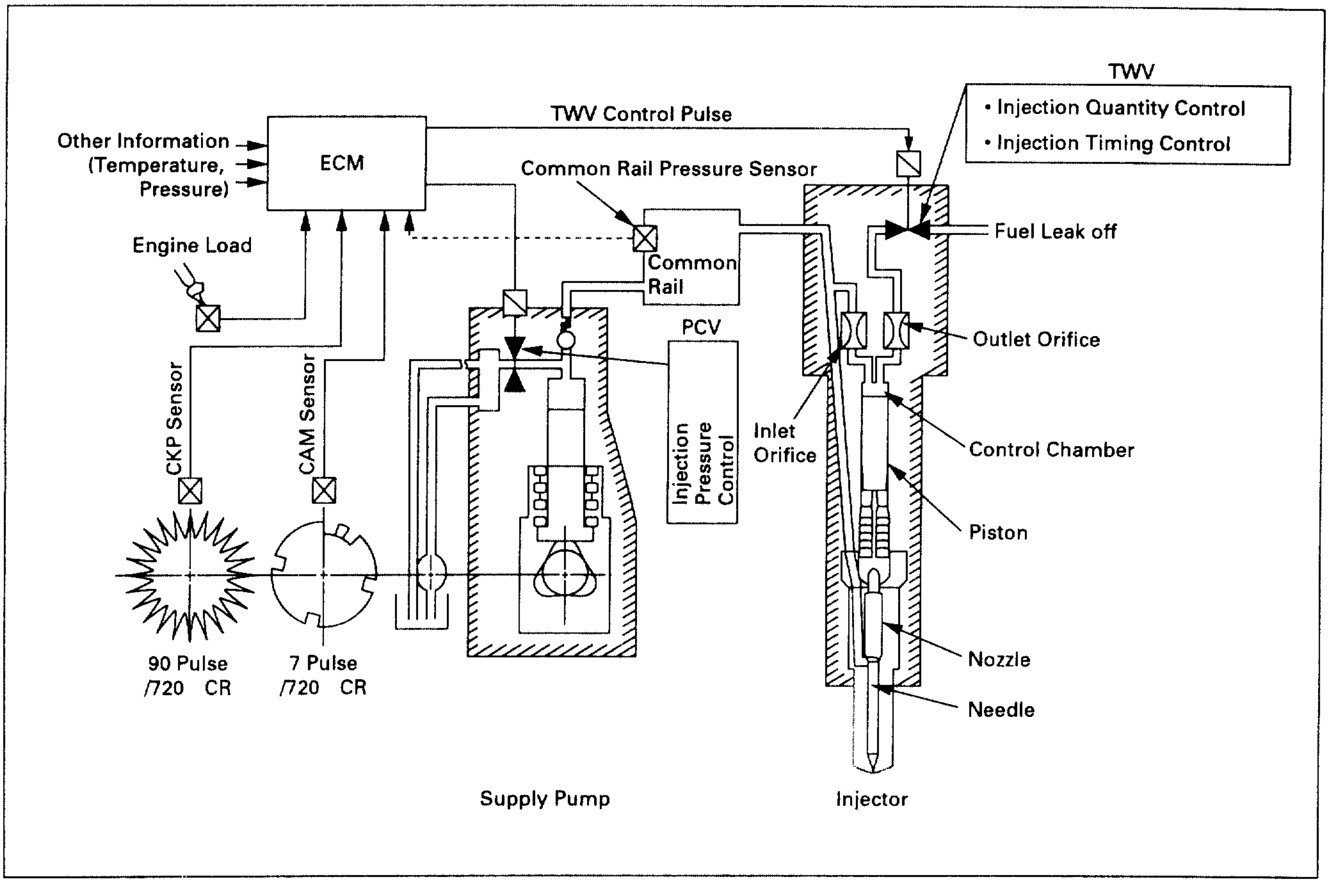
The common rail receives and distributes the fuel pressure made by the supply pump to each cylinder. Fuel pressure is detected by means of a common rail pressure sensor installed to the common rail and is feedback controlled so that the instructed pressure value set according to engine speed and load can agree with an actual pressure value.

The fuel pressure in the common rail is applied through the injection pipe of each cylinder to the nozzle side and control chamber of the injector.

The injector controls injection amount and time by switching on and off a TWV (Two Way Valve). When the TWV is switched on (to carry current), the fuel circuit is changed over to such a status that the high pressure fuel in the control chamber may flow out through and outlet orifice. Owing to nozzle valve opening force caused by the nozzle side of high pressure fuel, the needle valve is lifted to start fuel injection. When the TWV is switched off (to cut current), the fuel circuit is changed over to such a status that the high pressure fuel is flowed back through the inlet orifice into the control chamber.

Therefore, the needle valve comes down to stop fuel injection.

Thus, fuel injection time can be electronically controlled by TWV switching on and fuel injecting amount, by TWV switching off.



CONSTRUCTION AND OPERATION OF SUPPLY PUMP

SUPPLY PUMP

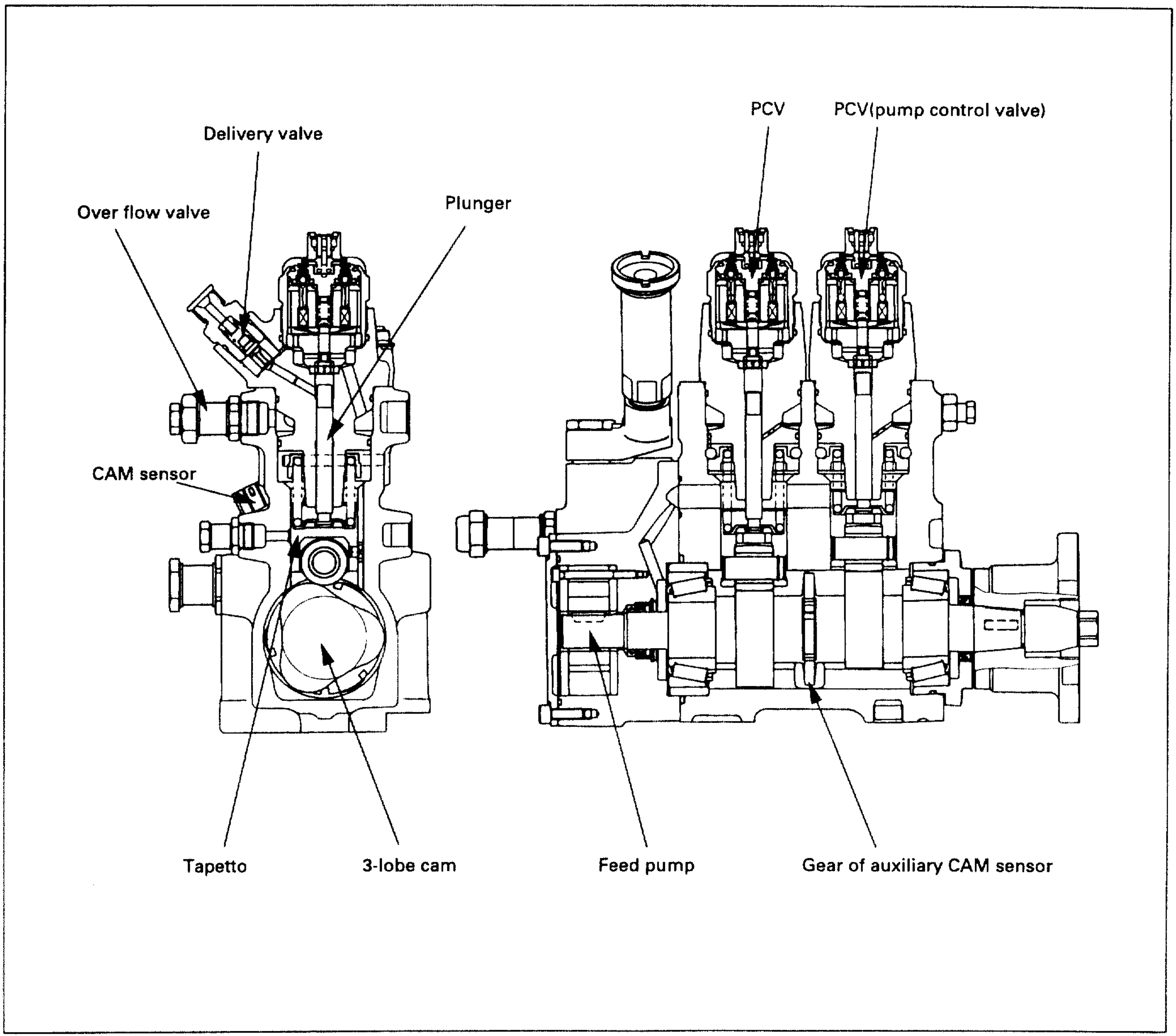
1. Outline

The function of the supply pump is to regulate the fuel discharge volume, thus generating the internal fuel pressure in the common rail.

2. Construction

The supply pump consists of a feed pump, which is similar to that of the conventional inline pump, and the PCVs (pump control valves), which are provided at each cylinder, to regulate the fuel discharge volume.

The supply pump uses a three-lobe cam to reduce the number of cylinders the pump must provide to one-third of the cylinders in the engine (e.g., a two-cylinder pump for an six-cylinder engine). Furthermore, a smooth and stable common rail pressure can be obtained because the frequency that the fuel is pumped to the common rail is the same as the frequency of injection.



3. Operation

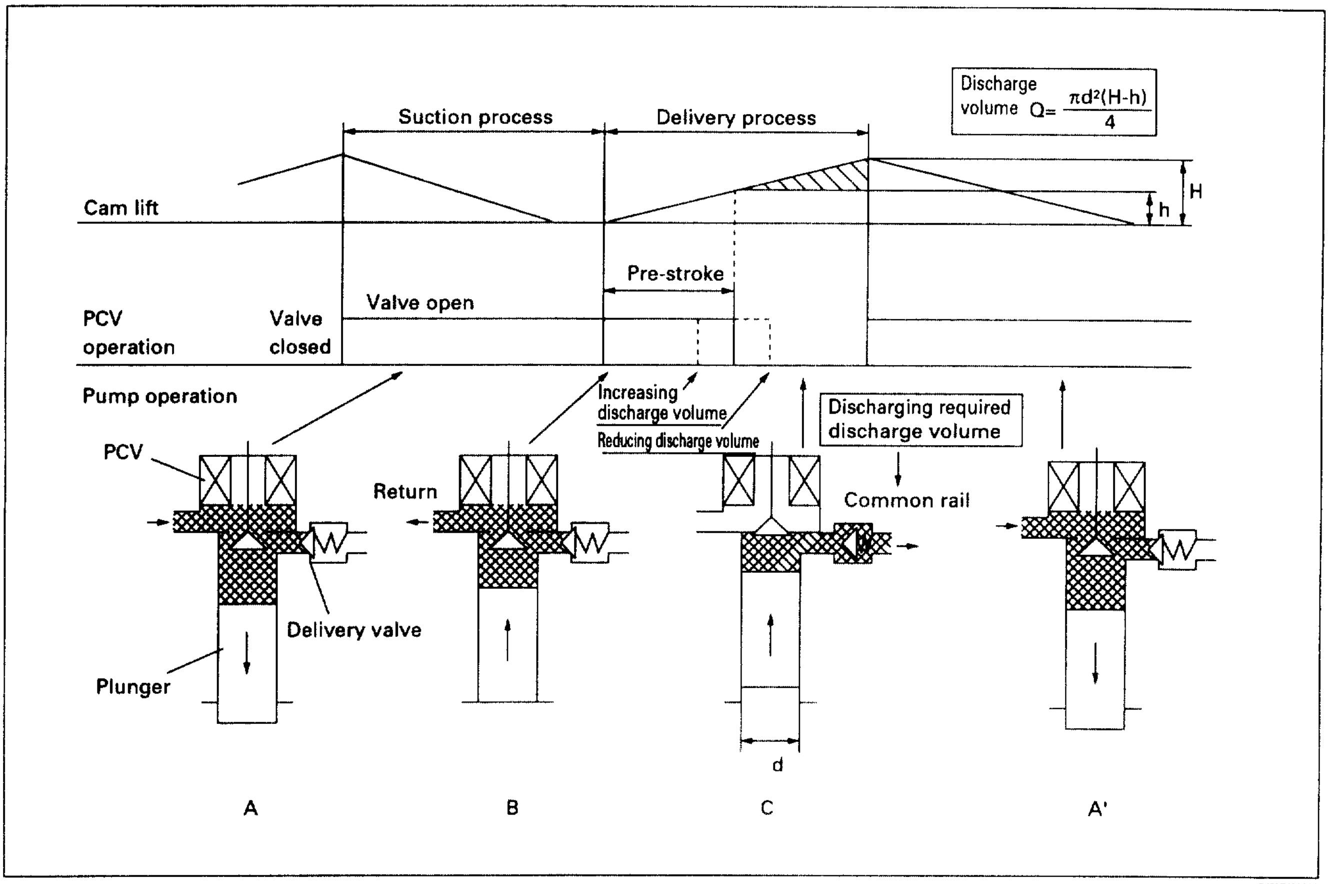
A The PCV remains open during the plunger's downward stroke, allowing the low-pressure fuel to be drawn into the plunger chamber by way of the PCV

B Even after the plunger begins its upward stroke, if the valve remains open because current is not applied to the PCV, the fuel that was drawn in returns via the PCV, without becoming pressurized.

C When current is applied to the PCV in order to close the valve at the timing that accommodates the required discharge volume, the return passage closes, causing the pressure in the plunger chamber to rise.

Accordingly, the fuel passe through the delivery valve (check valve) to the common rail. As a result, the amount of fuel that corresponds with the lifting of the plunger after the PCV closes becomes the discharge volume, and varying the timing of the closing of the PCV (plunger pre-stroke) causes the discharge volume to vary, thus regulating the common rail pressure.

A' After surpassing the cam's maximum lift, the plunger begins its downward stroke, causing the plunger chamber pressure to decrease. At this time, the delivery valve closes, thus stopping the pumping of the fuel. In addition, because the current to the PCV valve is stopped, the PCV opens, allowing the low-pressure fuel to be drawn into the plunger chamber. Thus, the pump assumes the condition given in "A".



WORKING ON ELECTRICAL ITEMS

The emission and electrical control system operates on a twelve volt power supply with negative ground polarity. Each wire in the vehicle is of a specific size and has an identifying colored insulation.

These colors are indicated in wiring diagrams and will help in tracing circuits and making proper connections. Wire size is determined by load capacity and circuit length. Some wires are grouped together and taped. Such a grouping of wires is called a harness.

The harness use a split corrugated tube to protect the wires from the elements. Each circuit consists of the following:

- Power source – The battery and the alternator.
- Wires – To carry electrical current through the circuit.
- Fuses – To protect the circuit against current overload.
- Relays – To protect voltage drop between the battery and the circuit parts and to protect the switch points against burning.
- Switches – To open and close the circuit.
- Load – Any device, such as a light or a motor, which converts the electrical current into useful work.
- Ground – To allow the current to flow back to the power source.

In this manual, such electrical device is classified by system. For major parts shown on the circuit based on the circuit diagram for each system, inspection and removal and installation procedures are detailed.

NOTES FOR WORKING ON ELECTRICAL ITEMS

BATTERY CABLE

Disconnecting the Battery Cable

1) All switches should be in the "OFF" position.
2) Disconnect the battery ground cable.
3) Disconnect the battery positive cable.

CAUTION:
It is important that the battery ground cable be disconnected first.
Disconnecting the battery positive cable first can result in a short circuit.

Connecting the Battery Cable

Follow the disconnecting procedure in the reverse order.

CAUTION:
Clean the battery terminal and apply a light coat of grease to prevent terminal corrosion.

Connecting Handling

Disconnecting The Connectors

Some connectors have a tang lock to hold the connectors together during vehicle operation.

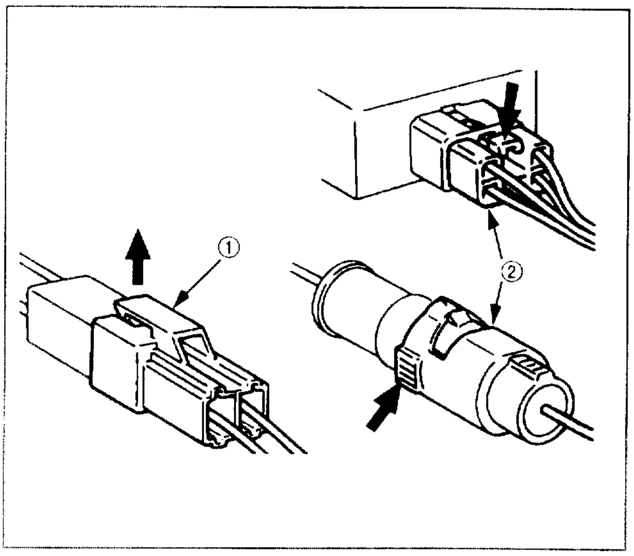
Some tang locks are released by pulling them towards you ①.

Other tang locks are released by pressing them forward ②.

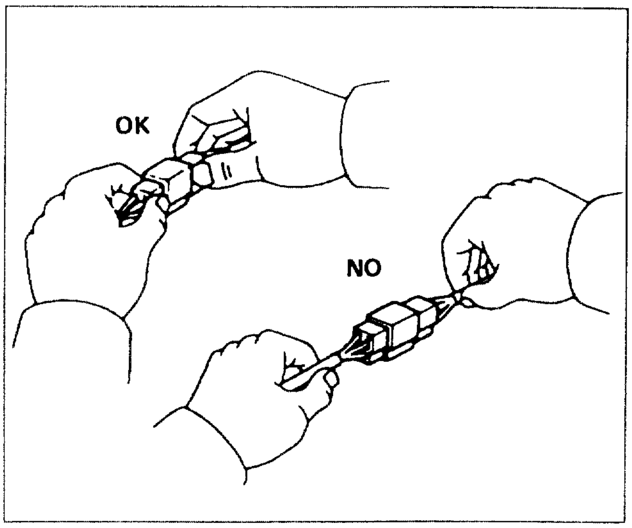
Determine which type of tang lock is on the connector being handled.

Firmly grasp both sides (male and female) of the connector.

Release the tang lock and carefully pull the two halves of the connector apart.

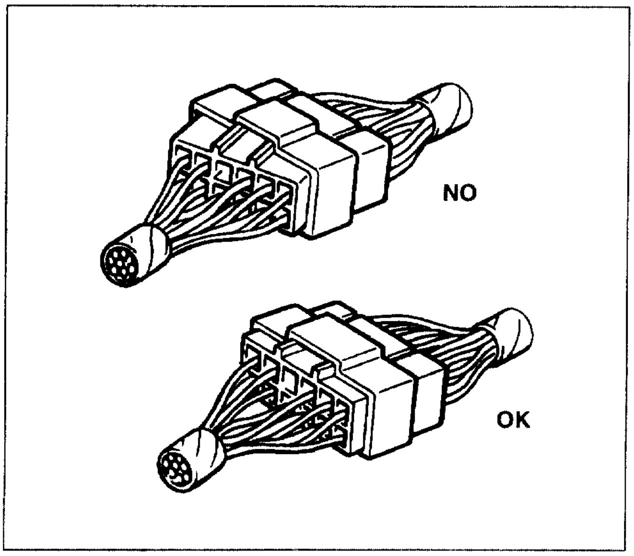


Never pull on the wires to separate the connectors. This will result in wire breakage.



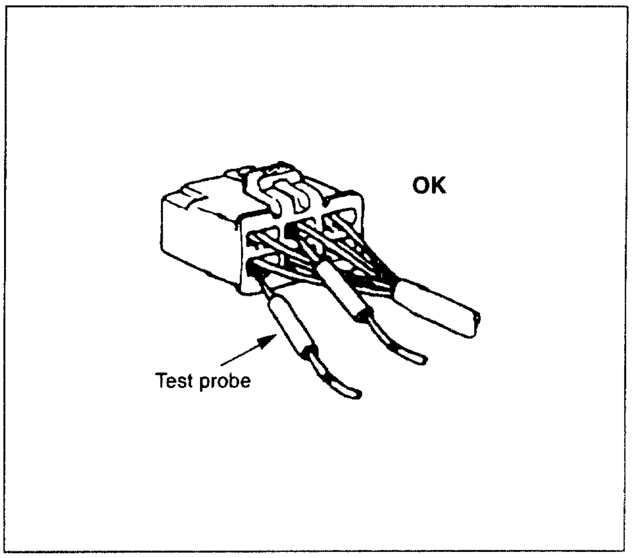
Connecting the Connector

Firmly grasp both sides (male and female) or the connector. Be sure that the connector pins and pin holes match. Be sure that both sides of the connector are aligned with each other. Firmly but carefully push the two sides of the connector together until a distinct click is heard.

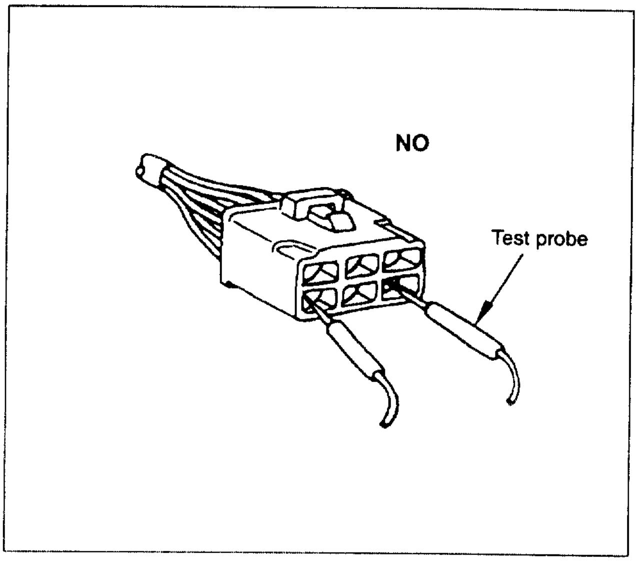


Connector Inspection

Use a circuit tester to check the connector for continuity. Insert the test probes from the connector wire side.

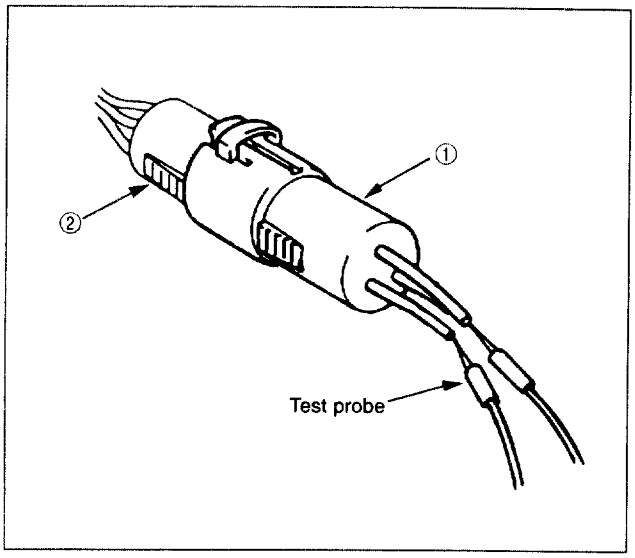


Never insert the circuit tester test probes into the connector open end to test the continuity. Broken or open connector terminals will result.



Waterproof Connector Inspection

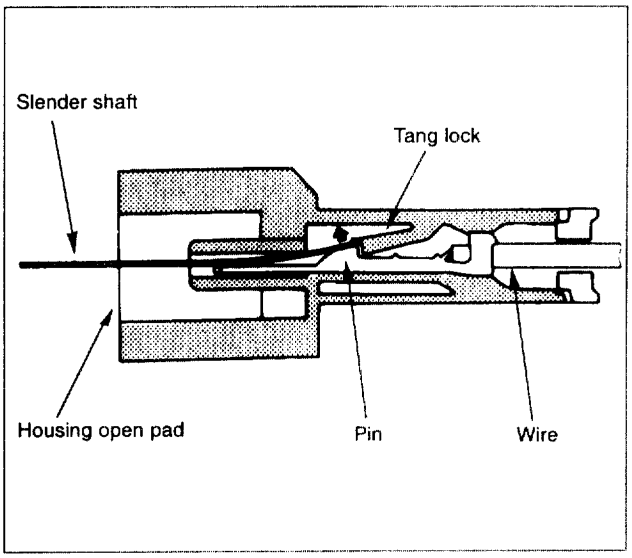
It is not possible to insert the test probes into the connector wire side of a waterproof connector. Prick the insulation on the wires with a straight pin. Connect the test probes to the straight pin to check for connector continuity. Use one side of a connector (1) with its wires cut to make the test. Connect the test connector (2) to the connector to be tested. Connect the test probes to the cut wires to check the connector continuity.



Connector Pin Removal

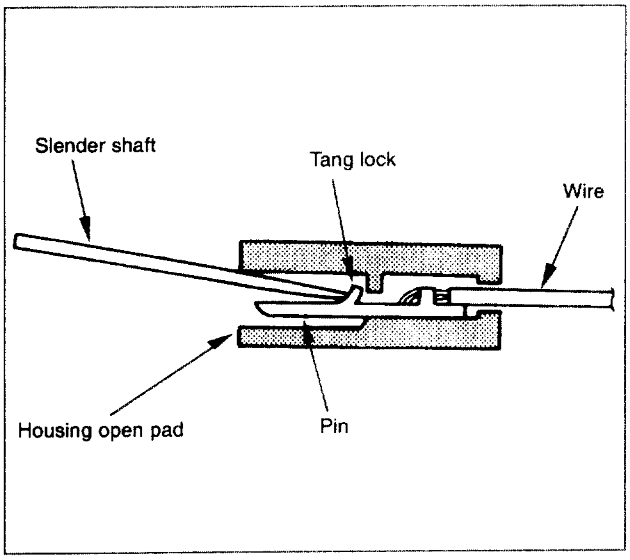
Connecting Housing Tang Lock Type

1) Insert a slender shaft into the connector housing open end.
2) Push the tang lock up (in the direction of the arrow in the illustration). Pull the wire with pin free from the wire side of the connector.



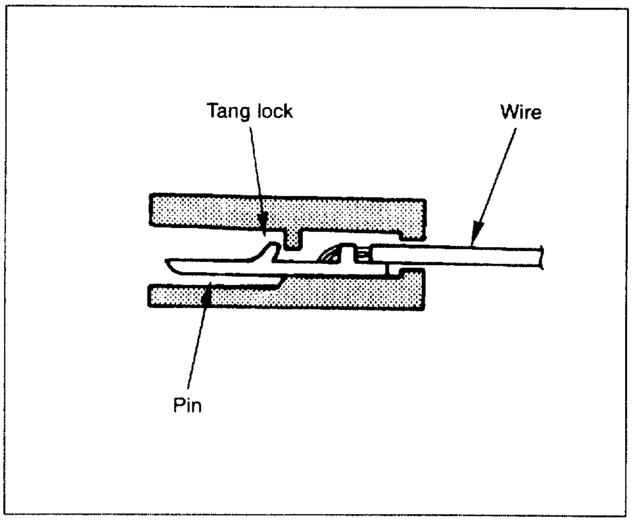
Pin Tang Lock Type

1) Insert a slender shaft into the Connector housing open end.
2) Push the tang lock flat (toward the wire side of the connector). Pull the wire with pin free from the wire side of the connector.



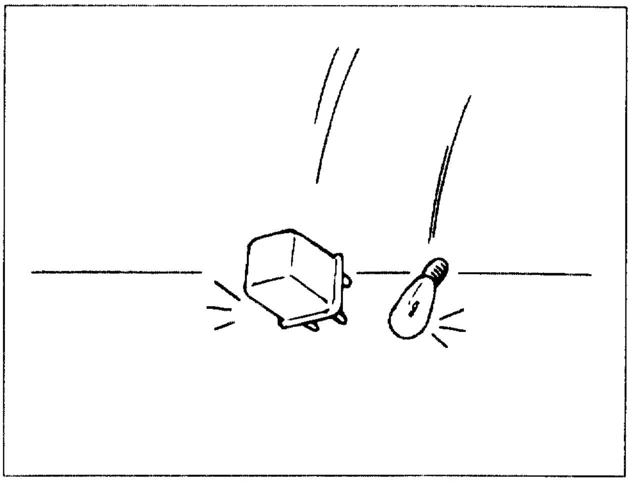
Connector Pin Insertion

1) Check that the tang lock is fully up.
2) Insert the pin from the connector wire side.
   Push the pin in until the tang lock closes firmly.
3) Gently pull on the wires to make sure that the connector pin is firmly set in place.



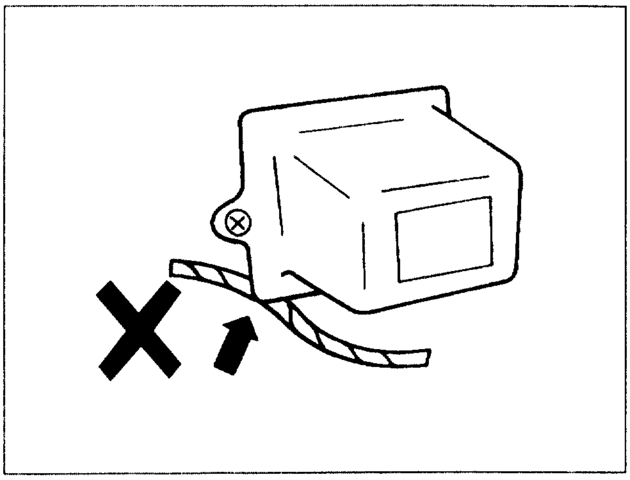
Parts Handling

Be careful when handling electrical parts. They should not be dropped or thrown, because short circuit or other damage may result.



Cable Harness

When installing the parts, be careful not to pinch or wedge the wiring harness.
All electrical connections must be kept clean and tight.



SPLICING WIRE

1. **Open the Harness**

   If the harness is taped, remove the tape. To avoid wire insulation damage, use a sewing "seam ripper" (available from sewing supply stores) to cut open the harness.
   If the harness has a block plastic conduit, simply pull out the desired wire.

2. **Cut the wire**

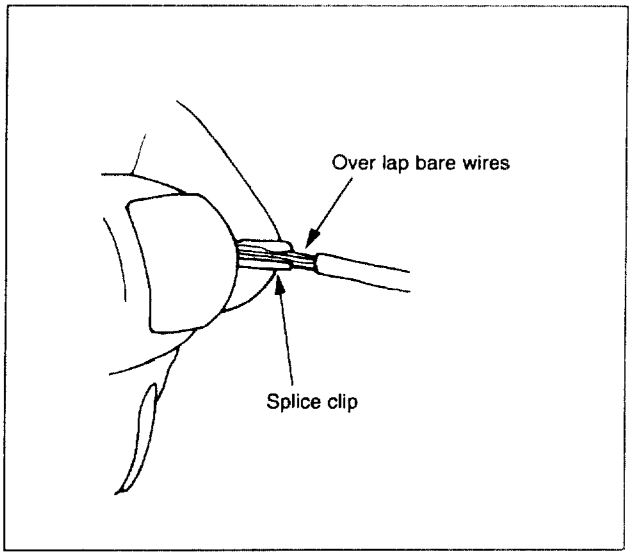
   Begin by cutting as little wire off the harness as possible. You may need the extra length of wire later if you decide to cut more wire off to change the location of a splice. You may have to adjust splice locations to make certain that each splice is at least 1-1/2 in (40 mm) away from other splices, harness branches, or connectors.

3. **Strip the Insulation**

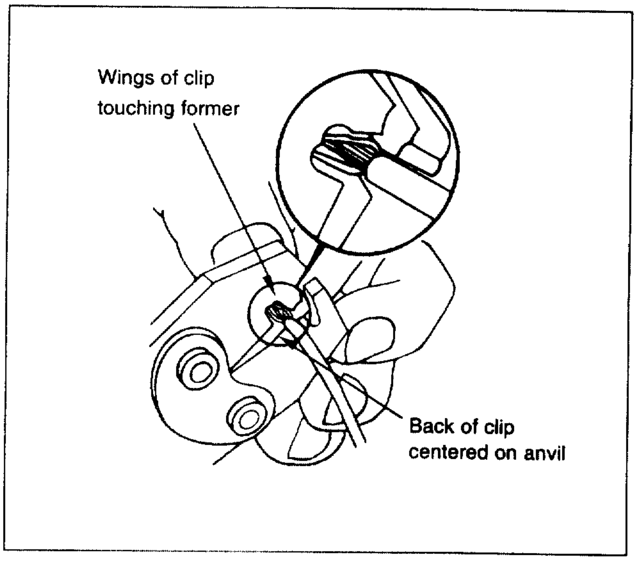
   When replacing a wire, use a wire of the same size as the original wire. Check the striped wire for nicks or cut stands. If the wire is damaged, repeat the procedure on a new section of wire. The two stripped wire ends should be equal in length.

4. **Crimp the Wires**

   Select the proper clip to secure the splice. To determine the proper clip size for the wire being spliced, follow the directions included with you clips. Select the correct anvil on the crimper. (On most crimpers your choice is limited to either a small or large anvil.) Overlap the two stripped wire ends and hold them between your thumb and forefinger. Then, center the splice clip under the stripped wires and hold it in place.



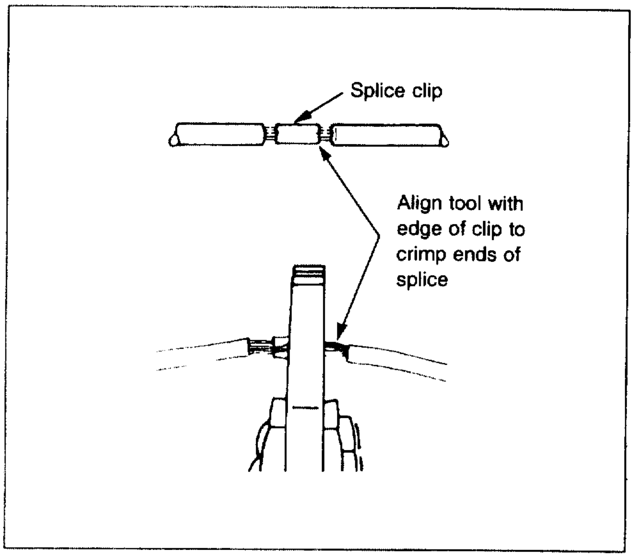
- Open the crimping tool to its full width and rest one handle on a firm flat surface.
- Center the back of the splice clip on the proper anvil and close the crimping tool to the point where the back of the splice clip touches the wings of the clip.
- Make sure that the clip and wires are still in the correct position. Then, apply steady pressure until the crimping tool closes.



Before crimping the ends of the clip, be sure that:

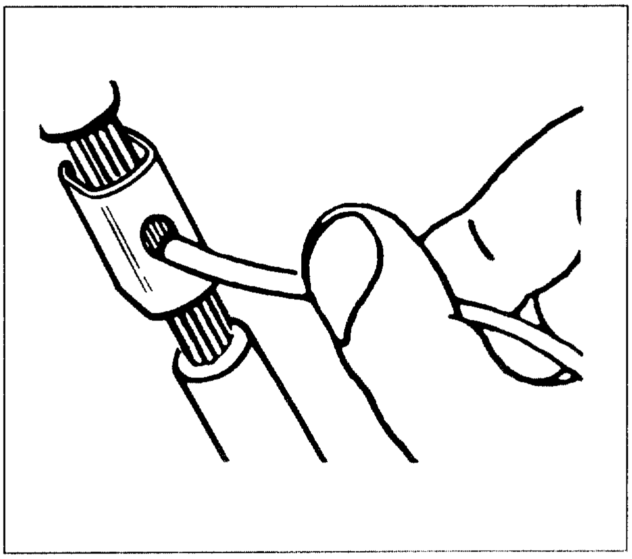
- The wires extend beyond the clip in each direction.
- No stands of wire are cut loose, and
- No insulation is caught under the clip.

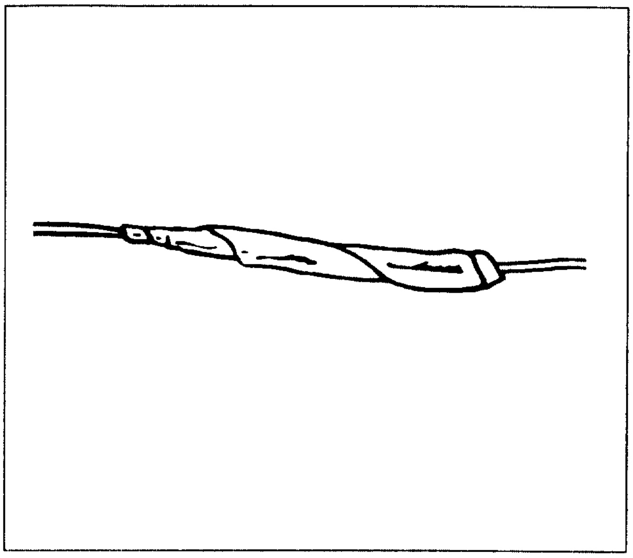
Crimp the splice again, once on each end. Do not let the crimping tool extend beyond the edge of the clip or you may damage or nick the wires.



5. **Solder**

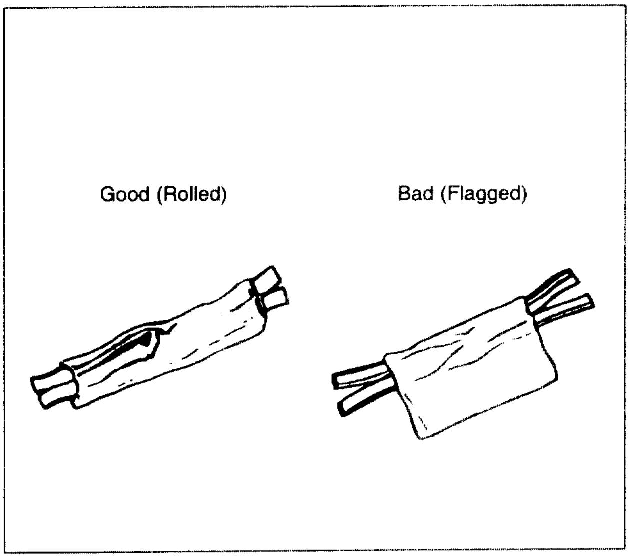
   Apply 60/40 rosin core colder to the opening in the back of the clip. Follow the manufacturer's instructions for the solder equipment you are using.





6. **Tape the Splice**

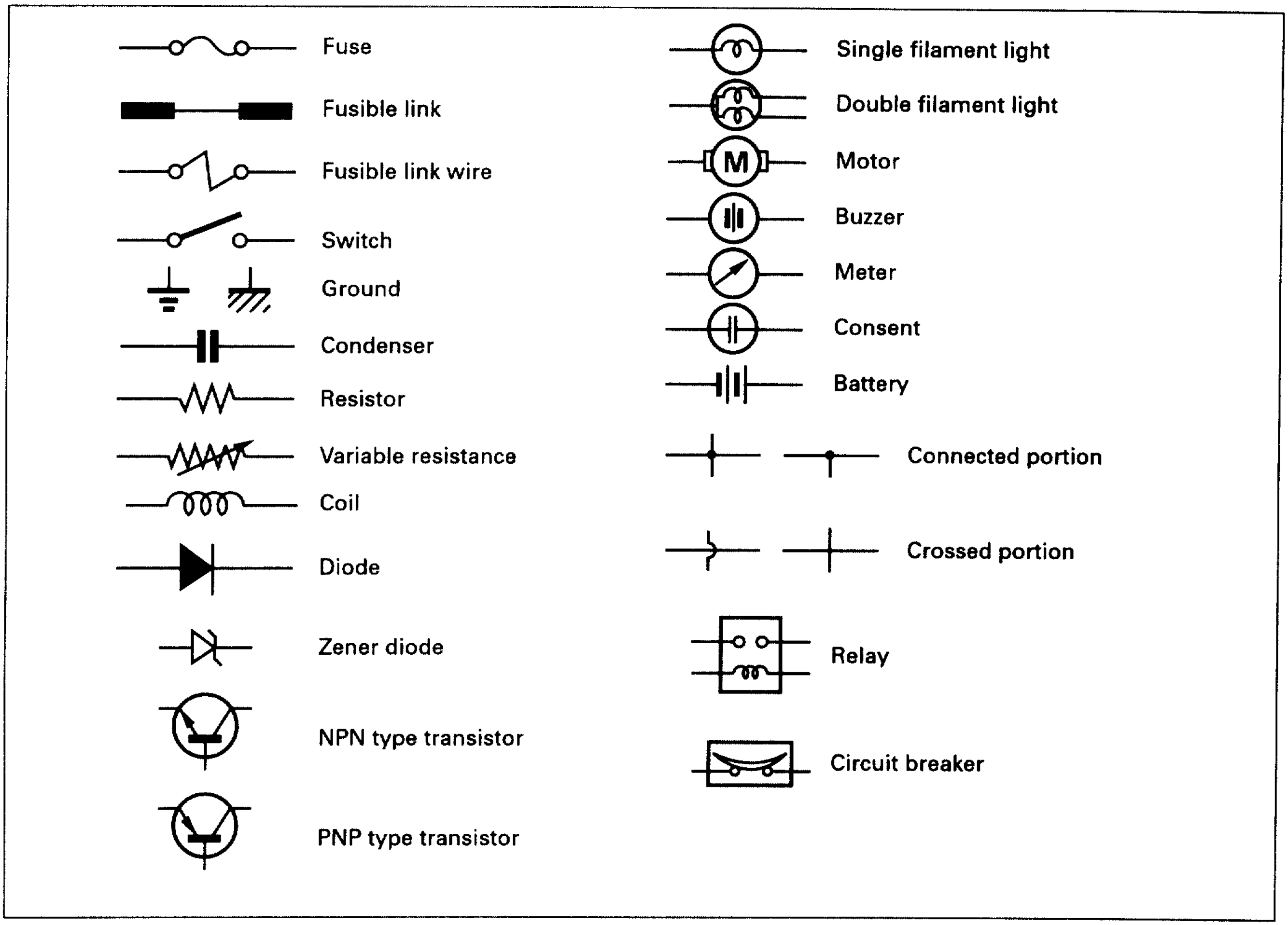
   Center and roll the splicing tape. The tape should cover the entire splice. Roll on enough tape to duplicate the thickness of the insulation on the existing wires. Do not flag the tape. Flagged tape may not provide enough insulation, and the flagged ends will tangle with the other wires in the harness.



If the wire does not belong in a conduit or other harness covering, tape the wire again. Use a winding motion to cover the first piece of tape.

SYMBOLS AND ABBREVIATIONS

Symbols



F07MT001

Abbreviations

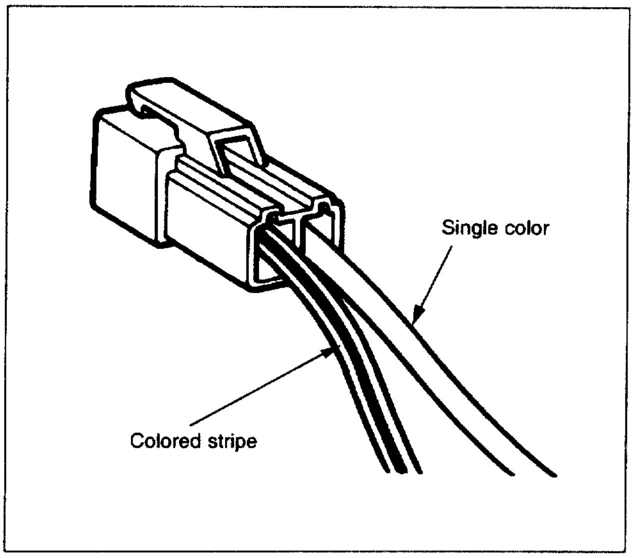
ABBREVIATION	MEANING
A	ANALOG
AAT	AMBIENT AIR TEMPERATURE
A/C	AIR CONDITIONER
A/D	ANALOG/DIGITAL
ACT	ACTUATOR
APP	ACCELERATOR PEDAL POSITION
A/T	AUTOMATIC TRANSMISSION
BARO	ATMOSPHERIC PRESSURE
BATT	BATTERY
B+	BATTERY (+)
CAM	PUMP POSITION/CAM POSITION
CKP	CRANKSHAFT POSITION
CONN	CONNECTOR
CSS	COMBINED CHARGING SYSTEM
C/U	CONTROL UNIT
D	DIGITAL
DC	DIRECT CURRENT
D/CONN	DIAGNOSIS CONNECTOR
DTC	DIAGNOSTIC TROUBLE CODE
EC	ELECTRICAL CONTROL GOVERNOR
ECM	ENGINE CONTROL MODULE
ECT	ENGINE COOLANT TEMPERATURE
EH	ELECTRICAL AND HYDRAULIC TIMER
EXH	EXHAUST
FCCB	FUEL CONSUMPTION OF CYLINDER BALANCE
FRT	FRONT
FT	FUEL TEMPERATURE
GND	GROUND (BODY EARTH)
IN	INLET, INTAKE
ISC	IDLE SPEED CONTROL
LH	LEFT HAND (SIDE)
LHD	LEFT HAND DRIVE
MAG	MAGNETIC
ME/CONN	MEMORY ERASER CONNECTOR
MIL	MALFUNCTION INDICATOR LAMP
M/V	MAGNETIC VALVE
N	NEUTRAL (TRANSMISSION GEAR)
N-TDC	NUMBERS TOP DEAD CENTER
NR	NOISE REDUCER
OFF	TURN OFF (SWITCH/LAMP)
ON	TURN ON (SWITCH/LAMP)
OPT	OPTION
P BOOST	BOOST PRESSURE
P/BRAKE	PARKING BRAKE
PC SENSOR	COMMON RAIL PRESSURE SENSOR
PCV	PRESSURE CONTROL VALVE
PGND	POWER GROUND (TO BODY EARTH)
PIN	PIN or TERMINAL
P/L	PRESSURE LIMITER
PRESS	PRESSURE
P/T	POWER TRAIN
Q ADJUSTMENT	INJECTION QUANTITY ADJUSTMENT
RH	RIGHT HAND (SIDE)
RHD	RIGHT HAND DRIVE
R/L	RELAY
RR	REAR
SIG	SIGNAL
STA	STARTER
STD	STANDARD
SW	SWITCH
THA	AMBIENT AIR TEMPERATURE
THF	FUEL TEMPERATURE
TICS	TIMING AND INJECTION RATE CONTROL SYSTEM
TWV	INJECTOR (TWO WAY VALVE)
VCC	POWER SOURCE
VS	VEHICLE SPEED
VSS C/U	VEHICLE SPEED SENSOR CONTROL UNIT
W/G	WASTEGATE
W/L	WARNING LAMP

PARTS FOR ELECTRICAL CIRCUIT

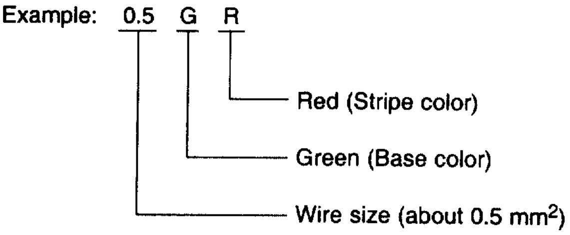
Wiring

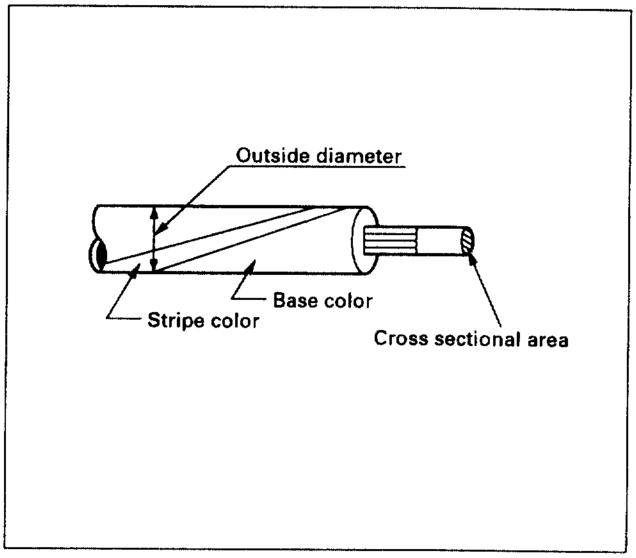
Wire Color

All wires have color-coded insulation.



Wires belonging to a system's main harness will have a single color. Wires belonging to a system's sub circuits will have a colored stripe. Striped wires use the following code to show wire size and colors.





Abbreviations are used to indicate wire color within a circuit diagram.
Refer to the following table.

Wire Color Coding

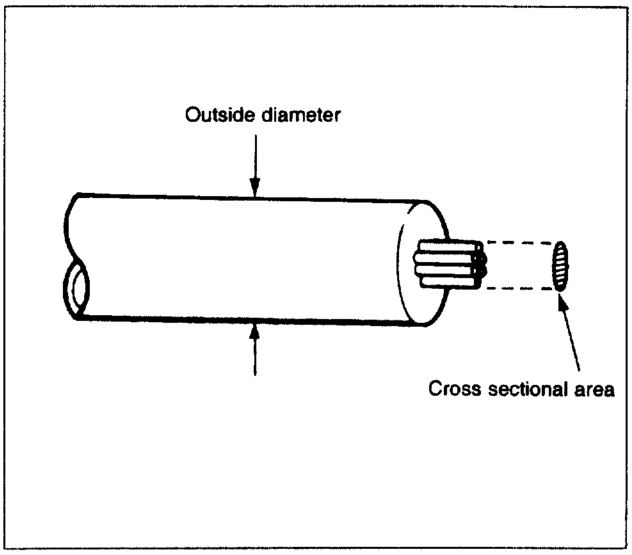
Color-coding	Meaning	Color-coding	Meaning
B	Black	Br	Brown
W	White	Lg	Light green
R	Red	Gr	Gray
G	Green	P	Pink
Y	Yellow	Sb	Sky blue
L	Blue	V	Violet
O	Orange	—	—

Stripe Color Coding

Color coding	Base color	Stripe color
LB	Blue	Black
OB	Orange	Black
PB	Pink	Black
PG	Pink	Green
PL	Pink	Blue
RY	Red	Yellow
VR	Violet	Red
VW	Violet	White
YB	Yellow	Black
YB	Yellow	Green
YV	Yellow	Violet

Wire Size

The size of wire, used in a circuit is determined by the amount of current (amperage), the length of the circuit, and the voltage drop allowed. The following wire size and load capacity, shown below, are specified by SAE.



Nominal size	Cross sectional area (mm^2)	Outside diameter (mm)	Allowable current (A)
0.3	0.372	1.8	9
0.5	0.563	2.0	12
0.85	0.885	2.2	16
1.25	1.287	2.5	21
2	2.091	2.9	28
3	3.296	3.6	37.5
5	5.227	4.4	53
8	7.952	5.5	67
15	13.36	7.0	75
20	20.61	8.2	97

Diagnosis

Strategy-Based Diagnostics

Strategy-Based Diagnostics

The strategy-based diagnostic is a uniform approach to repair all Electrical/Electronic (E/E) systems. The diagnostic flow can always be used to resolve an E/E system problem and is a starting point when repairs are necessary. The following steps will instruct the technician how to proceed with a diagnosis:

1. Verify the customer complaint.
   - To verify the customer complaint, the technician should know the normal operation of the system.
2. Perform preliminary checks.
   - Conduct a thorough visual inspection.
   - Review the service history.
   - Detect unusual sounds or odors.
   - Gather diagnostic trouble code information to achieve an effective repair.
3. Check bulletins and other service information.
   - This includes videos, newsletters, etc.
4. Refer to service information (manual) system check(s).
   - "System checks" contain information on a system that may not be supported by one or more DTCs. System checks verify proper operation of the system. This will lead the technician in an organized approach to diagnostics.
5. Refer to service diagnostics.

DTC Stored

Follow the designated DTC chart exactly to make an effective repair.

No DTC

Select the symptom from the symptom tables. Follow the diagnostic paths or suggestions to complete the repair. You may refer to the applicable component/system check in the system checks.

No Matching Symptom

1. Analyze the complaint.
2. Develop a plan for diagnostics.
3. Utilize the wiring diagrams and the theory of operation.

Call technical assistance for similar cases where repair history may be available. Combine technician knowledge with efficient use of the available service information.

Intermittents

Conditions that are not always present are called intermittents. To resolve intermittents, perform the following steps:

1. Observe history DTCs, DTC modes.
2. Evaluate the symptoms and the conditions described by the customer.
3. Use a check sheet or other method to identify the circuit or electrical system component.
4. Follow the suggestions for intermittent diagnosis found in the service documentation.

Most scan tool, such as the Tech II have data-capturing capabilities that can assist in detecting intermittents.

No Trouble Found

This condition exists when the vehicle is found to operate normally. The condition described by the customer may be normal. Verify the customer complaint against another vehicle that is operating normally. The condition may be intermittent. Verify the complaint under the conditions described by the customer before releasing the vehicle.

1. Re-examine the complaint
   When the Complaint cannot be successfully found or isolated, a re-evaluation is necessary. The complaint should be re-verified and could be intermittent as defined in Intermittents, or could be normal.
2. Repair and verify.
   After isolating the cause, the repairs should be made. Validate for proper operation and verify that the symptom has been corrected. This may involve road testing or other methods to verify that the complaint has been resolved under the following conditions:
   - Conditions noted by the customer.

General Service Information

OBD Serviceability Issues

The list of non-vehicle faults that could affect the performance of the OBD system has been compiled. These non-vehicle faults vary from environmental conditions to the quality of fuel used.

The illumination of the MIL ("Check Engine Soon" lamp) due to a non-vehicle fault could lead to misdiagnosis of the vehicle, increased warranty expense and customer dissatisfaction. The following list of non-vehicle faults does not include every possible fault and may not apply equally to all product lines.

Poor Vehicle Maintenance

The sensitivity of OBD diagnostics will cause the MIL to turn on if the vehicle is not maintained properly. Restricted air filters, fuel filters, and crankcase deposits due to lack of oil changes or improper oil viscosity can trigger actual vehicle faults that were not previously monitored prior to OBD. Poor vehicle maintenance can not be classified as a "non-vehicle fault", but with the sensitivity of OBD diagnostics, vehicle maintenance schedules must be more closely followed.

Maintenance Schedule

Refer to the Maintenance Schedule.

Visual/Physical Engine Compartment Inspection

Perform a careful visual and physical engine compartment inspection when performing any diagnostic procedure or diagnosing the cause of an emission test failure. This can often lead to repairing a problem without further steps. Use the following guidelines when performing a visual/physical inspection:

- Inspection all vacuum hoses for punches, cuts, disconnects, and correct routing.
- Inspect hoses that are difficult to see behind other components.

- Inspect all wires in e engine compartment for proper connections, burned or chafed spots, pinched wires, contact with sharp edges or contact with hot exhaust manifolds or pipes.

Basic Knowledge of Tools Required

NOTE: Lack of basic knowledge of this powertrain when performing diagnostic procedures could result in an incorrect diagnosis or damage to powertrain components. Do not attempt to diagnose a powertrain problem without this basic knowledge.

A basic understanding of hand tools is necessary to effectively use this section of the Service Manual.

On-Board Diagnostic (OBD)

Passive and Active Diagnostic Tests

A passive test is a diagnostic test which simply monitors a vehicle system or component. Conversely, an active test, actually takes some sort of action when performing diagnostic functions, often in response to a failed passive test.

Intrusive Diagnostic Tests

This is any on-board test run by the Diagnostic Management System which may have an effect on vehicle performance or emission levels.

Warm-Up Cycle

A warm-up cycle means that engine at temperature must reach a minimum of 70°C (160°F) and rise at least 22°C (40°F) over the course of a trip.

Common OBD Terms

Diagnostic

When used as a noun, the word diagnostic refers to any on-board test run by the vehicle's Diagnostic Management System. A diagnostic is simply a test run on a system or component to determine if the system or component is operating according to specification.

Enable Criteria

The term "enable criteria" is engineering language for the conditions necessary for a given diagnostic test to run. Each diagnostic has a specific list of conditions which must be met before the diagnostic will run. "Enable criteria" is another way of saying "conditions required".

The Diagnostic Executive

The Diagnostic Executive is a unique segment of software which is designed to coordinate and prioritize the diagnostic procedures as well as define the protocol for recording and displaying their results. The main responsibilities of the Diagnostic Executive are listed as following:

- Commanding the MIL ("Check Engine Soon" lamp) on and off
- DTC logging and clearing
- Current status information on each diagnostic
- System Status

Diagnostic Information

The diagnostic charts and functional checks are designed to locate a faulty circuit or component through a process of logical decisions. The charts are prepared with the requirement that the vehicle functioned correctly at the time of assembly and that there are not multiple faults present.

There is a continuous self-diagnosis on certain control functions. This diagnostic capability is complemented by the diagnostic procedures contained in this manual. The language of communicating the source of the malfunction is a system of diagnostic trouble codes. When a malfunction is detected by the control module, a diagnostic trouble code is set and the Malfunction Indicator Lamp (MIL) is illuminated.

Malfunction Indicator Lamp (MIL)

The Malfunction Indicator Lamp (MIL) looks the same as the MIL you are already familiar with ("Service Engine Soon" lamp). However, OBD requires that the it illuminate under a strict set of guide lines.

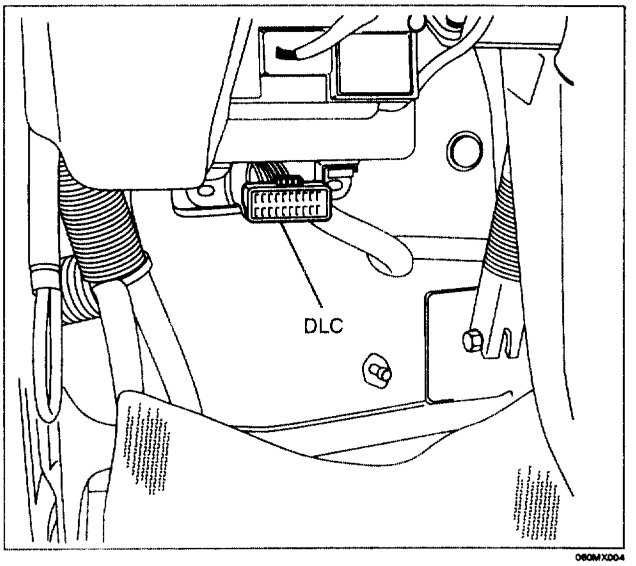
Basically, the MIL is turned on when the ECM detects a DTC that will impact the vehicle emissions and performance.

Extinguishing the MIL

Connect the memory clear switch (Blue) one to two second then disconnect the memory clear switch (Blue).

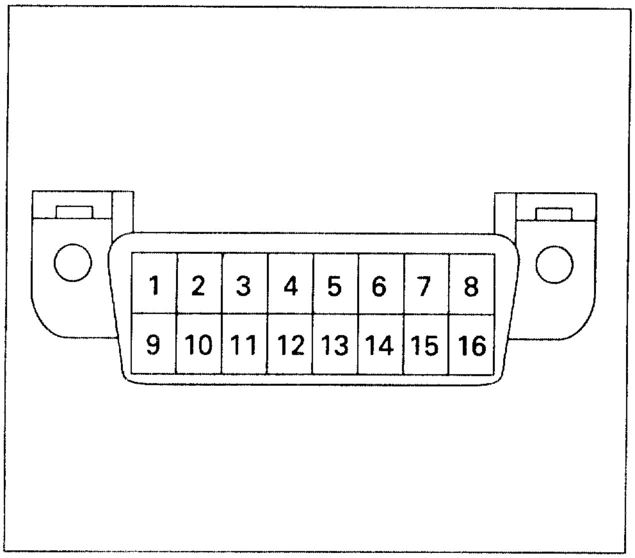
Data Link Connector (DLC)

The provision for communication with the control module is the Data Link Connector (DLC). It is located at the lower left of the instrument panel behind a small square cover.



The DLC is used to connect to a scan tool. Some common uses of the scan tool are listed below:

- Identifying stored Diagnostic Trouble Codes (DTCs).
- Clearing DTCs.
- Performing output control tests.
- Reading serial data.



Decimal/Binary/Hexadecimal Conversions

All scan tool manufacturer will display a variety of vehicle information which will aid in repairing the vehicle. Some scan tools will display encoded messages which will aid in determining the nature of the concern. The method of encoding involves the use of a two additional numbering systems: Binary and Hexadecimal.

The binary number system has a base of two numbers. Each digit is either a 0 or a 1. A binary number is an eight digit number and is read from right to left. Each digit has a position number with the farthest right being the 0 position and the farthest left being the 7 position. The 0 position, when displayed by a 1, indicates 1 in decimal. Each position to the left is double the previous position and added to any other position values marked as a 1.

A hexadecimal system is composed of 16 different alpha numeric characters. The alpha numeric characters used are numbers 0 through 9 and letters A through F. The hexadecimal system is the most natural and common approach for scan tool manufacturers to display data represented by binary numbers and digital code.

Verifying Vehicle Repair

Verification of vehicle repair will be more comprehensive for vehicles with OBD system diagnostic. Following a repair, the technician should perform the following steps:

1. Review and record the Fail Records for the DTC which has been diagnosed.
2. Clear DTC(s).
3. Operate the vehicle within conditions noted in the Fail Records.
4. Monitor the DTC status information for the specific DTC which has been diagnosed until the diagnostic test associated with that DTC runs.

Following these steps are very important in verifying repairs on OBD systems. Failure to follow these steps could result in unnecessary repairs.

Reading Diagnostic Trouble Codes Using A Tech 2 or Other Scan Tool

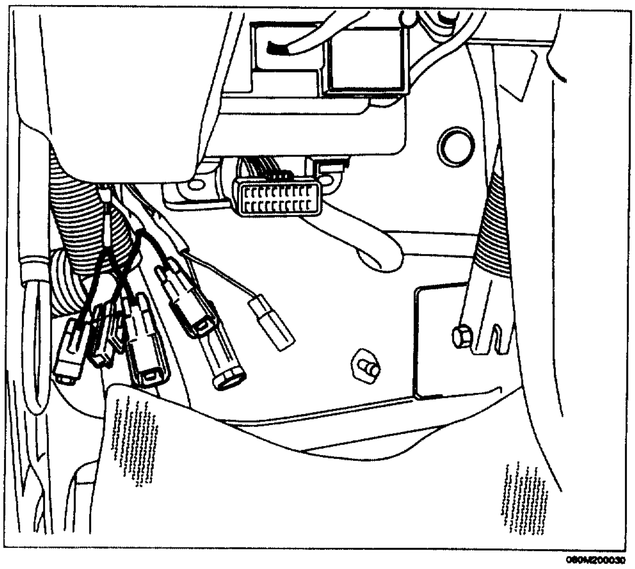
The procedure for reading diagnostic trouble code(s) is to used a diagnostic scan tool. When reading DTC(s), follow instructions supplied by tool manufacturer.

Clearing Diagnostic Trouble Codes

IMPORTANT: Do not clear DTCs unless directed to do so by the service information provided for each diagnostic procedure. When DTCs are cleared, the Failure Record data which may help diagnose an intermittent fault will also be erased from memory.

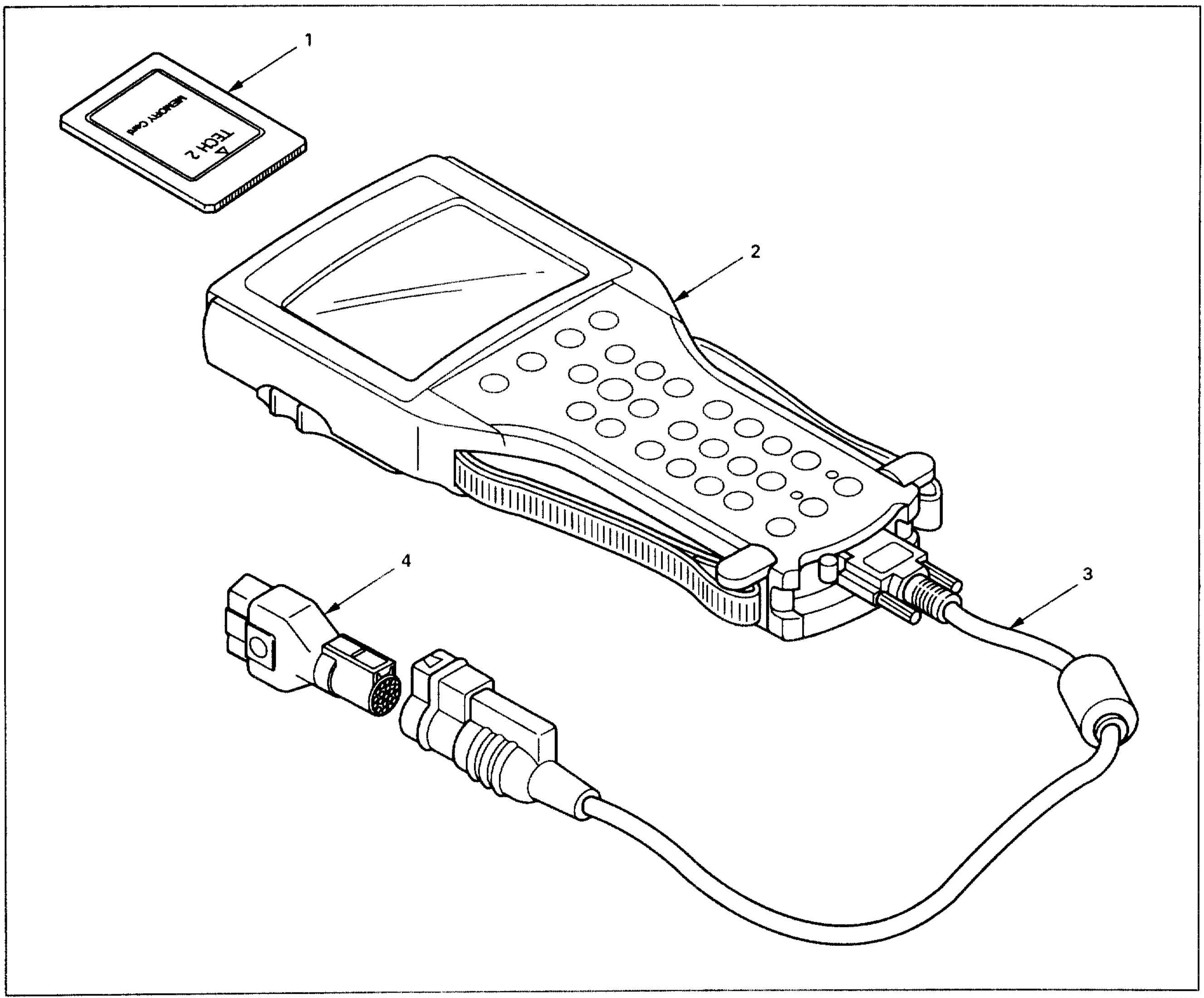
To clear Diagnostic Trouble Codes (DTCs), use the diagnostic scan tool "clear DTC information" function. When clearing DTCs follow instructions supplied by the tool manufacturer.

When a scan tool is not available, DTCs can also be cleared by connect the memory clear switch (Blue) one to two second then disconnect the memory clear switch (Blue).



Tech 2 Scan Tool

From 98 MY, Isuzu Dealer service departments are recommended to use Tech 2. Refer to Tech 2 scan tool user guide.



Legend

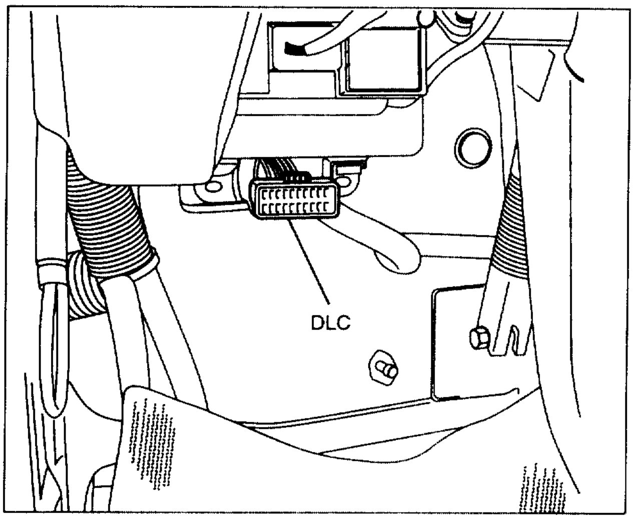
(1) PCMCIA Card
(2) Tech-2
(3) DLC Cable
(4) SAE 16/19 Adapter

Tech 2 Features

1. Tech 2 is a 12 volt system. Do not apply 24 volt.
2. After connecting and/or installing, the Vehicle Communications Interface (VCI) module, PCMCIA card and DLC connector to the Tech 2, connect the tool to the vehicle DLC.
3. Make sure the Tech 2 is powered OFF when removing or installing the PCMCIA card.
4. The PCMCIA card has a capacity of 10 Megabytes which is 10 times greater than the memory of the Tech 1 Mass Storage Cartridge.
5. The Tech 2 has the capability of two snapshots.
6. The PCMCIA card is sensitive to magnetism and static electricity, so care should be taken in the handling of the card.
7. The Tech 2 can plot a graph when replaying a snapshot.
8. Always return to the Main Menu by pressing the EXIT key several times before shutting down.
9. To clear Diagnostic Trouble Codes (DTCs), open Application Menu and press “F1: Clear DTC Info”.

Getting Started

- Before operating the Isuzu PCMCIA card with the Tech 2, the following steps must be performed:
  1. The Isuzu 98 System PCMCIA card (1) inserts into the Tech 2 (2).
  2. Connect the SAE 16/19 adapter (4) to the DLC cable (3).
  3. Connect the DLC cable to the Tech 2 (2).
  4. Make sure the vehicle starter key is off.
  5. Connect the Tech 2 SAE 16/19 adapter to the vehicle DLC.



6. The vehicle starter switch turns on.
7. Verify the Tech 2 power up display.

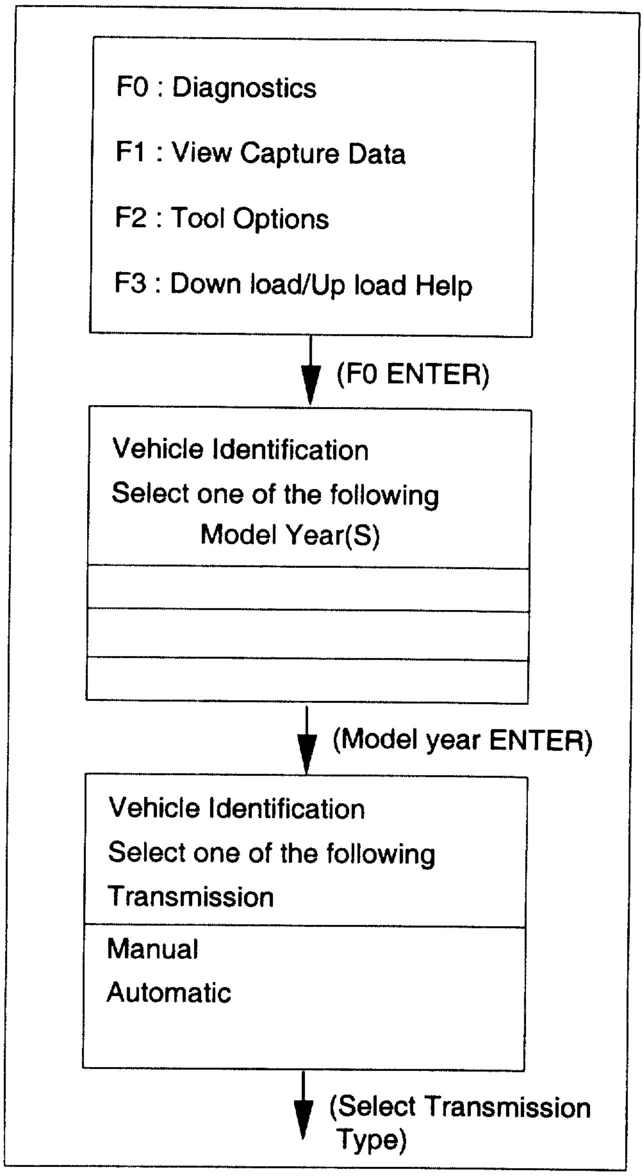
Tech 2

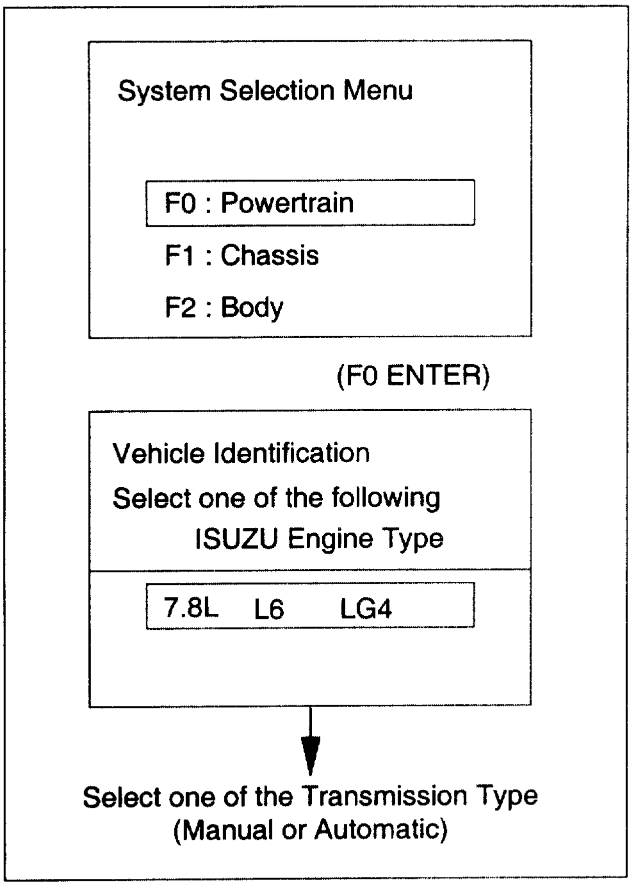
Press (ENTER) To Continue

ISUZU Development

Operating Procedure (For example)

The power up screen is displayed when you power up the tester with the Isuzu systems PCMCIA card. Follow the operating procedure below.





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Menu

- The following table shows, which functions are used the available equipment versions.

F0: Diagnostic Trouble Codes
    F0: DTC Information
        F0: Engine
        F1: History
    F1: Clear DTC Information

F1: Data Display
    F0: Engine Data 1
    F1: Engine Data 2
    F2: Engine Data 3
    F3: Engine Data 4
    F4: Engine Data 5
    F5: Engine Data 6

F2: Special Functions
    F0: Engine Output Controls
    F1: Fuel System
    F2: Capture & Restore Fuel Rate Data

F3: Snapshot

F4: ID Information

DTC

On OBD has two options available in the Tech 2 DTC mode to display the enhanced information available. A description of the new modes, DTC Info and Clear DTC Information. After selecting DTC, the following menu appears:

- DTC Info
- Clear DTC Information

DTC Information Mode

Use the DTC info mode to search for store DTC information. There are two choices. The service manual may instruct the technician to test for DTCs in a certain manner. Always follow published service procedures.

To get a complete description of any status, press the "Enter" key before pressing the desired F-key. For example, pressing "Enter" then an F-key will display a definition of the abbreviated scan tool status.

Engine

This selection will display all DTCs that have failed during the present ignition cycle.

History

This selection will display only DTCs that are stored in the ECM's history memory. It will not display Type B DTCs that have not requested the MIL. It will display all type A DTCs that have requested the MIL and have failed within the last 40 warm-up cycles.

Clear DTC Information

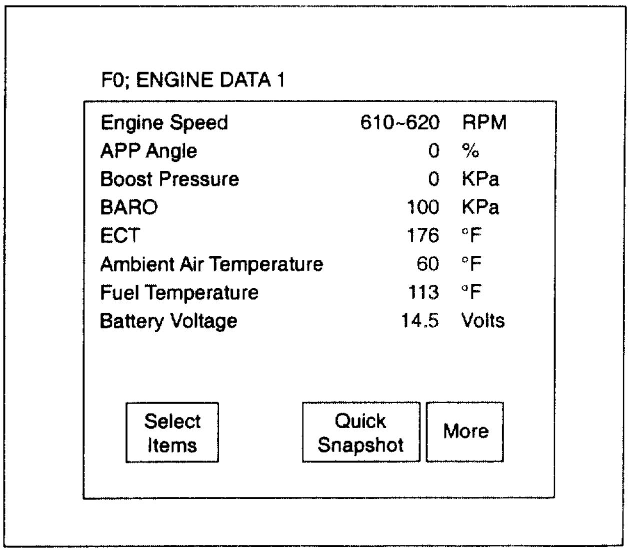
To clear Diagnostic Trouble Codes (DTCs), use the diagnostic scan tool "clear DTC information" function.

Tech2 Data Display

Use the Tech 2 Data Values only after the On-Board Diagnostic System Check has been completed, no DTC(s) were noted, and you have determined that the on-board diagnostics are functioning properly. Tech 2 values from a properly-running engine may be used for comparison with the engine you are diagnosing. The Tech 2 data values represent values that would be seen on a normally-running engine.

Engine Data 1

(For example)



F0; ENGINE DATA 1

Engine Speed	610~620	RPM
APP Angle	0	%
Boost Pressure	0	KPa
BARO	100	KPa
ECT	176	°F
Ambient Air Temperature	60	°F
Fuel Temperature	113	°F
Battery Voltage	14.5	Volts

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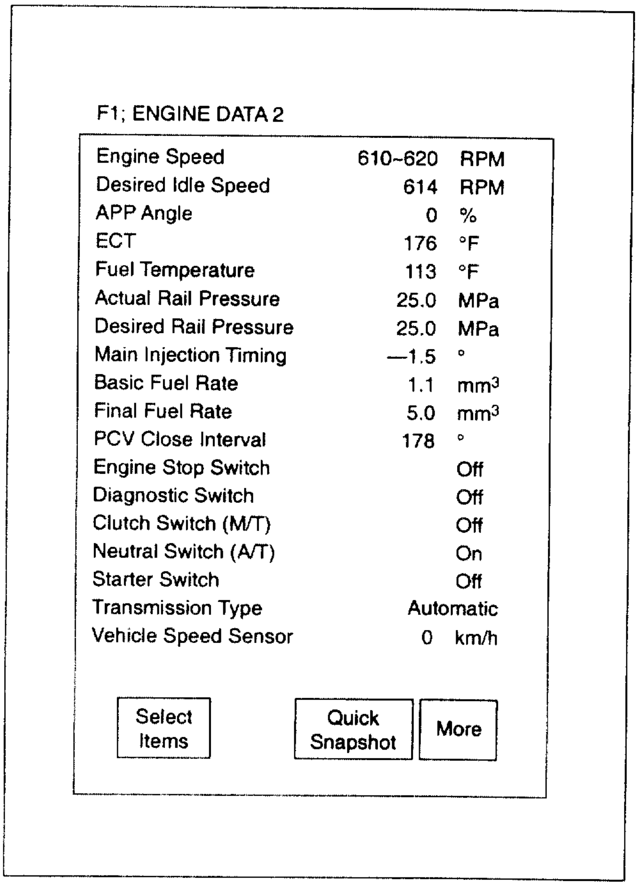
Engine Data 2

(For example)



F1; ENGINE DATA 2

Engine Speed	610~620	RPM
Desired Idle Speed	614	RPM
APP Angle	0	%
ECT	176	°F
Fuel Temperature	113	°F
Actual Rail Pressure	25.0	MPa
Desired Rail Pressure	25.0	MPa
Main Injection Timing	—1.5	°
Basic Fuel Rate	1.1	mm^3
Final Fuel Rate	5.0	mm^3
PCV Close Interval	178	°
Engine Stop Switch		Off
Diagnostic Switch		Off
Clutch Switch (M/T)		Off
Neutral Switch (A/T)		On
Starter Switch		Off
Transmission Type		Automatic
Vehicle Speed Sensor	0	km/h

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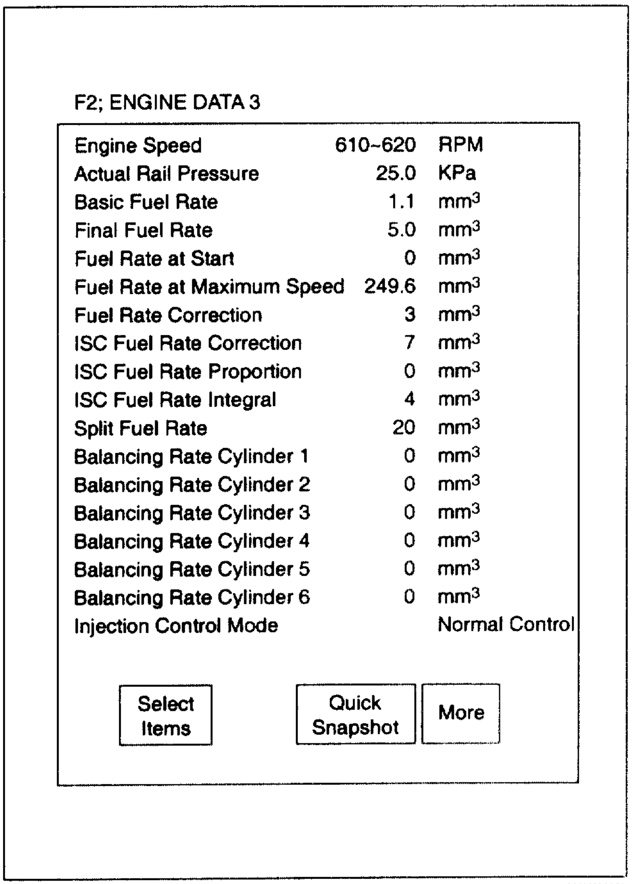
Engine Data 3

(For example)



F2; ENGINE DATA 3

Engine Speed	610~620	RPM
Actual Rail Pressure	25.0	KPa
Basic Fuel Rate	1.1	mm^3
Final Fuel Rate	5.0	mm^3
Fuel Rate at Start	0	mm^3
Fuel Rate at Maximum Speed	249.6	mm^3
Fuel Rate Correction	3	mm^3
ISC Fuel Rate Correction	7	mm^3
ISC Fuel Rate Proportion	0	mm^3
ISC Fuel Rate Integral	4	mm^3
Split Fuel Rate	20	mm^3
Balancing Rate Cylinder 1	0	mm^3
Balancing Rate Cylinder 2	0	mm^3
Balancing Rate Cylinder 3	0	mm^3
Balancing Rate Cylinder 4	0	mm^3
Balancing Rate Cylinder 5	0	mm^3
Balancing Rate Cylinder 6	0	mm^3
Injection Control Mode		Normal Control

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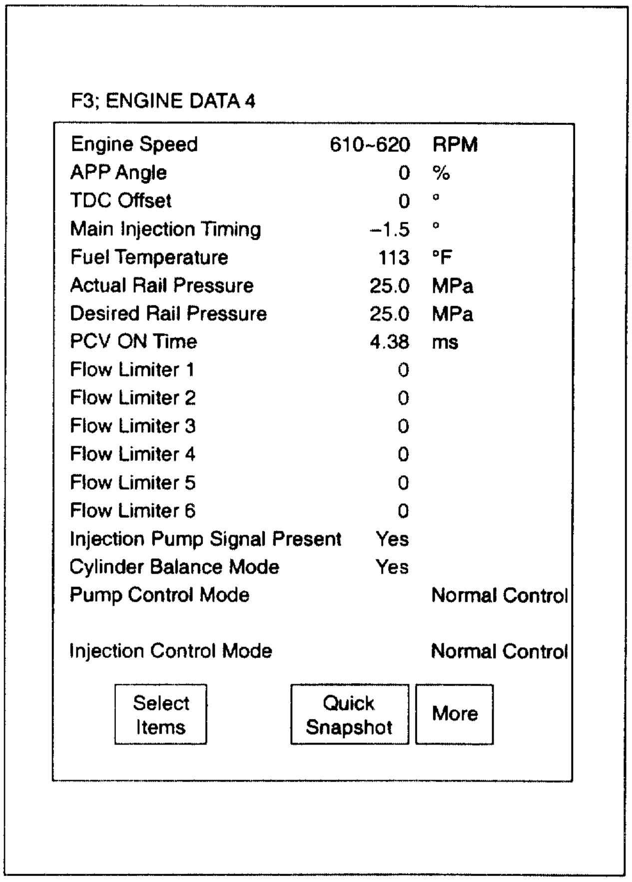
Engine Data 4

(For example)



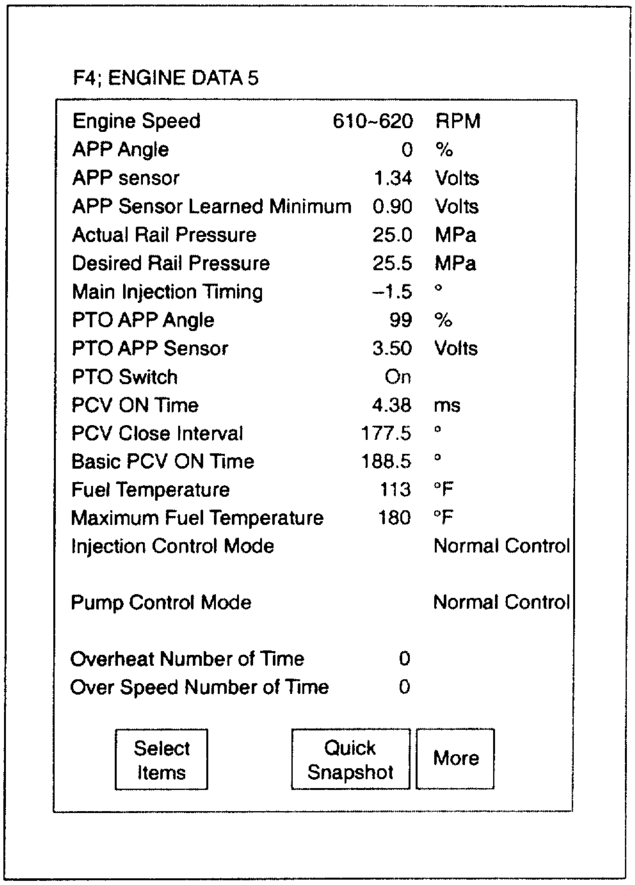
F3; ENGINE DATA 4

Engine Speed	610~620	RPM
APP Angle	0	%
TDC Offset	0	°
Main Injection Timing	–1.5	°
Fuel Temperature	113	°F
Actual Rail Pressure	25.0	MPa
Desired Rail Pressure	25.0	MPa
PCV ON Time	4.38	ms
Flow Limiter 1	0	
Flow Limiter 2	0	
Flow Limiter 3	0	
Flow Limiter 4	0	
Flow Limiter 5	0	
Flow Limiter 6	0	
Injection Pump Signal Present	Yes	
Cylinder Balance Mode	Yes	
Pump Control Mode		Normal Control
Injection Control Mode		Normal Control

060M200059

Engine Data 5

(For example)



F4; ENGINE DATA 5

Engine Speed	610~620	RPM
APP Angle	0	%
APP sensor	1.34	Volts
APP Sensor Learned Minimum	0.90	Volts
Actual Rail Pressure	25.0	MPa
Desired Rail Pressure	25.5	MPa
Main Injection Timing	–1.5	°
PTO APP Angle	99	%
PTO APP Sensor	3.50	Volts
PTO Switch	On	
PCV ON Time	4.38	ms
PCV Close Interval	177.5	°
Basic PCV ON Time	188.5	°
Fuel Temperature	113	°F
Maximum Fuel Temperature	180	°F
Injection Control Mode		Normal Control
Pump Control Mode		Normal Control
Overheat Number of Time	0	
Over Speed Number of Time	0	

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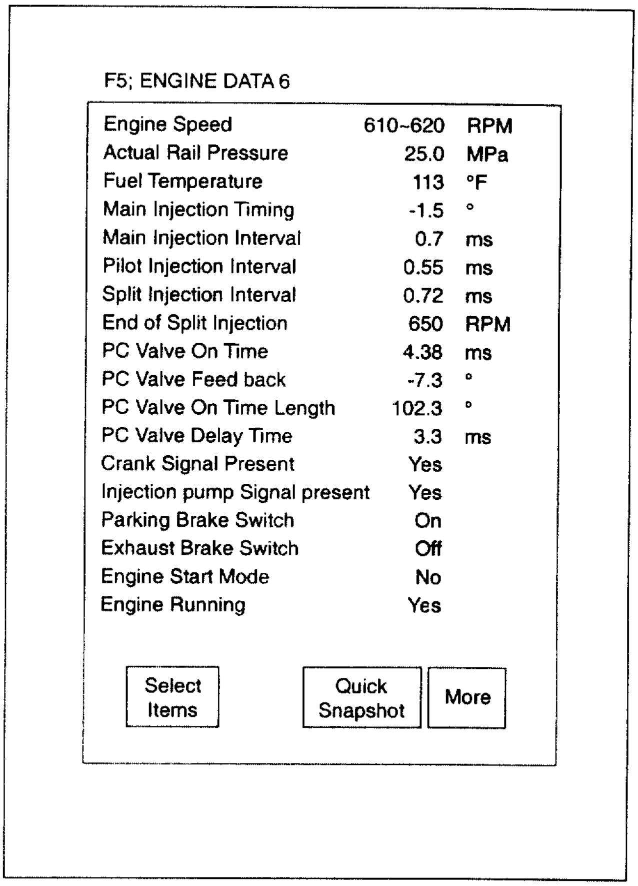
Engine Data 6

(For example)



F5; ENGINE DATA 6

Engine Speed	610~620	RPM
Actual Rail Pressure	25.0	MPa
Fuel Temperature	113	°F
Main Injection Timing	-1.5	°
Main Injection Interval	0.7	ms
Pilot Injection Interval	0.55	ms
Split Injection Interval	0.72	ms
End of Split Injection	650	RPM
PC Valve On Time	4.38	ms
PC Valve Feed back	-7.3	°
PC Valve On Time Length	102.3	°
PC Valve Delay Time	3.3	ms
Crank Signal Present	Yes	
Injection pump Signal present	Yes	
Parking Brake Switch	On	
Exhaust Brake Switch	Off	
Engine Start Mode	No	
Engine Running	Yes	

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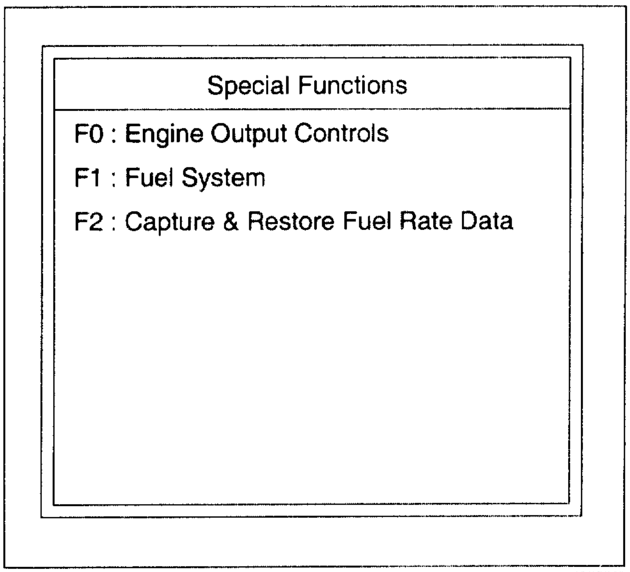
Special Functions

This special functions of three menus:



Special Functions

F0 : Engine Output Controls

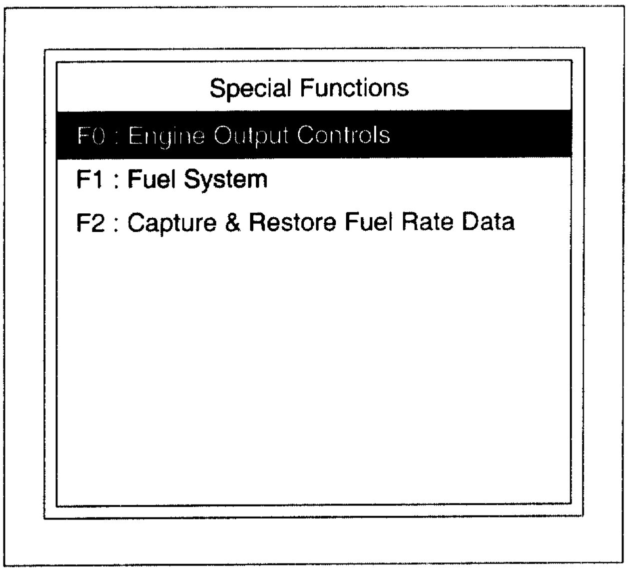
F1 : Fuel System

F2 : Capture & Restore Fuel Rate Data

080MX025

Engine Output Controls

This engine output controls of two menus:



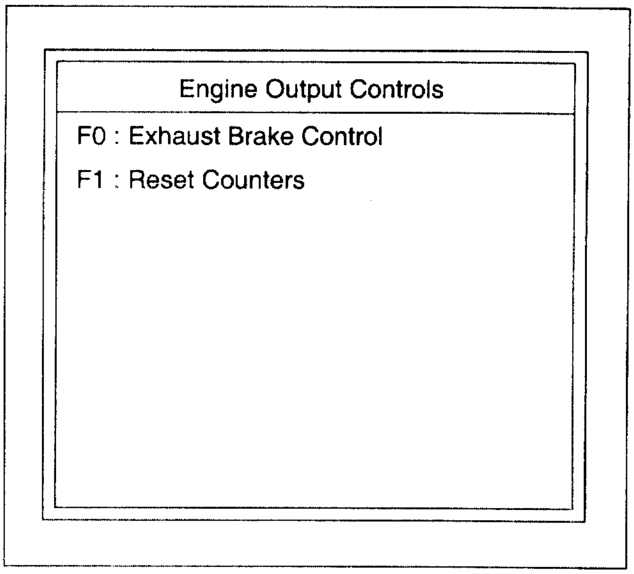
Special Functions

F0 : Engine Output Controls

F1 : Fuel System

F2 : Capture & Restore Fuel Rate Data

080MX027



Engine Output Controls

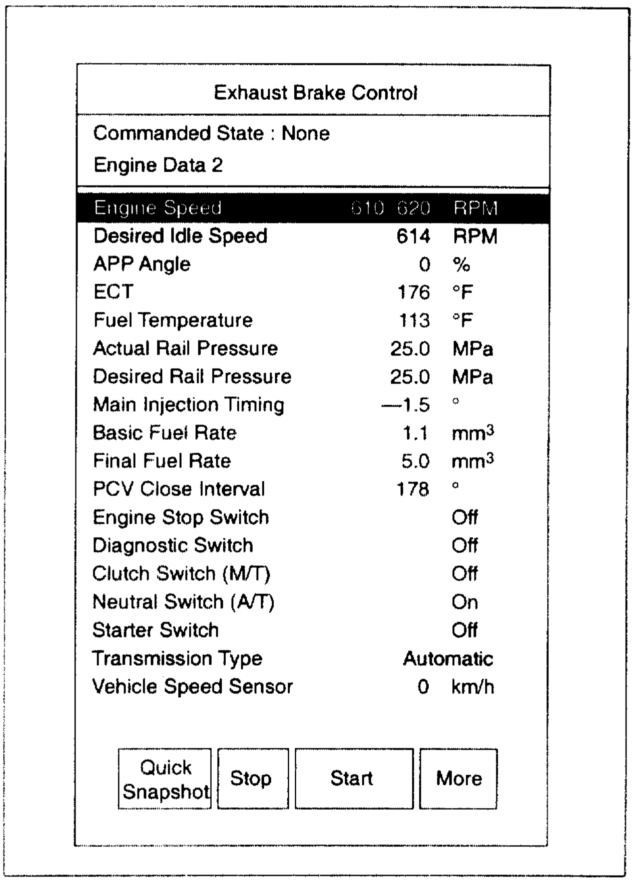
F0 : Exhaust Brake Control

F1 : Reset Counters

080MX026

F0: Exhaust Brake Control

This test is conducted to check Exhaust Brake Relay for proper operation.



Exhaust Brake Control

Commanded State : None

Engine Data 2

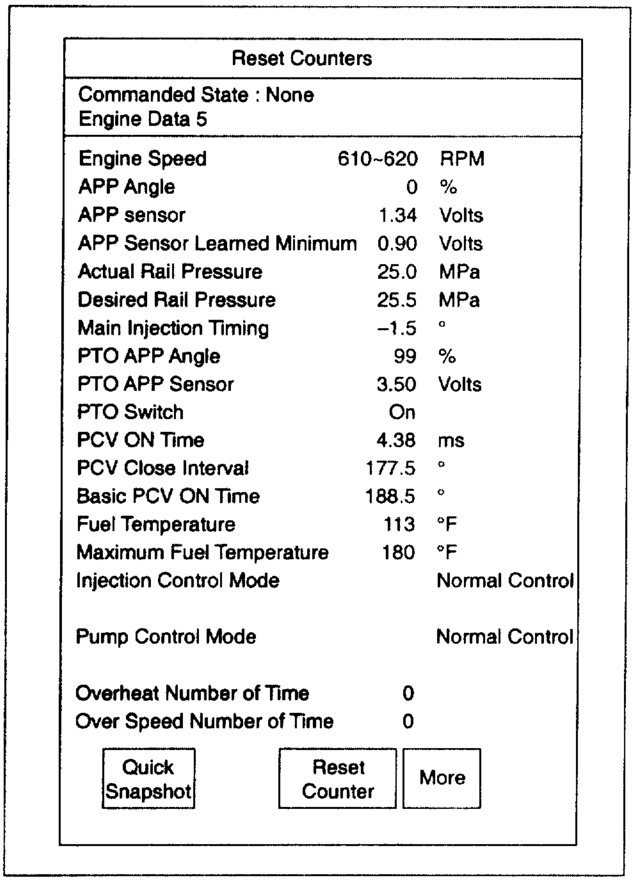
Engine Speed	610 620	RPM
Desired Idle Speed	614	RPM
APP Angle	0	%
ECT	176	°F
Fuel Temperature	113	°F
Actual Rail Pressure	25.0	MPa
Desired Rail Pressure	25.0	MPa
Main Injection Timing	—1.5	°
Basic Fuel Rate	1.1	mm^3
Final Fuel Rate	5.0	mm^3
PCV Close Interval	178	°
Engine Stop Switch		Off
Diagnostic Switch		Off
Clutch Switch (M/T)		Off
Neutral Switch (A/T)		On
Starter Switch		Off
Transmission Type		Automatic
Vehicle Speed Sensor	0	km/h

080M200083

F1: Reset Counters

If a reset counter function is performed, the data (shown below) memorized in ECM will be reset.

- Overheat Number of Time
- Over Speed Number of Time
- Maximum Fuel Temperature
- Flow Limiter (Damper) Counter



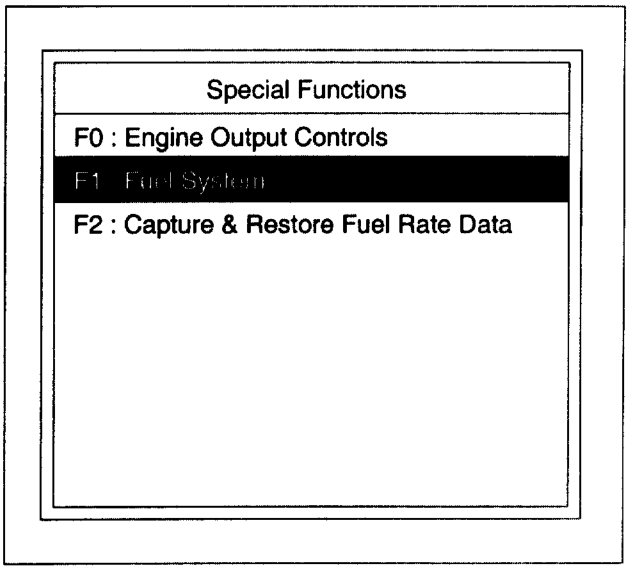
Reset Counters

Commanded State : None
Engine Data 5

Engine Speed	610~620	RPM
APP Angle	0	%
APP sensor	1.34	Volts
APP Sensor Learned Minimum	0.90	Volts
Actual Rail Pressure	25.0	MPa
Desired Rail Pressure	25.5	MPa
Main Injection Timing	−1.5	°
PTO APP Angle	99	%
PTO APP Sensor	3.50	Volts
PTO Switch	On	
PCV ON Time	4.38	ms
PCV Close Interval	177.5	°
Basic PCV ON Time	188.5	°
Fuel Temperature	113	°F
Maximum Fuel Temperature	180	°F
Injection Control Mode		Normal Control
Pump Control Mode		Normal Control
Overheat Number of Time	0	
Over Speed Number of Time	0	

060M200070

Fuel System Test



Special Functions

F0 : Engine Output Controls
F1 : Fuel System
F2 : Capture & Restore Fuel Rate Data

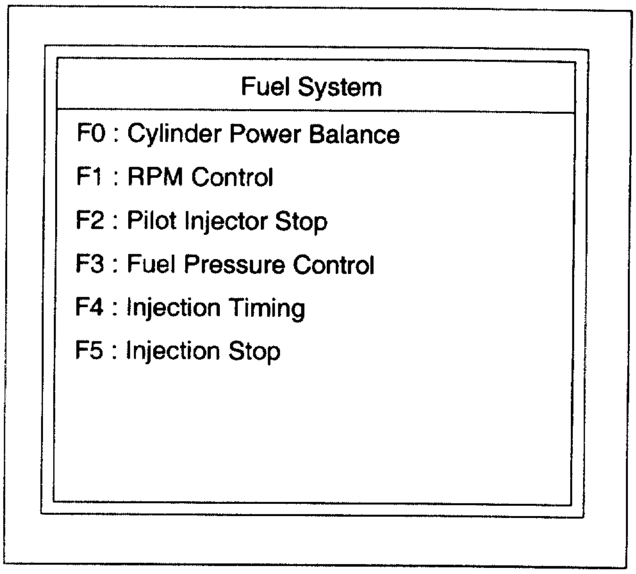
060MX028

This test consists of six menus -

Cylinder Power Balance
RPM Control
Pilot Injector Stop
Fuel Pressure Control
Injection Timing
Injection Stop

In these tests, Tech 2 sends operating signals to the systems to confirm their operations thereby to judge the normality of electric circuit.

To judge intermittent trouble,



Fuel System

F0 : Cylinder Power Balance
F1 : RPM Control
F2 : Pilot Injector Stop
F3 : Fuel Pressure Control
F4 : Injection Timing
F5 : Injection Stop

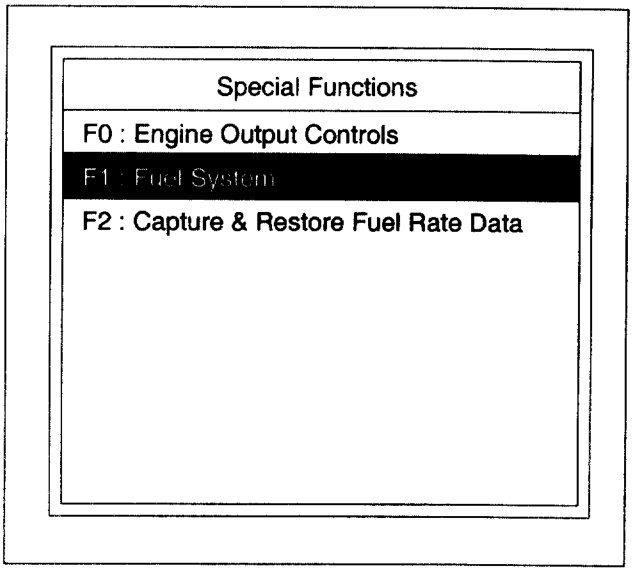
060MX010

Cylinder Power Balance Test

Tech 2 must be used for this test.

Test Procedure:

1. Connect Tech 2 to the vehicle DLC.
2. Run the Engine at idle.
3. Select F1: Fuel System in the Application Menu.

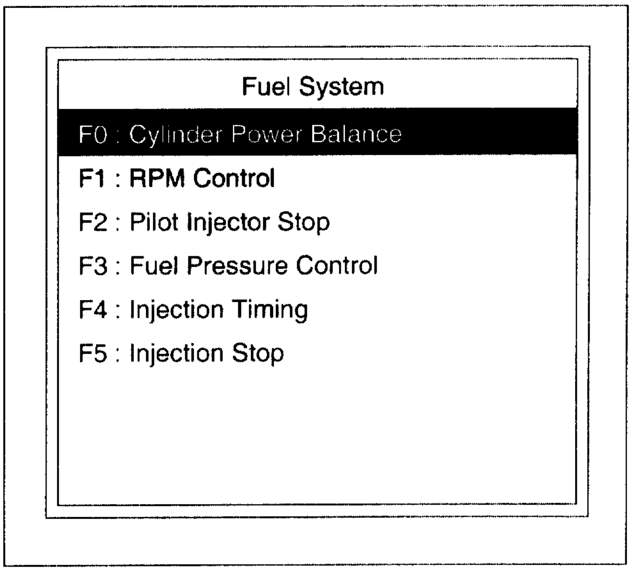


Special Functions

F0 : Engine Output Controls
F1 : Fuel System
F2 : Capture & Restore Fuel Rate Data

060MX028

4. Select F0: Cylinder Power Balance Test in the Fuel System.



Fuel System

F0 : Cylinder Power Balance

F1 : RPM Control

F2 : Pilot Injector Stop

F3 : Fuel Pressure Control

F4 : Injection Timing

F5 : Injection Stop

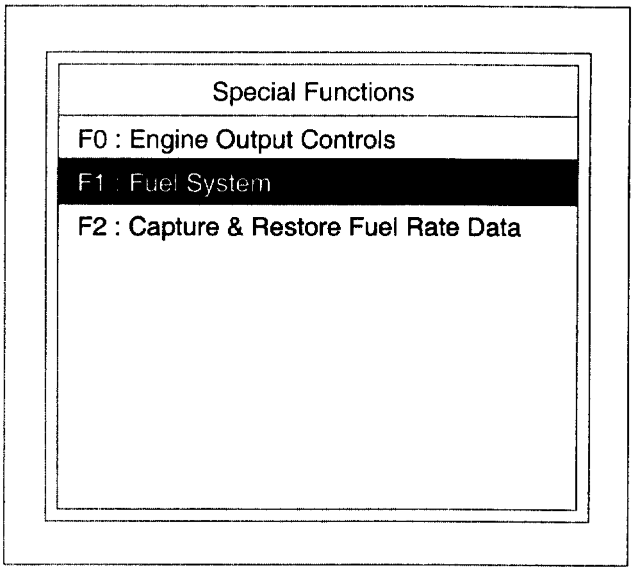
060MX019

RPM Control System Test

Tech 2 must be used for this test.

Test Procedure:

1. Connect Tech 2 to the vehicle DLC.
2. Run the Engine at idle.
3. Select F1: Fuel System in the Application Menu.



Special Functions

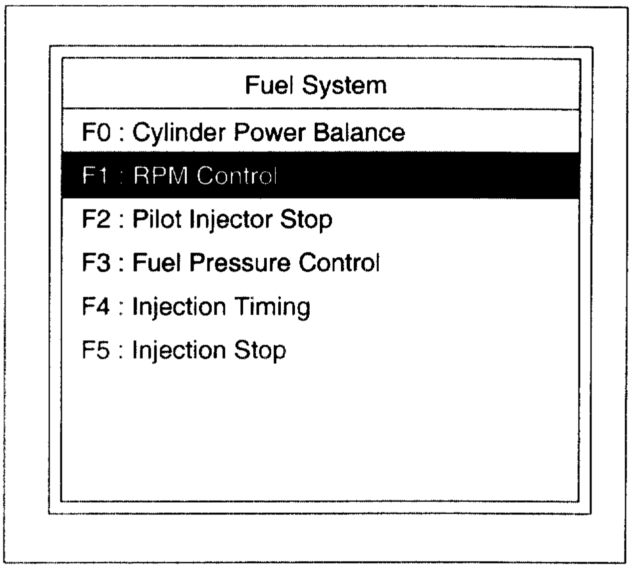
F0 : Engine Output Controls

F1 : Fuel System

F2 : Capture & Restore Fuel Rate Data

060MX028

4. Select F1: RPM Control Test in the Fuel System.



Fuel System

F0 : Cylinder Power Balance

F1 : RPM Control

F2 : Pilot Injector Stop

F3 : Fuel Pressure Control

F4 : Injection Timing

F5 : Injection Stop

060MX020

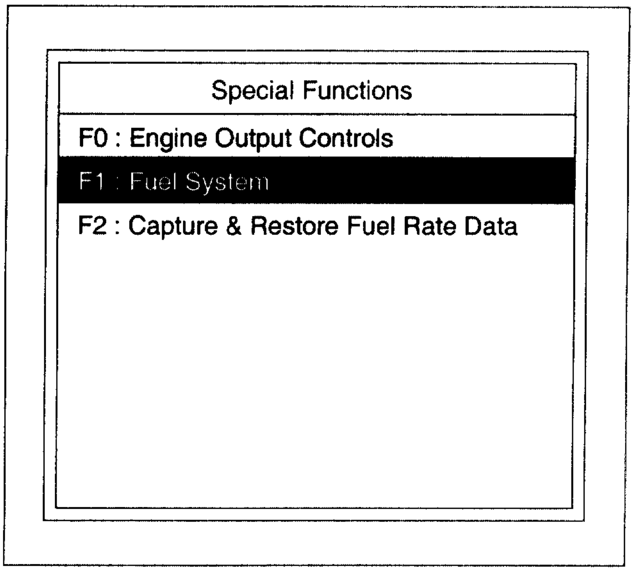
Pilot Injector Stop Test

This test is conducted to check Pilot Injector operation for proper operation.

Tech 2 must be used for this test.

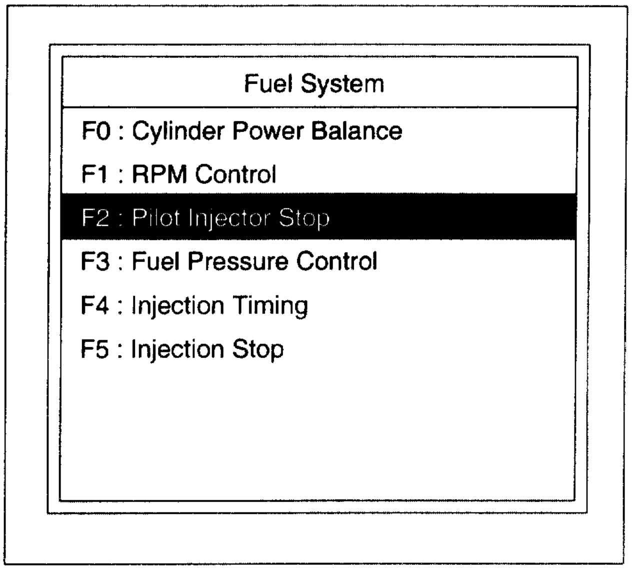
Test Procedure:

1. Connect Tech 2 to the vehicle DLC.
2. Run the Engine at idle.
3. Select F1: Fuel System in the Application Menu.



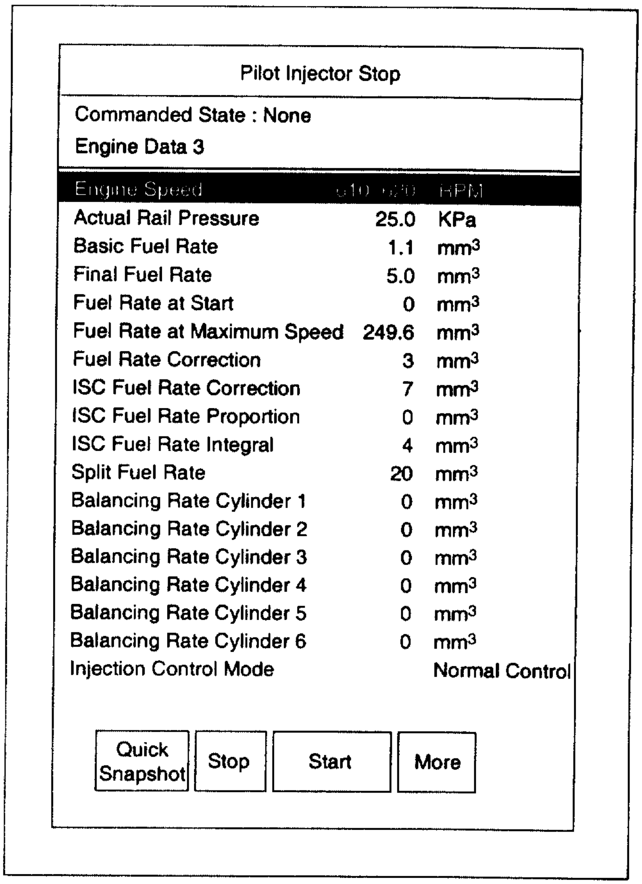
020MX028

4. Select F2: Pilot Injector Stop in the Fuel system.



060MX018

5. Push "Stop" soft key.



Commanded State : None

Engine Data 3

Engine Speed	610 620	RPM
Actual Rail Pressure	25.0	KPa
Basic Fuel Rate	1.1	mm^3
Final Fuel Rate	5.0	mm^3
Fuel Rate at Start	0	mm^3
Fuel Rate at Maximum Speed	249.6	mm^3
Fuel Rate Correction	3	mm^3
ISC Fuel Rate Correction	7	mm^3
ISC Fuel Rate Proportion	0	mm^3
ISC Fuel Rate Integral	4	mm^3
Split Fuel Rate	20	mm^3
Balancing Rate Cylinder 1	0	mm^3
Balancing Rate Cylinder 2	0	mm^3
Balancing Rate Cylinder 3	0	mm^3
Balancing Rate Cylinder 4	0	mm^3
Balancing Rate Cylinder 5	0	mm^3
Balancing Rate Cylinder 6	0	mm^3
Injection Control Mode		Normal Control

060M200086

6. If the engine R.P.M. changes, the Pilot Injector is normal.

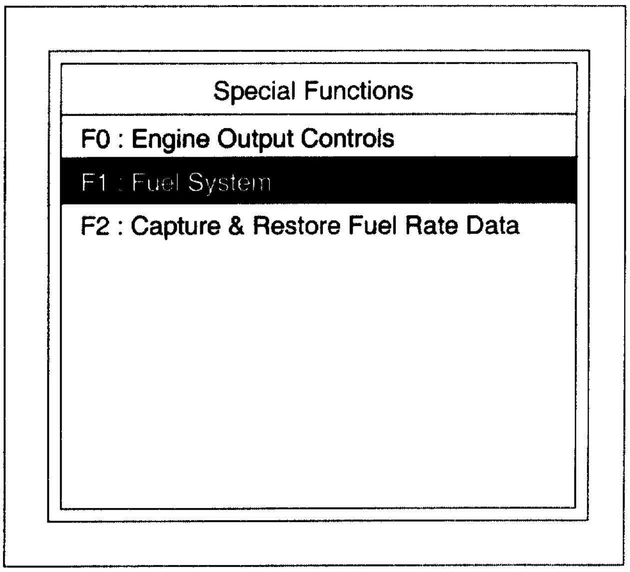
Fuel Pressure Control Test

This test is conducted to check Fuel Pressure Control system for its working.

Tech 2 must be used for this test.

Test Procedure:

1. Connect Tech 2 to the vehicle DLC.
2. Run the Engine at idle.
3. Select F1: Fuel System in the Application Menu.



Special Functions

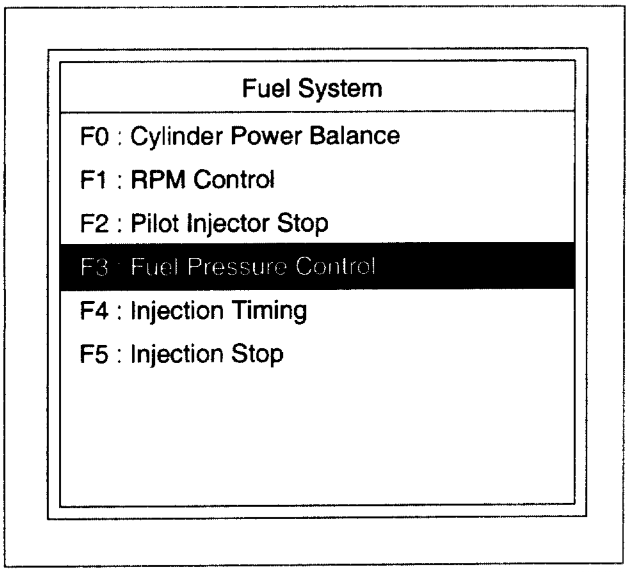
F0 : Engine Output Controls

F1 : Fuel System

F2 : Capture & Restore Fuel Rate Data

060MX028

4. Select F3: Fuel Pressure Control Test in the Fuel System.



Fuel System

F0 : Cylinder Power Balance

F1 : RPM Control

F2 : Pilot Injector Stop

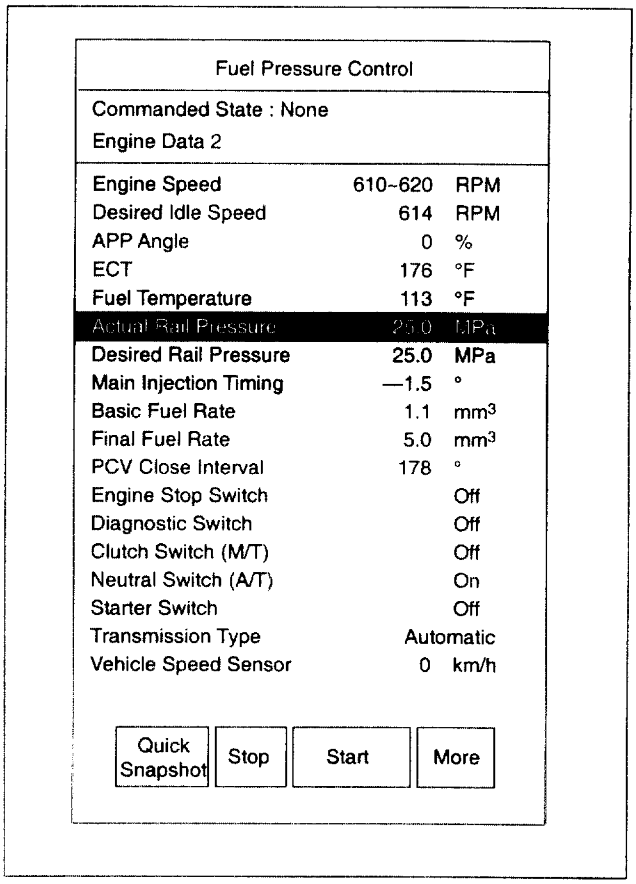
F3 : Fuel Pressure Control

F4 : Injection Timing

F5 : Injection Stop

060MX017

5. Push "Start" soft key.



Fuel Pressure Control

Commanded State : None

Engine Data 2

Engine Speed	610~620	RPM
Desired Idle Speed	614	RPM
APP Angle	0	%
ECT	176	°F
Fuel Temperature	113	°F
Actual Rail Pressure	25.0	MPa
Desired Rail Pressure	25.0	MPa
Main Injection Timing	—1.5	°
Basic Fuel Rate	1.1	mm^3
Final Fuel Rate	5.0	mm^3
PCV Close Interval	178	°
Engine Stop Switch		Off
Diagnostic Switch		Off
Clutch Switch (M/T)		Off
Neutral Switch (A/T)		On
Starter Switch		Off
Transmission Type		Automatic
Vehicle Speed Sensor	0	km/h

060M200086

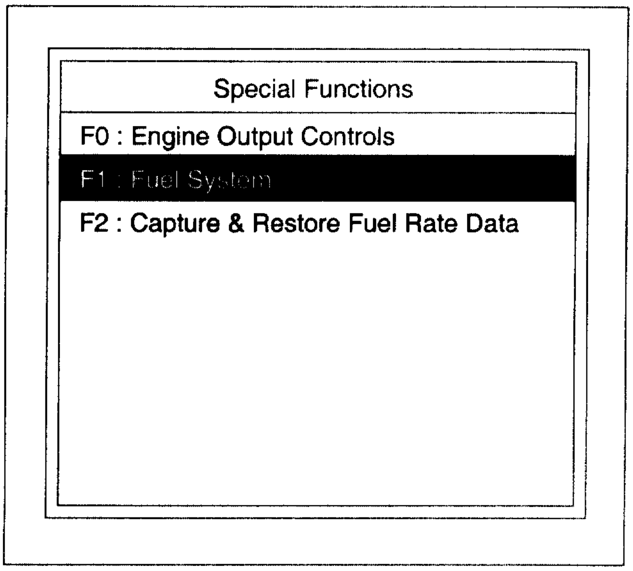
6. Control Fuel Pressure and check data list.
7. If the data list changes, the Fuel Pressure Control System is normal.

Injection Timing

Tech 2 must be used for this test.

Test Procedure:

1. Connect Tech 2 to the vehicle DLC.
2. Run the Engine at idle.
3. Select F1: Fuel System in the Application Menu.



Special Functions

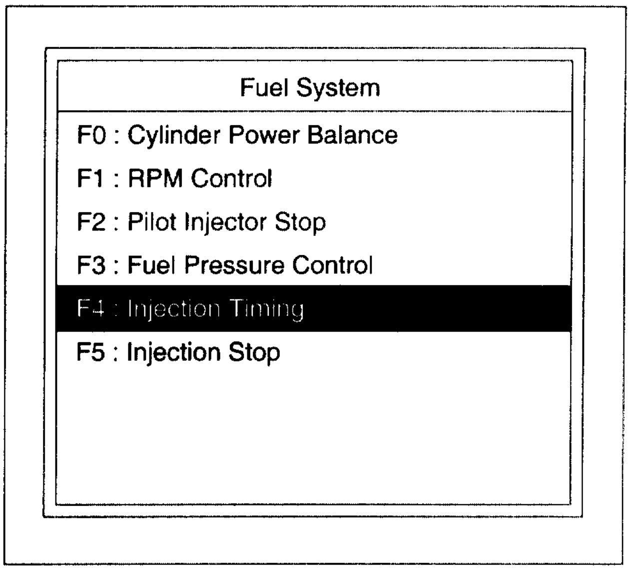
F0 : Engine Output Controls

F1 : Fuel System

F2 : Capture & Restore Fuel Rate Data

060MX028

4. Select F4: Injection Timing.



Fuel System

F0 : Cylinder Power Balance

F1 : RPM Control

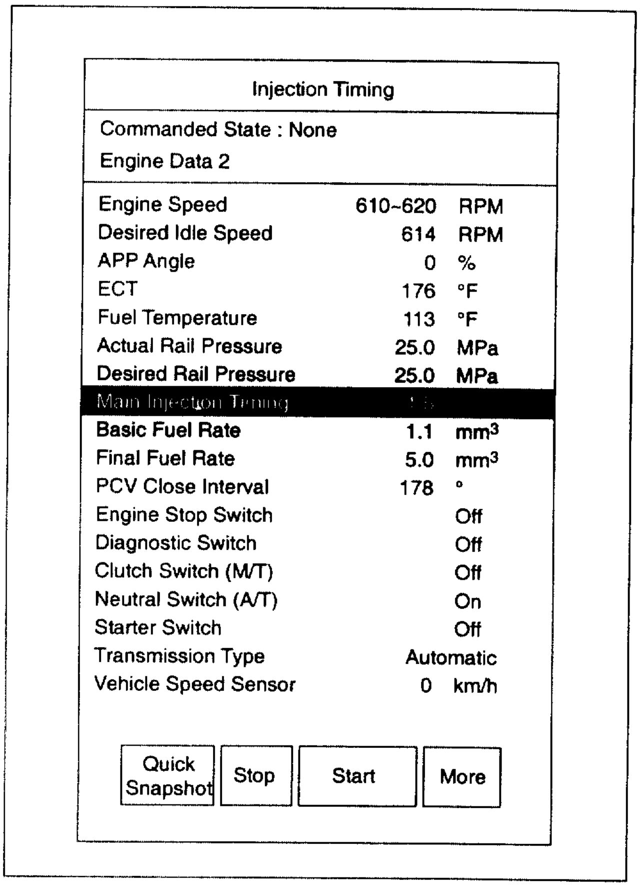
F2 : Pilot Injector Stop

F3 : Fuel Pressure Control

F4 : Injection Timing

F5 : Injection Stop

060MX016



Injection Timing

Commanded State : None

Engine Data 2

Engine Speed	610~620	RPM
Desired Idle Speed	614	RPM
APP Angle	0	%
ECT	176	°F
Fuel Temperature	113	°F
Actual Rail Pressure	25.0	MPa
Desired Rail Pressure	25.0	MPa
Main Injection Timing	1.5	
Basic Fuel Rate	1.1	mm^3
Final Fuel Rate	5.0	mm^3
PCV Close Interval	178	°
Engine Stop Switch		Off
Diagnostic Switch		Off
Clutch Switch (M/T)		Off
Neutral Switch (A/T)		On
Starter Switch		Off
Transmission Type		Automatic
Vehicle Speed Sensor	0	km/h

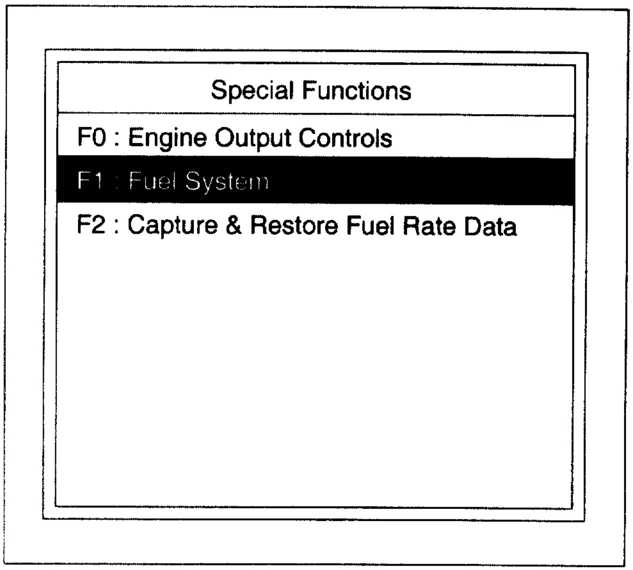
060M200087

Injection Stop

Tech 2 must be used for this test.

Test Procedure:

1. Connect Tech 2 to the vehicle DLC.
2. Run the Engine at idle.
3. Select F1: Fuel System in the Application Menu.



Special Functions

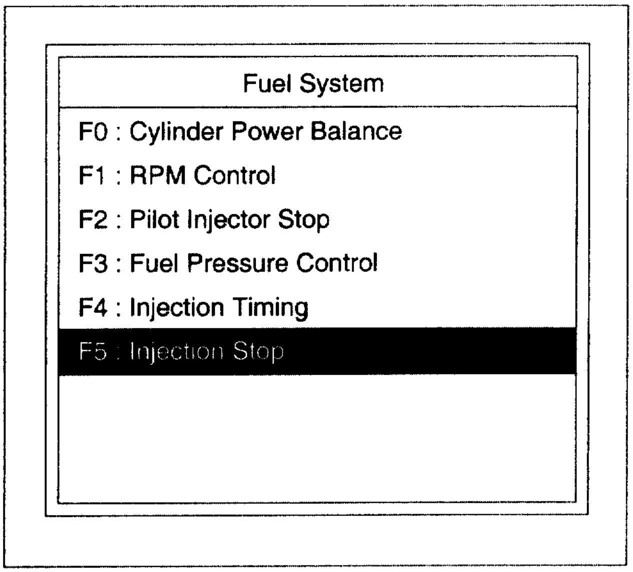
F0 : Engine Output Controls

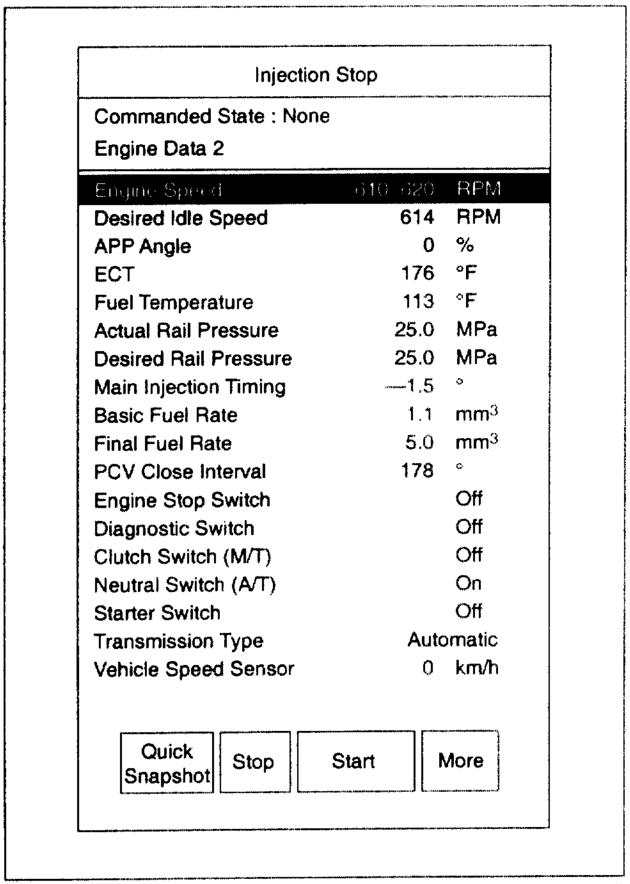
F1 : Fuel System

F2 : Capture & Restore Fuel Rate Data

060MX028

4. Select F5: Injection Stop in the Fuel System.




Injection Stop

Commanded State : None

Engine Data 2

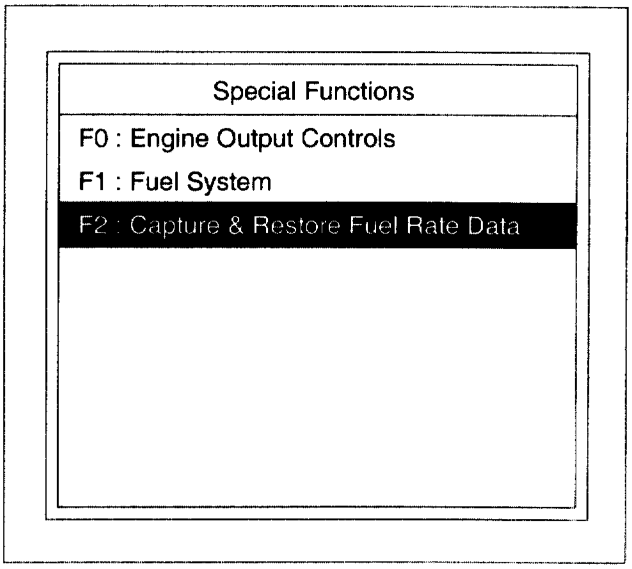
Engine Speed	610 620	RPM
Desired Idle Speed	614	RPM
APP Angle	0	%
ECT	176	°F
Fuel Temperature	113	°F
Actual Rail Pressure	25.0	MPa
Desired Rail Pressure	25.0	MPa
Main Injection Timing	—1.5	°
Basic Fuel Rate	1.1	mm^3
Final Fuel Rate	5.0	mm^3
PCV Close Interval	178	°
Engine Stop Switch		Off
Diagnostic Switch		Off
Clutch Switch (M/T)		Off
Neutral Switch (A/T)		On
Starter Switch		Off
Transmission Type		Automatic
Vehicle Speed Sensor	0	km/h

Capture & Restore Fuel Rate Data

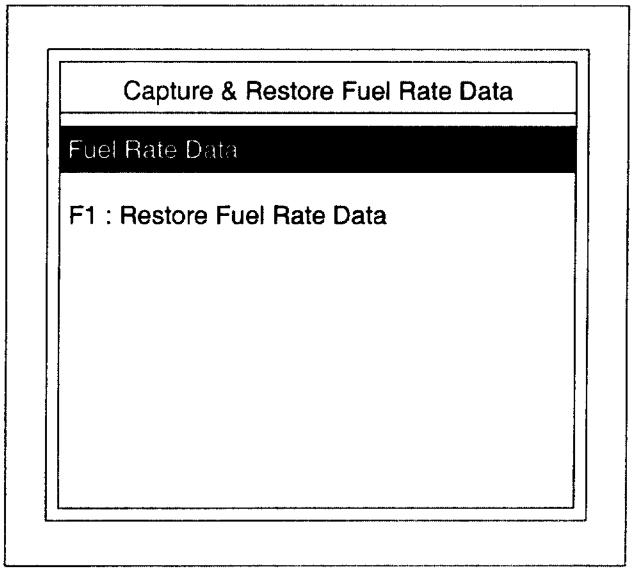
IMPORTANT; The replacement ECM must be stored the capture fuel rate data by Tech 2.

ECM Replace procedure

1. Ignition "ON", Engine "OFF".
2. Tech2 "ON".
3. Push "ENTER" key, when the "Tech2" appeared display screen.
4. Operate "△" or "▽" key, put on the hi-light bar to the "F0: Diagnostic".
5. Operate "△" or "▽" key, put on the hi-light bar to the "Model Year(s)", and push "ENTER" key.
6. Select "ISUZU", and push "ENTER"/
7. Select "F0: Power Train" and push "ENTER".
8. Select "7.8L L6 LG4" by operating "△" or "▽" key.
9. Select "Automatic".
10. Select "F2: Special Functions" by operating "△" or "▽" key, and push "ENTER" key.
11. Select "F2: Capture & Restore . . . . ." by operating "△" or "▽" key, and push "ENTER" key.



12. Select "F0: Capture Fuel Rate . . . . ." by operating "△" or "▽" key, and push "ENTER" key.



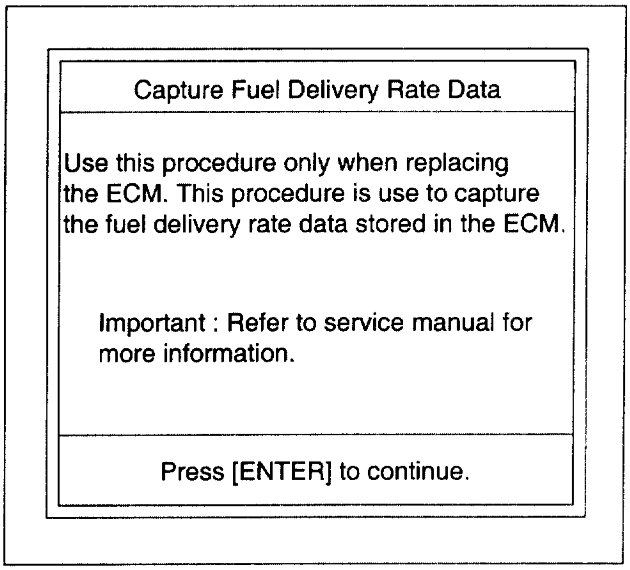
Capture & Restore Fuel Rate Data

Fuel Rate Data

F1 : Restore Fuel Rate Data

060MX014

13. The message will be appeared on the Display Screen, and push "ENTER" key few times. When the Up Load was successfully, the message "Fuel Delivery" rate data capture complete.



Capture Fuel Delivery Rate Data

Use this procedure only when replacing the ECM. This procedure is use to capture the fuel delivery rate data stored in the ECM.

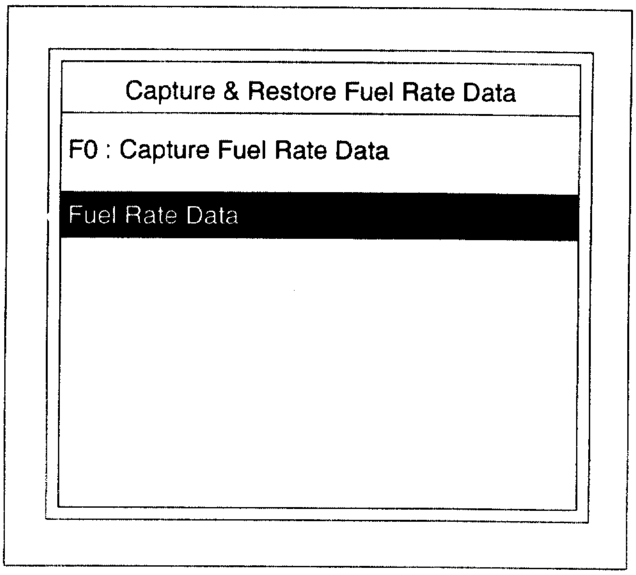
Important : Refer to service manual for more information.

Press [ENTER] to continue.

060MY00023

14. Tech2 "OFF" after this message appeared.
15. Ignition "OFF"
16. Replace the ECM.
17. Ignition "ON". Tech2 "ON".
18. Repeat from Item 3 to 11 (This procedure).

19. Select "F1: Restore Fuel Rate . . . . ." by operating "△" or "▽" key, and push "ENTER" key.



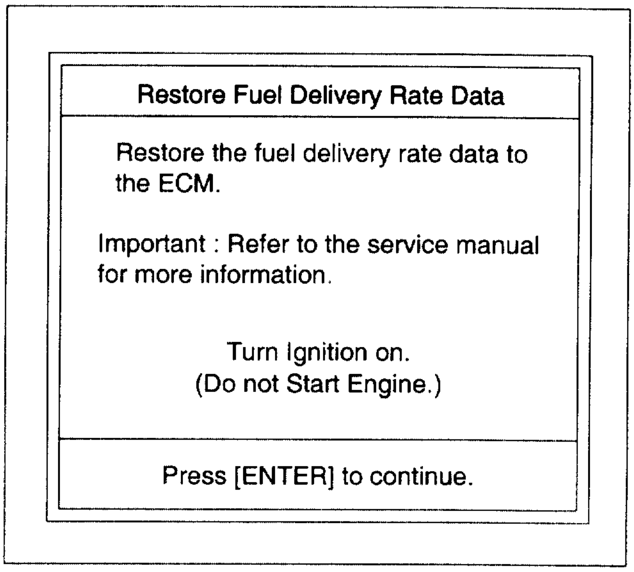
Capture & Restore Fuel Rate Data

F0 : Capture Fuel Rate Data

Fuel Rate Data

060MX013

20. Push "ENTER" key following message few times, when some message will be appeared.



Restore Fuel Delivery Rate Data

Restore the fuel delivery rate data to the ECM.

Important : Refer to the service manual for more information.

Turn Ignition on.
(Do not Start Engine.)

Press [ENTER] to continue.

060MY00022

When the "Fuel delivery rate data storage complete was appeared, the procedure was successfully completed". At this moment the "Self Diagnosis Lamp" will be turned off.

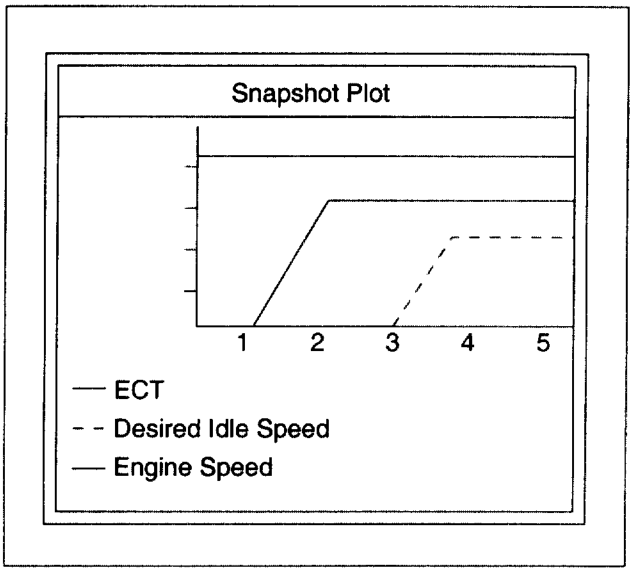
NOTE: Unfortunately if you have failed, return to the initial menu screen by operating the "ENTER" key and repeat again.

There is a possibility to be appeared some information in relation to failure.

Also in this case, by operating "EXIT" key, return to the initial menu screen and then repeat from first step.

Plotting Snapshot Graph

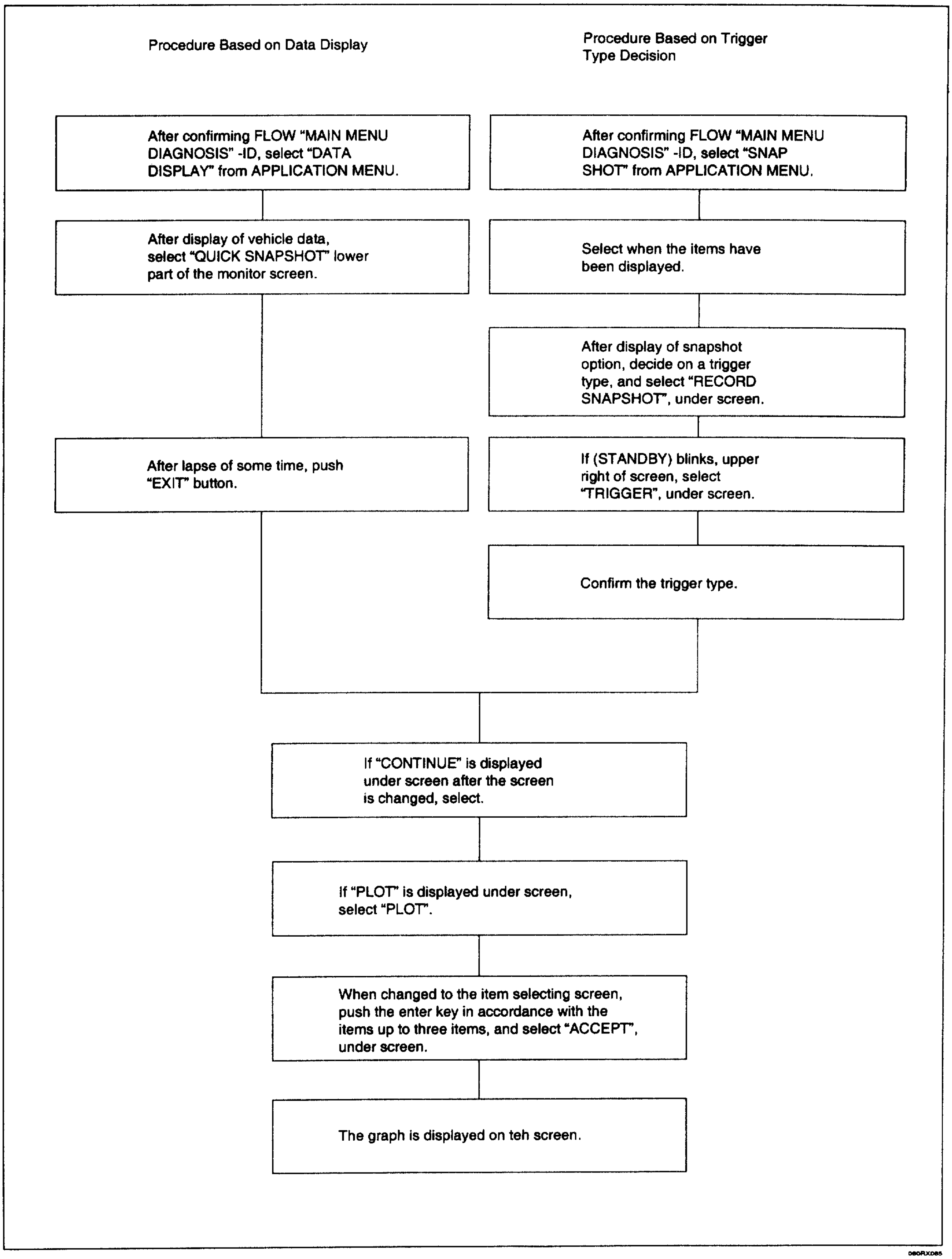
This test selects several necessary items from the data list to plot graphs and makes data comparison on a long term basis. It is an effective test particularly in emission related evaluations.



060RX037

For trouble diagnosis, you can collect graphic data (snapshot) directly from the vehicle. You can replay the snapshot data as needed. Therefore, accurate diagnosis is possible, even though the vehicle is not available.

Plotting Graph Flow Chart (Plotting graph after obtaining vehicle information)



Procedure Based on Data Display

After confirming FLOW "MAIN MENU DIAGNOSIS" -ID, select "DATA DISPLAY" from APPLICATION MENU.

After display of vehicle data, select "QUICK SNAPSHOT" lower part of the monitor screen.

After lapse of some time, push "EXIT" button.

Procedure Based on Trigger Type Decision

After confirming FLOW "MAIN MENU DIAGNOSIS" -ID, select "SNAP SHOT" from APPLICATION MENU.

Select when the items have been displayed.

After display of snapshot option, decide on a trigger type, and select "RECORD SNAPSHOT", under screen.

If (STANDBY) blinks, upper right of screen, select "TRIGGER", under screen.

Confirm the trigger type.

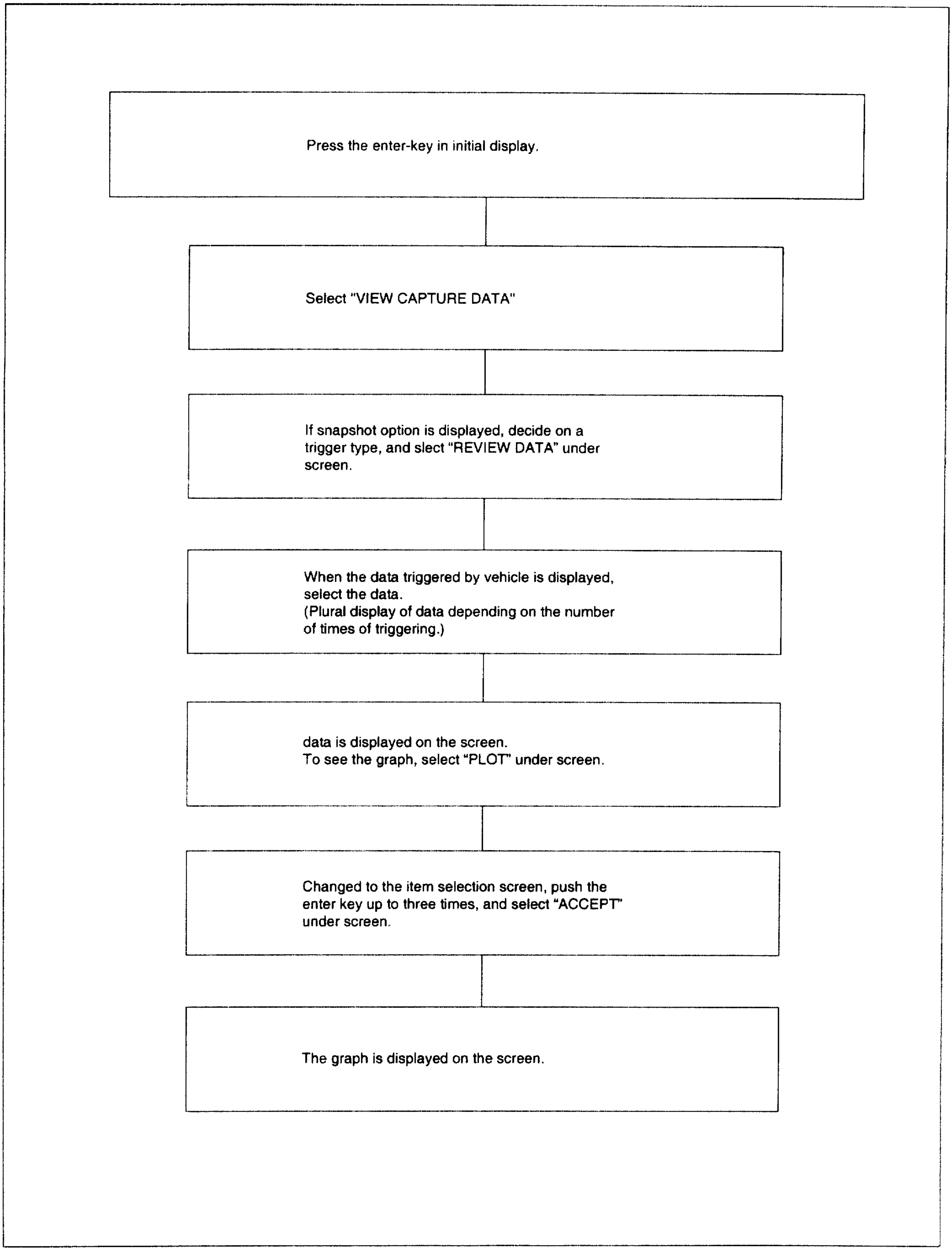
If "CONTINUE" is displayed under screen after the screen is changed, select.

If "PLOT" is displayed under screen, select "PLOT".

When changed to the item selecting screen, push the enter key in accordance with the items up to three items, and select "ACCEPT", under screen.

The graph is displayed on teh screen.

Flow Chart for Snapshot Replay (Plotting Graph)



Press the enter-key in initial display.

Select "VIEW CAPTURE DATA"

If snapshot option is displayed, decide on a trigger type, and slect "REVIEW DATA" under screen.

When the data triggered by vehicle is displayed, select the data.
(Plural display of data depending on the number of times of triggering.)

data is displayed on the screen.
To see the graph, select "PLOT" under screen.

Changed to the item selection screen, push the enter key up to three times, and select "ACCEPT" under screen.

The graph is displayed on the screen.

060RX040

System Parts Description

Supply Pump

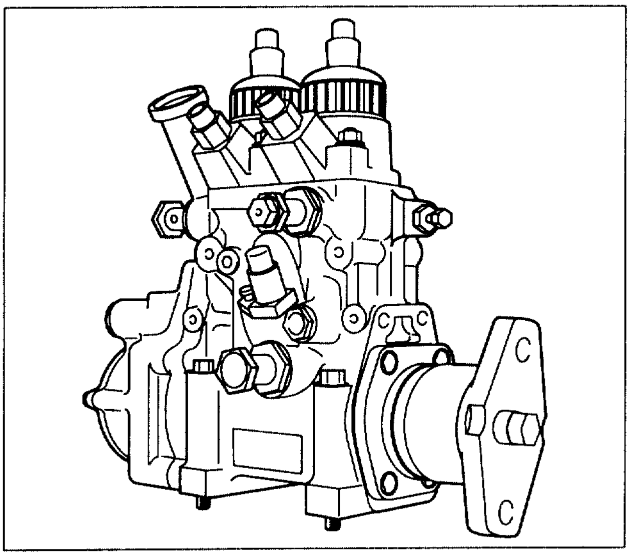
The supply pump is comprised of pump proper, feed pump, and coupling.

Engine output goes to idle gear, air compressor, and drive gear and is transmitted through coupling to the camshaft of supply pump.

Plunger is lubricated and cooled with fuel, be sure not to use any fuel other than specified one.

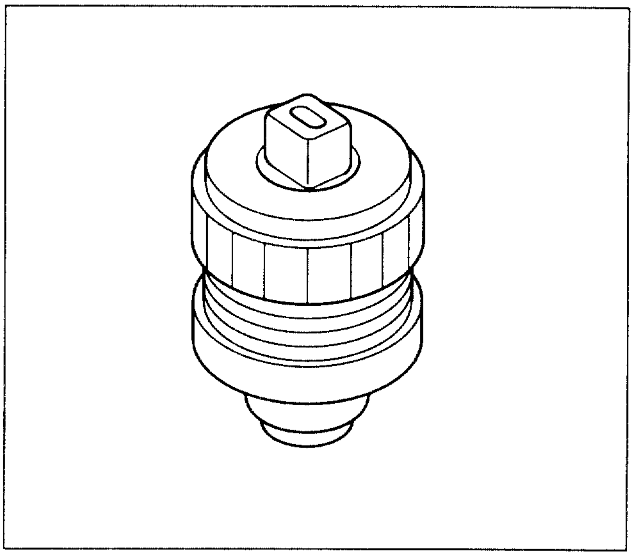
Supply Pump Unit

The supply pump unit comprises the same feed system as is used in the conventional duplex pump and two cylinders each having a pressure control valve (PCV). Using triple action cam has reduced the number of pump cylinders required to one third of the number of engine cylinders (2 cyl. pump in case of 6 cyl. engine). Further, the number of times of feeding to common rail is equal to that of injection, giving smooth, stable common rail pressure.



Pressure Control Valve (PCV)

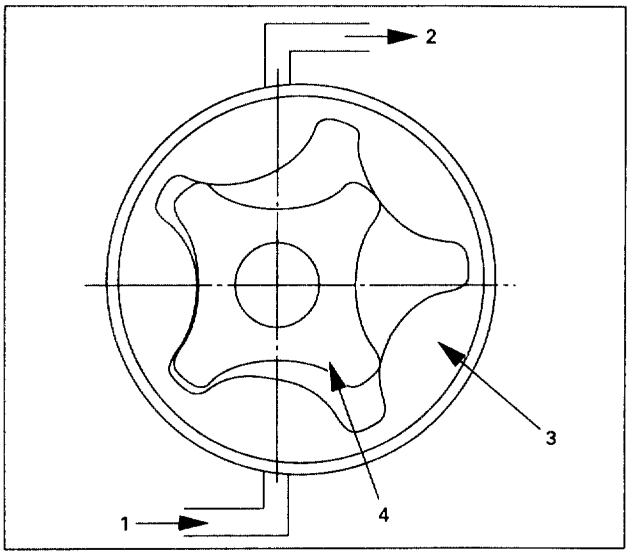
PCV is used to adjust supply pump discharge amount so as to adjust common rail pressure. Discharge amount from the supply pump to the common rail is determined by continuity timing to PCV.



NOTE: Do not remove from fuel supply pump.

Feed Pump

The feed pump built in the supply pump to fuel pump up and supply fuel through fuel filter into the supply pump unit. Feed pump inside rotor is driven by supply pump camshaft. When the inside rotor starts to rotate, outside rotor also rotate together with inside rotor. The outside rotor has more one teeth number than inside rotor, therefore, inside rotor tooth sliding on the face of inside tooth in the outside rotor during them rotating. The fuel hold clearance of between outside rotor and inside rotor tooth then fuel is pressed to be pushed out of discharge port.

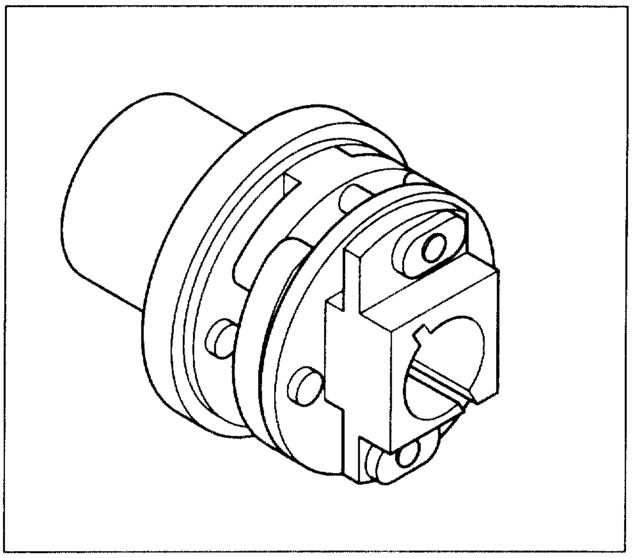


Legend

(1) From fuel tank
(2) To fuel filter
(3) Outside rotor
(4) Inside rotor

Coupling

The coupling is a laminated type, serving to transmit the driving torque from the engine side to the camshaft of the supply pump.



040MV049

Pump Position Sensor (CAM Sensor)

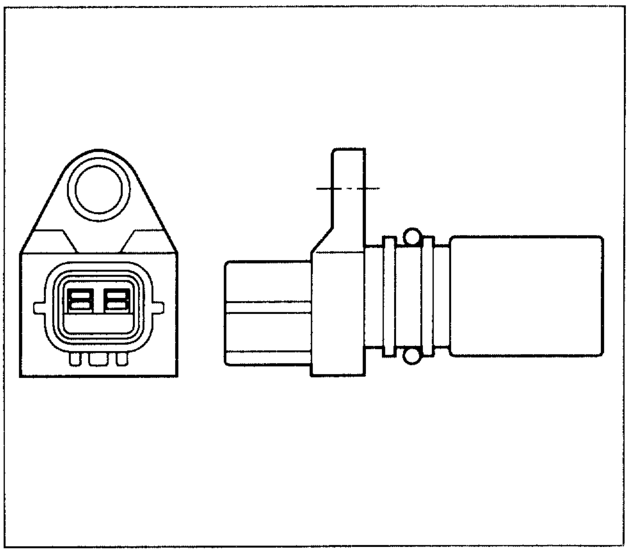
CAM sensor is installed at the side of the supply pump, serving to distinguish the cylinders of the engine and back up the detection of engine speed (in case of CKP sensor trouble).

This CAM sensor comprises the same parts as in CKP sensor, but the number of turns of its coil is different from that of CKP sensor and installed to the supply pump.

With the engine started, the pulser notches in the middle of the supply pump camshaft cut off intermittently the magnetic field made by the sensor magnet, thereby generating alternating current.

The pulser notches are made every 60° of camshaft (every 120° of crank angle) and there is a surplus tooth.

Therefore, seven pulses are outputted per one rotation of camshaft (2 rotations of the engine). The pulse outputted by the surplus tooth is recognized as engine number 1 cylinder reference pulse.



056MV043

Common Rail

The common rail is installed to intake manifold, equipped with flow damper, pressure limiter, and common rail pressure sensor.

The common rail unit has a common fuel passage, fuel passage holes, and installing threaded holes. The common fuel passage is a through hole made in the common rail unit. The common rail pressure sensor is installed at the left end of the hole.

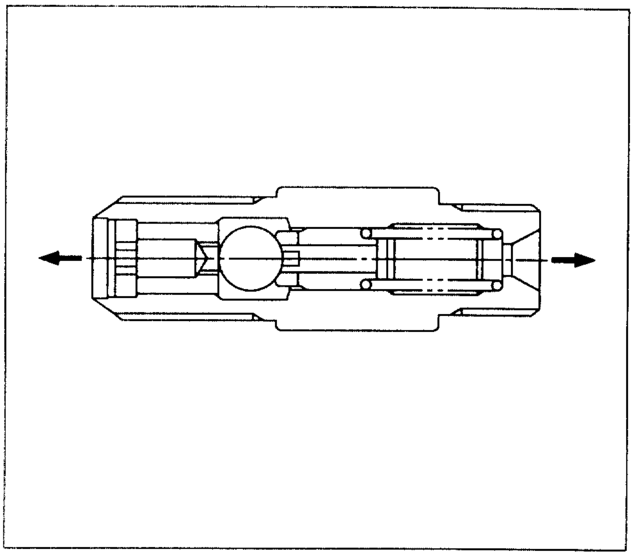
Flow Damper

The flow damper comprises a piston, ball, spring seat, and spring.

The flow damper is used to damp the pressure pulsating in the common rail and the injection pipe.

During driving the flow of fuel makes the piston, ball, and spring seat move a little to the injector side and float.

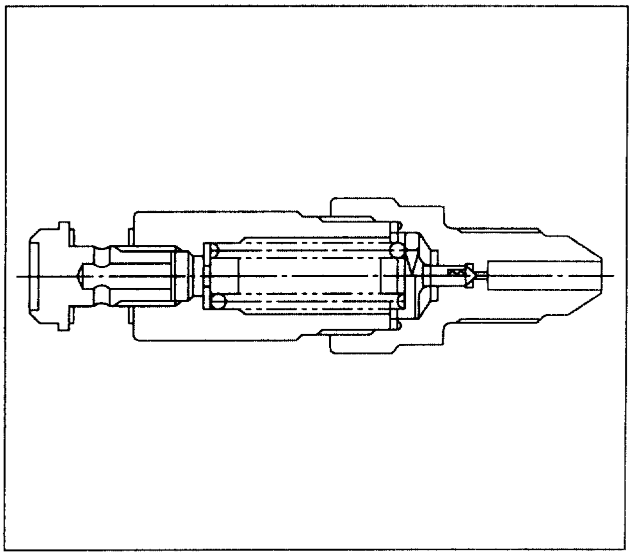
Should too much fuel pass the flow damper, the ball moves further toward the injector until the ball comes into contact with the seat surface of the flow damper unit, thereby shutting the fuel passages.



060MX057

Pressure Limiter

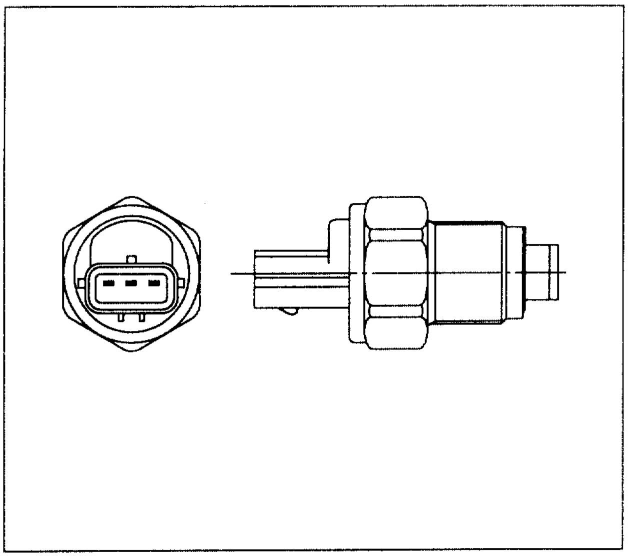
The pressure limiter opens when abnormally high pressure is generated, releasing the pressure. When the common rail pressure reaches approx. 170 MPa (1,734 kg/cm^2), the pressure limiter is actuated (opens), and when the pressure drops to approx. 30 MPa (310 kg/cm^2) later, it works to maintain the pressure, thereby enabling continuous running.



Common Rail Pressure Sensor

The common rail pressure sensor, installed at left end of the common rail, serving to detect fuel pressure. It is a semiconductor type pressure sensor utilizing silicon's property that the electric resistance of pressurized silicone is varied.

Further, a special gasket is used at the connection part with the common rail body so as to seal high pressure fuel.

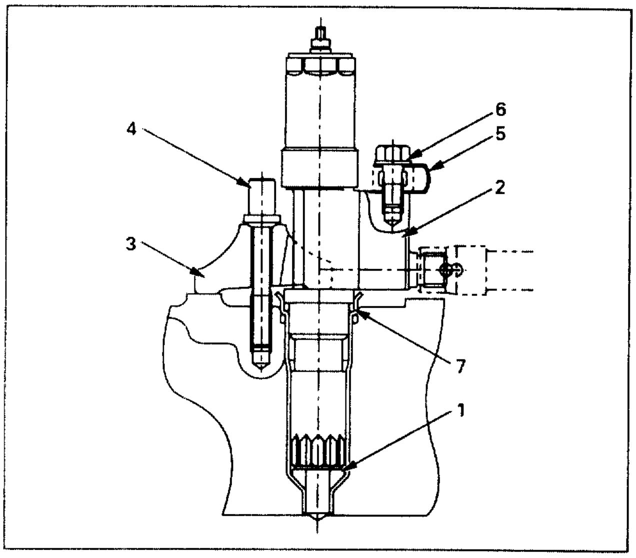


Injector

The injector comprises a two-way solenoid valve, hydraulic piston, and nozzle. The solenoid valve controls the injection amount, injection timing, and injection rate of fuel by controlling the pressure in the control chamber.

The nozzle is a multihole type with a injection starting pressure (valve opening pressure) of 8.7 MPa (85 kg/cm^2).

The injection body is clamped. The cylinder head injection part is provided with an O-ring by which the entry of engine oil into the injector hole of the cylinder head is prevented.



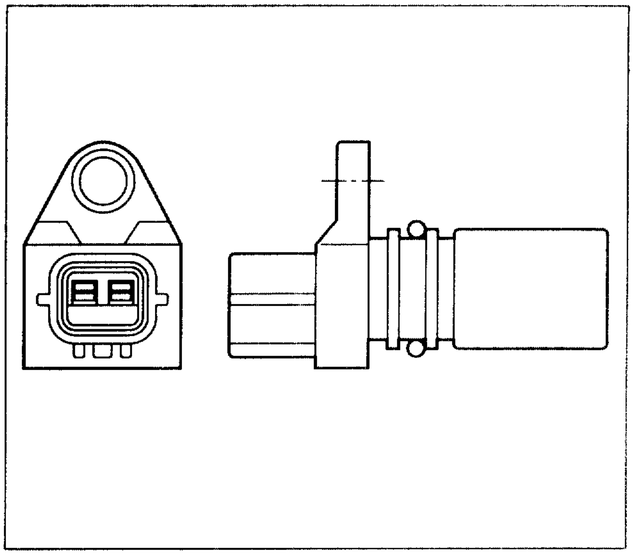
Legend

(1) Injector gasket
(2) Injector assembly
(3) Injector clamp
(4) Clamp bolt
(5) Fuel return pipe
(6) Eye bolt
(7) Injector sleeve

Crank Position Sensor (CKP Sensor)

This sensor comprises a permanent magnet, coil, and iron core and is installed to the flywheel housing. With the engine started, the signal holes made on the outer periphery of the flywheel cut off intermittently the magnetic field made by the magnet, thereby generating AC in the coil.

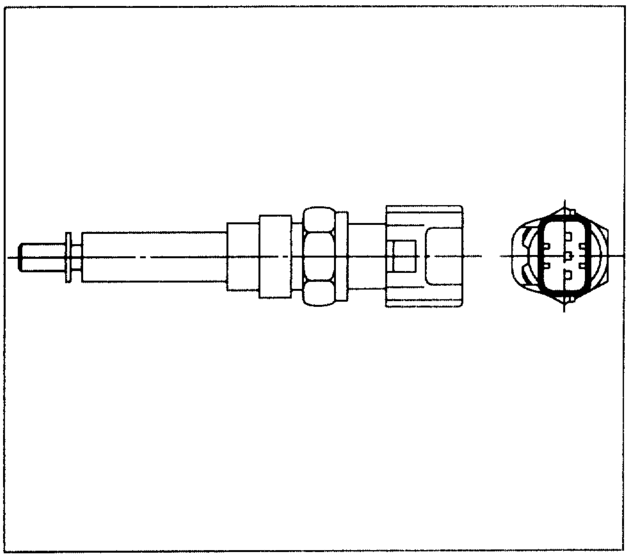
The signal holes on the flywheel are provided every 7.5°, but 3 point is holeless. 90 pulses are outputted per 2 rotations of the engine. By this signal, engine speed and 7.5°-based crank angle can be detected.



ECT Sensor

This sensor is a thermister type installed on the thermostat case. Change in coolant temperature as a resistance change signal is sent to ECM to optimize fuel injection control.

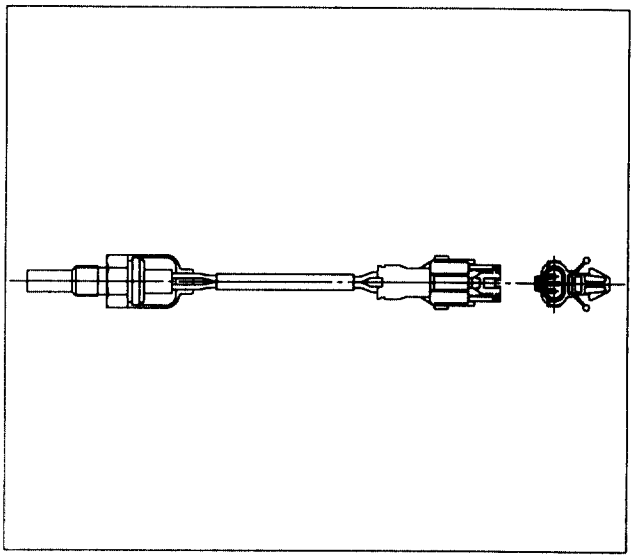
ECM applies voltage to the thermister and detects from the voltage divided between in ECM and thermister resistance values.



FT Sensor (THF)

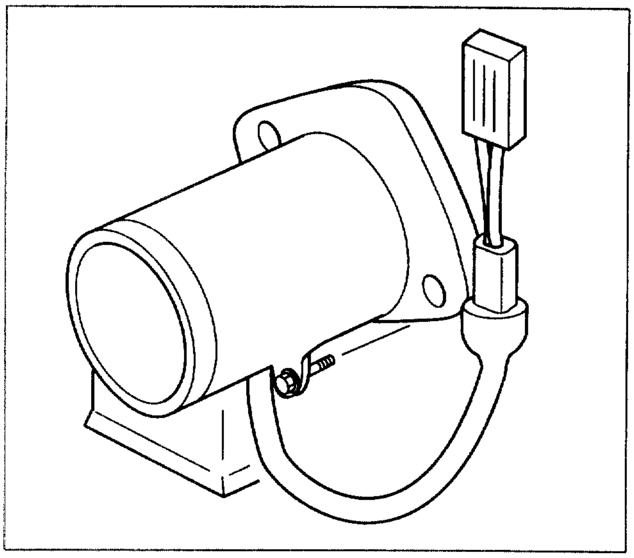
The FT sensor is a thermister type installed in the casing provided in the fuel return (from the injector) circuit.

Change in fuel temperature is changed into a resistance change signal and sent to ECM for optimization of fuel injection control.



Accelerator Sensor

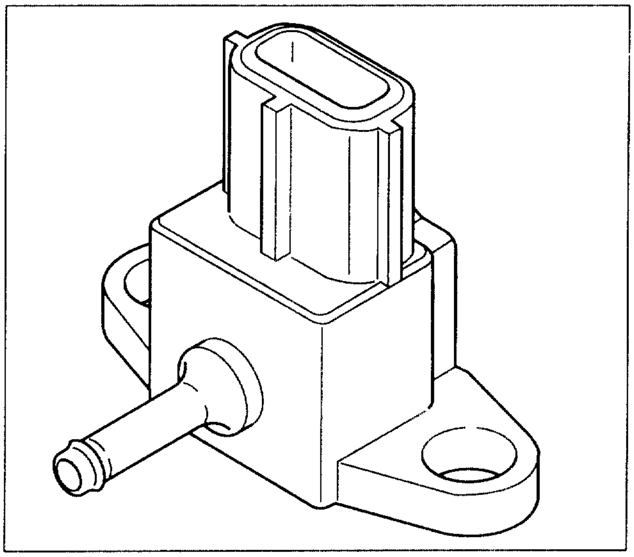
This sensor is a hole IC type substituting electric signals for accelerator pedaling amount to be sent to ECM. It is installed to accelerator pedal bracket assembly.



Boost Sensor

The boost sensor is fixed on the cab back frame and is connected to rear portion of inlet manifold by vacuum hose.

The boost sensor generates voltage according to air aspiration pressure and generation voltage is input to ECM for boost sensor signal.



Ambient Air Temperature Sensor (THA)

The Ambient Air TEMP. Sensor is located inside of cab front panel.

The atmosphere temperature is changed into a resistance change signal and sent to ECM for optimization of fuel injection control.

BARO Sensor (BARO Pressure)

BARO Pressure sensor is located in the ECM.

The BARO pressure sensor signal send to the ECM for optimization of fuel injection control under vehicle operation high.

Vehicle Speed Sensor (VSS)

Vehicle Speed Sensor (VSS) is located on the transmission.

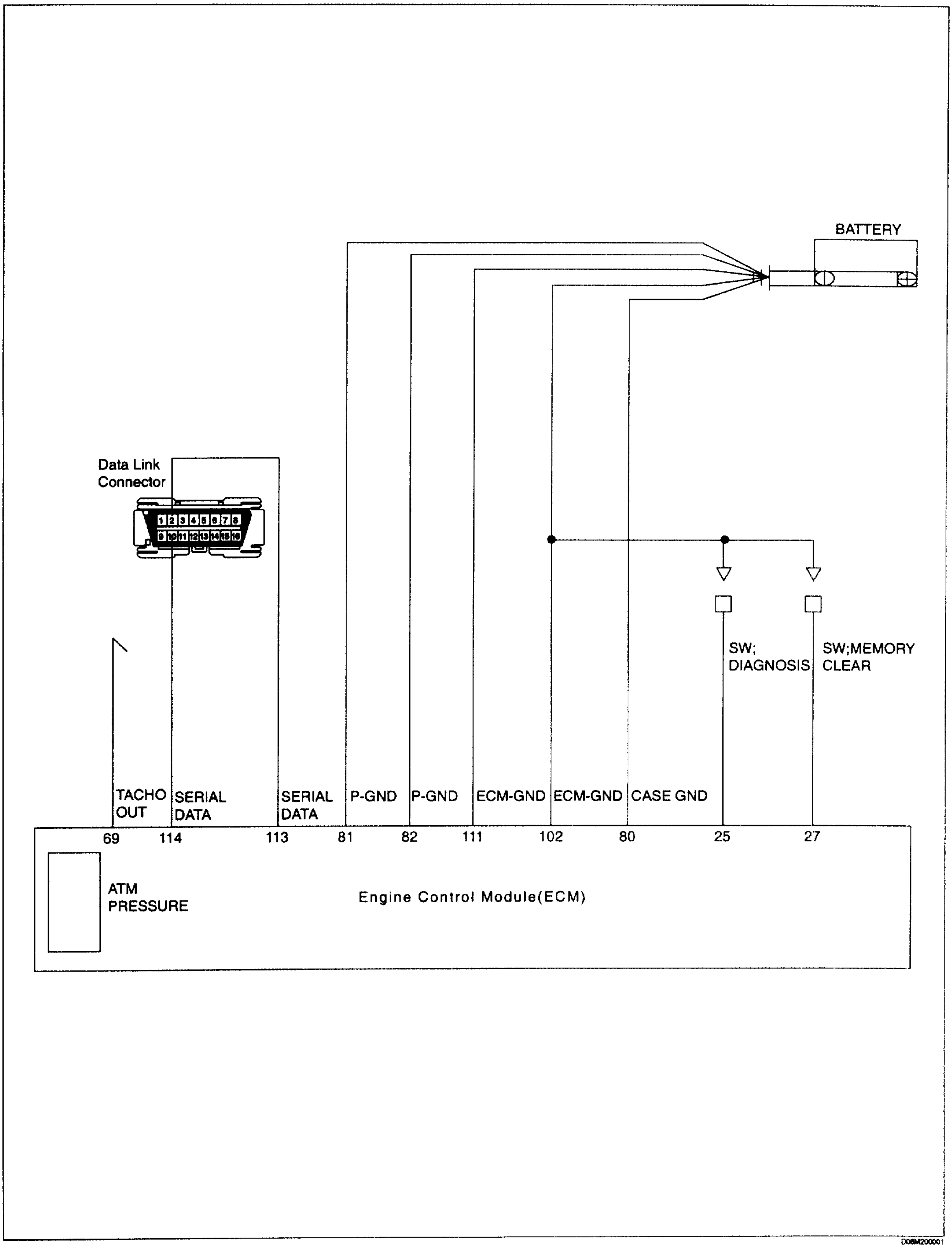
VSS signal is used for PTO control. (Fuel injection control: All speed map control)

PTO Accelerator Position Sensor

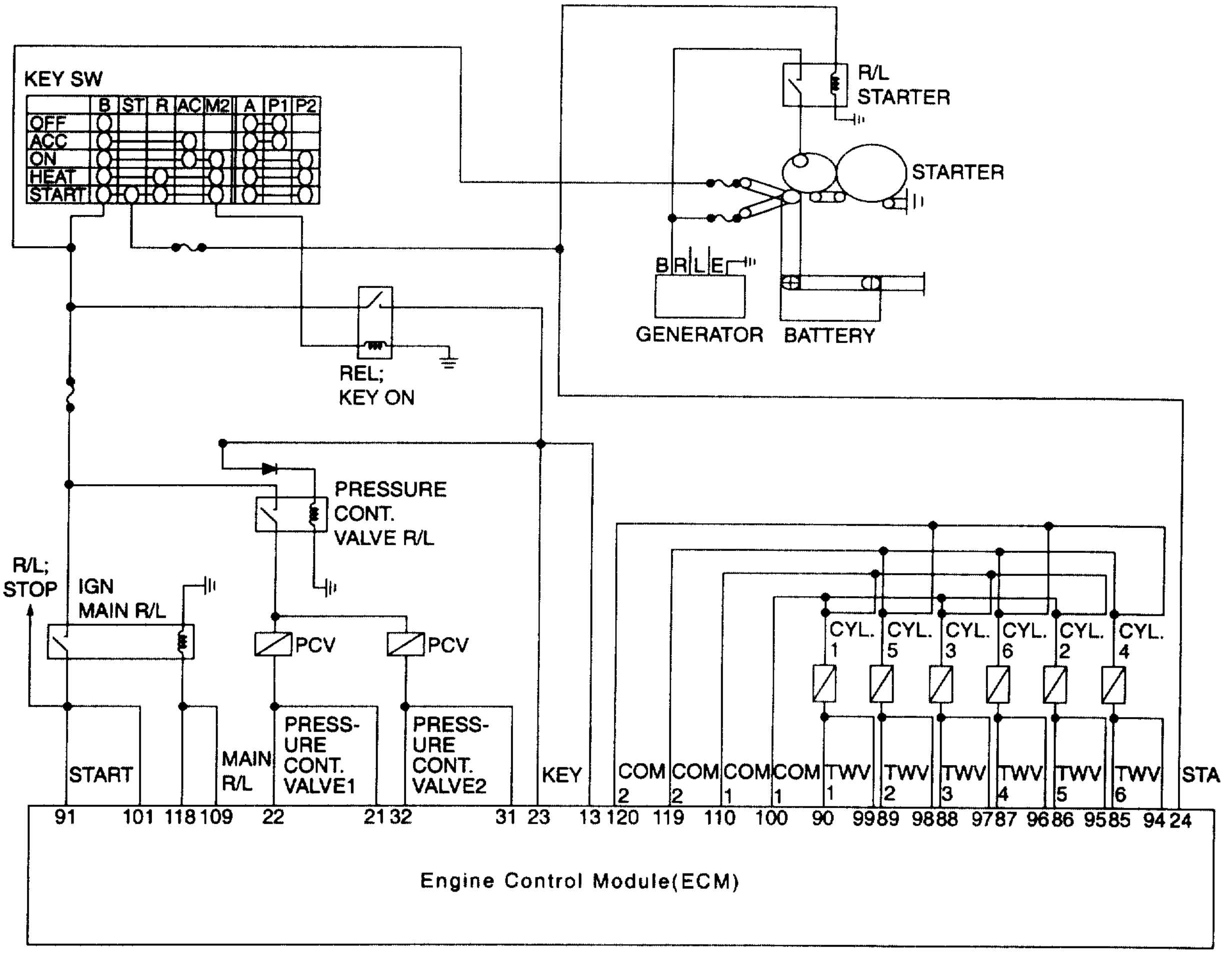
PTO Accelerator position sensor is used for PTO control. (Fuel injection control: All speed Map).

As for sensor, the volume type is used for engine control.

ECM System Wiring Diagram (1 of 5)



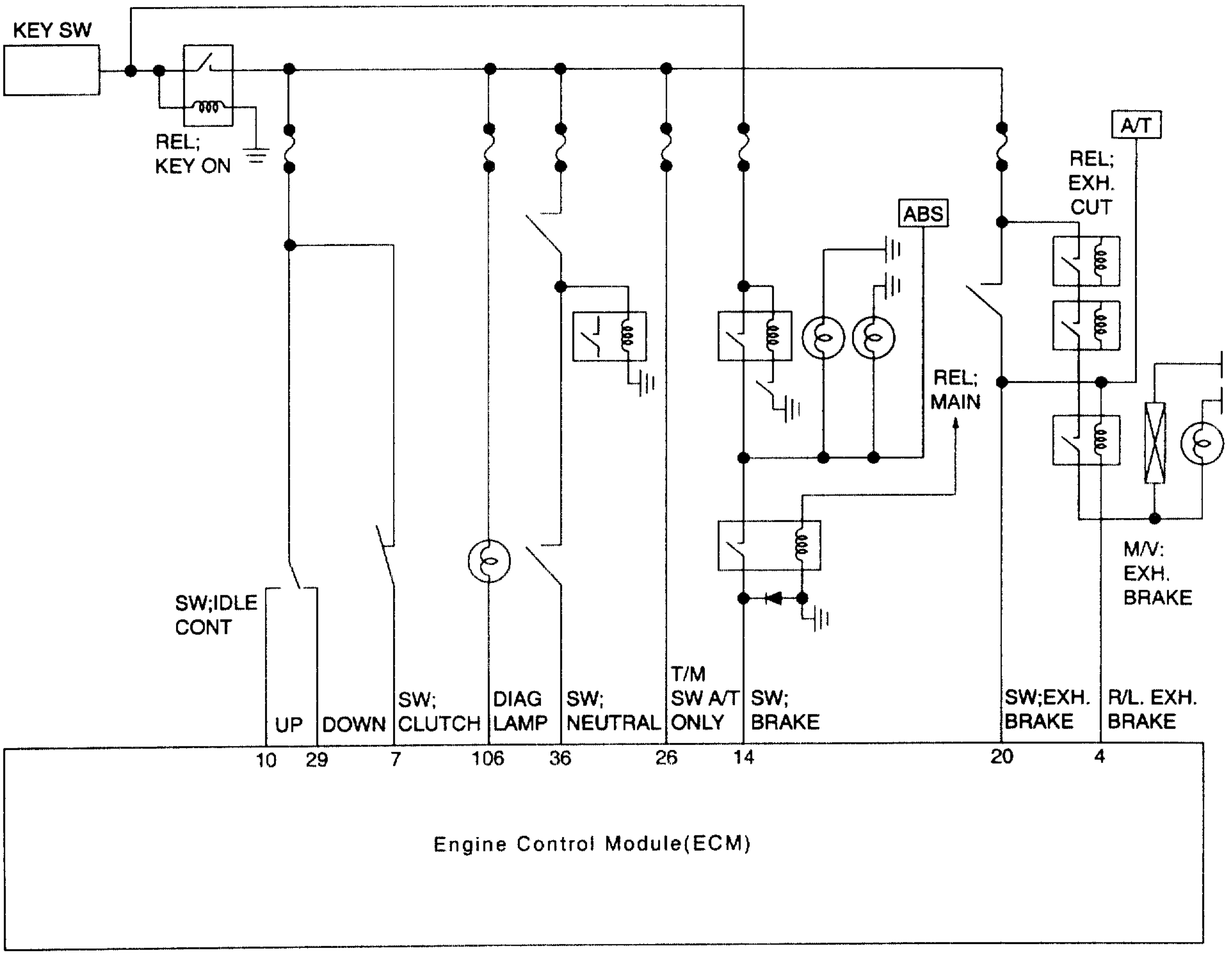
ECM System Wiring Diagram (2 of 5)



(TWV=Injector)

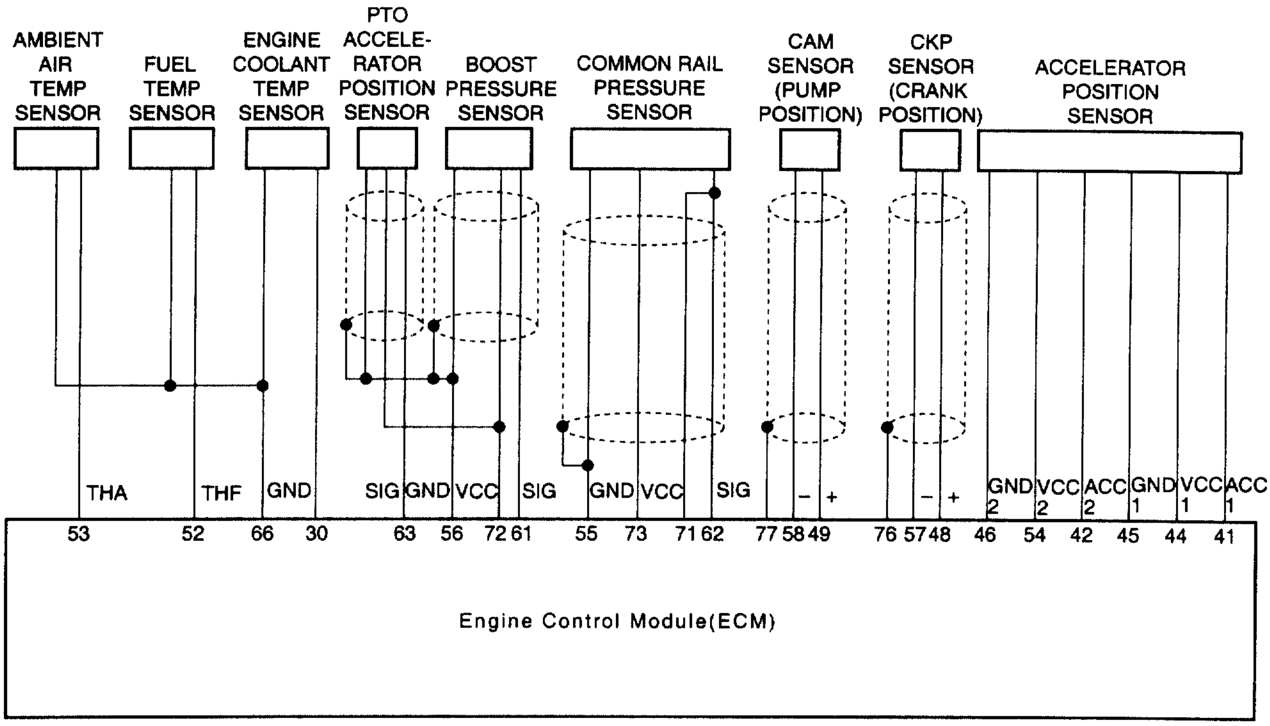
D08M200027

ECM System Wiring Diagram (3 of 5)



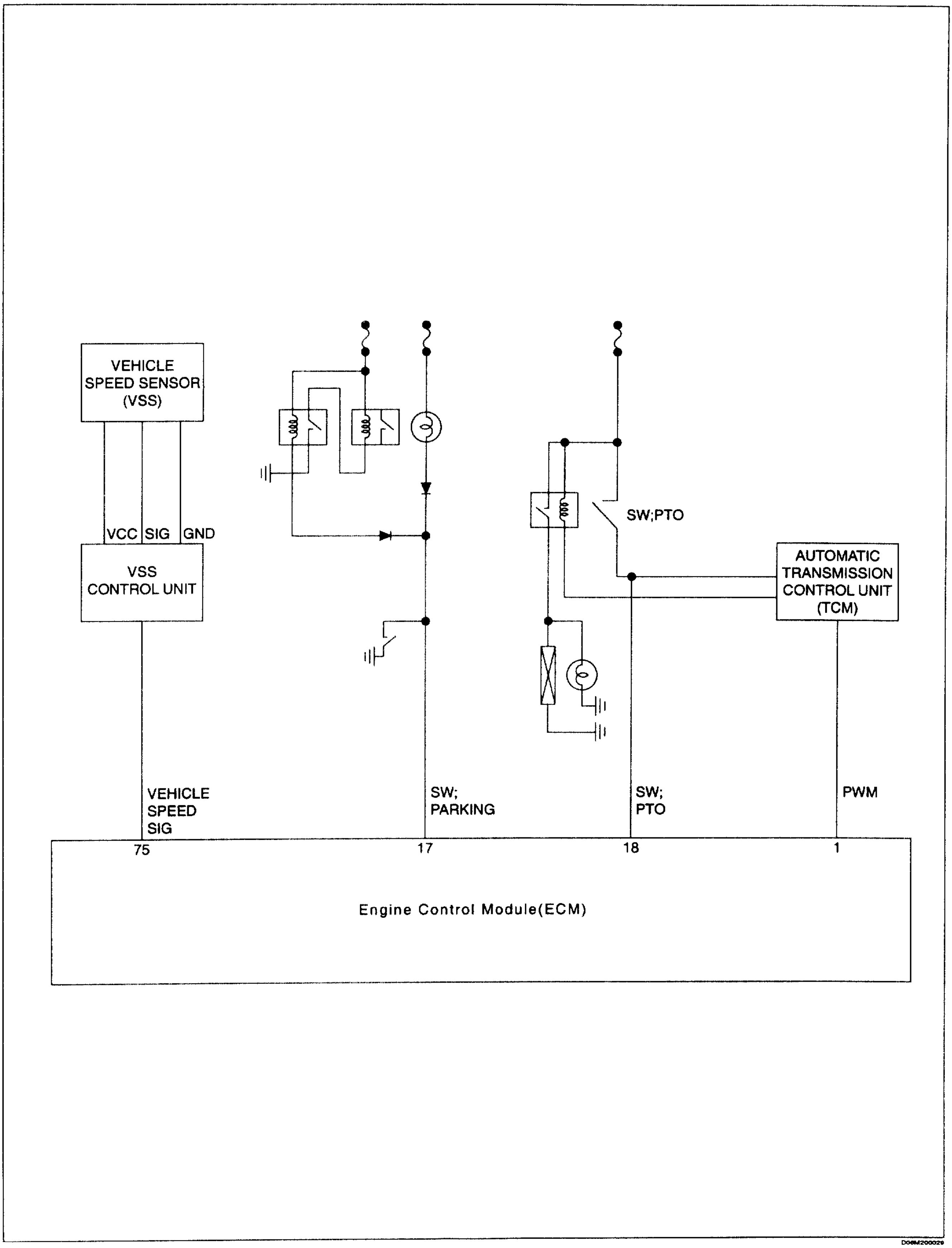
D06M200004

ECM System Wiring Diagram (4 of 5)

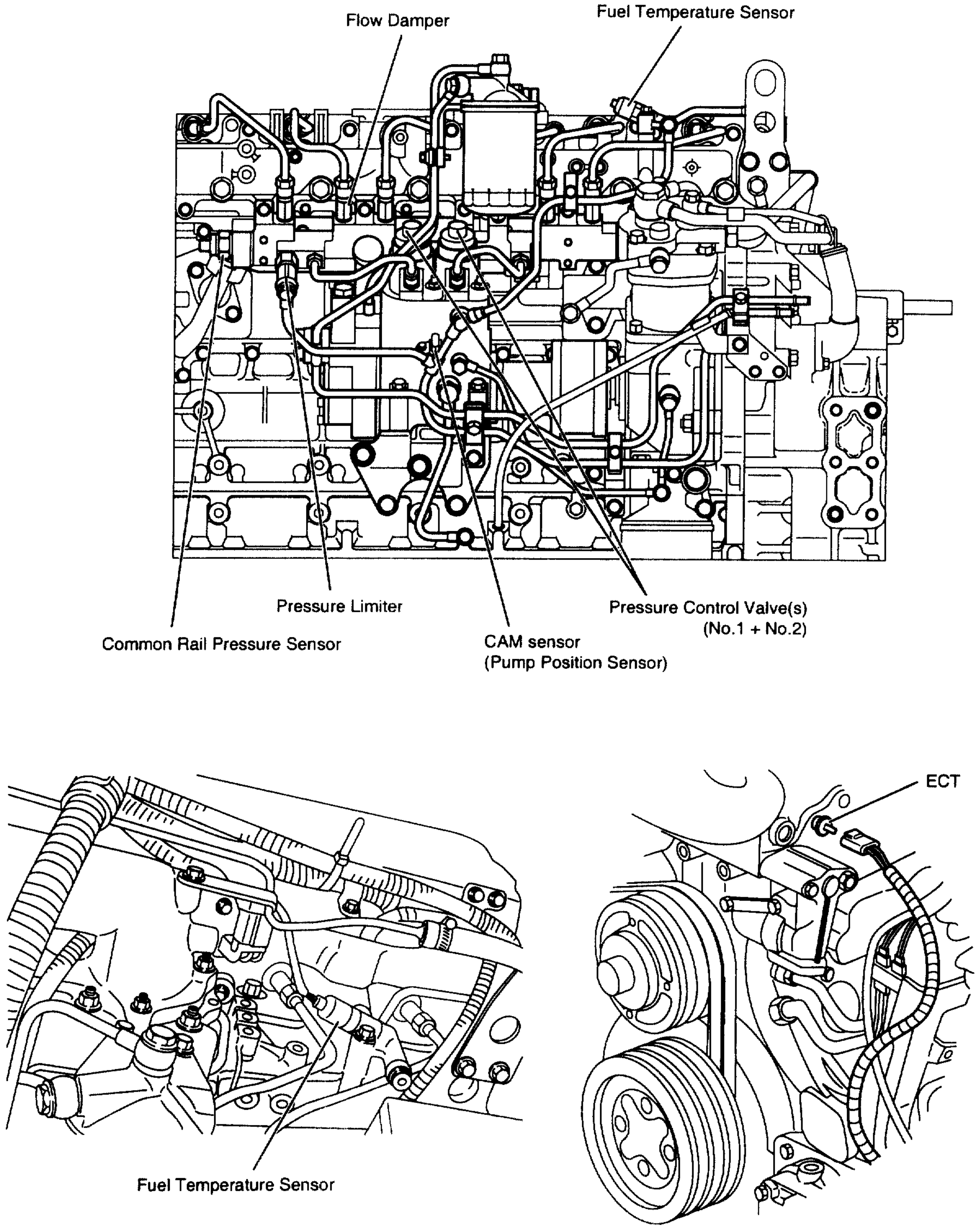


D06M200003

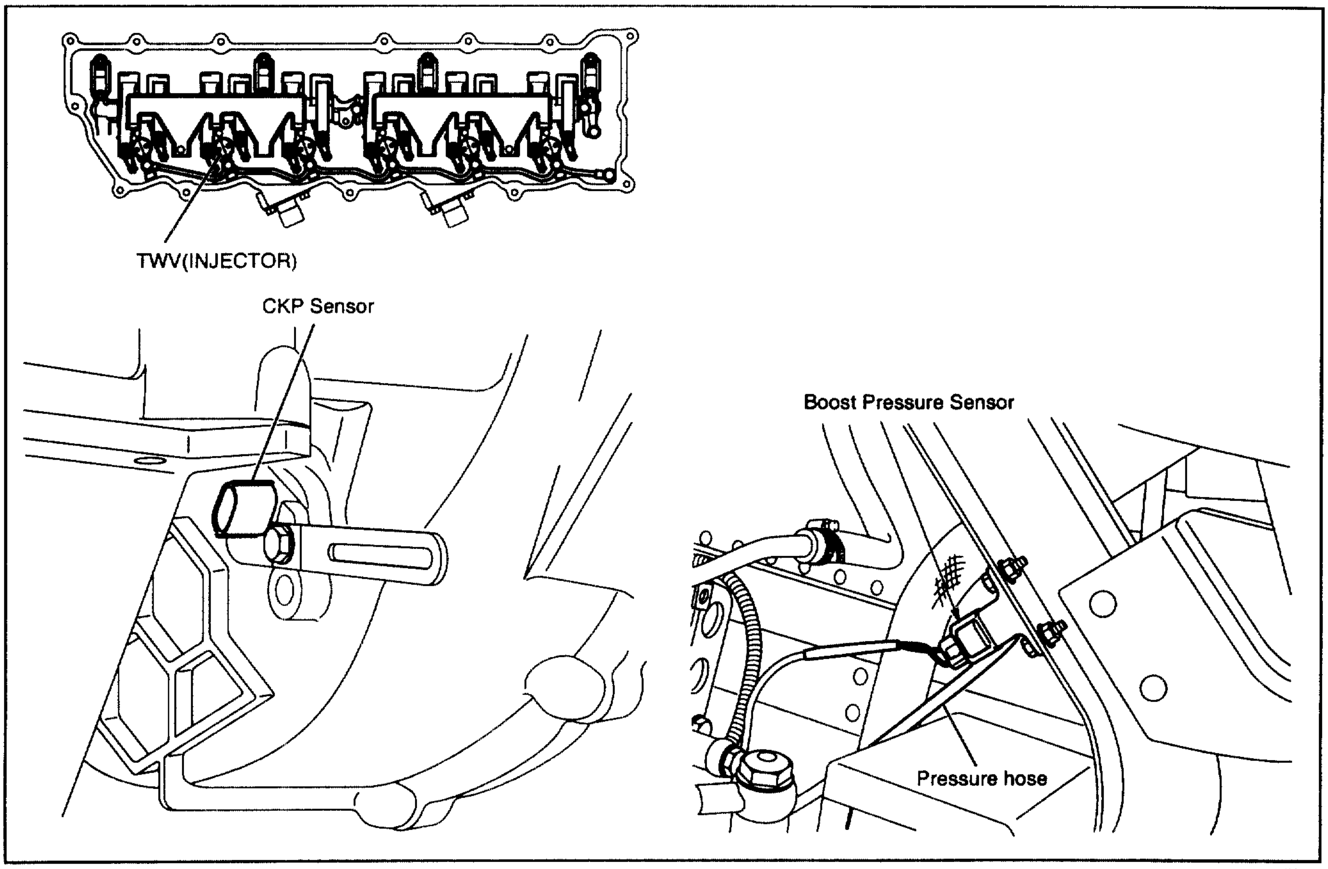
ECM System Wiring Diagram (5 of 5)



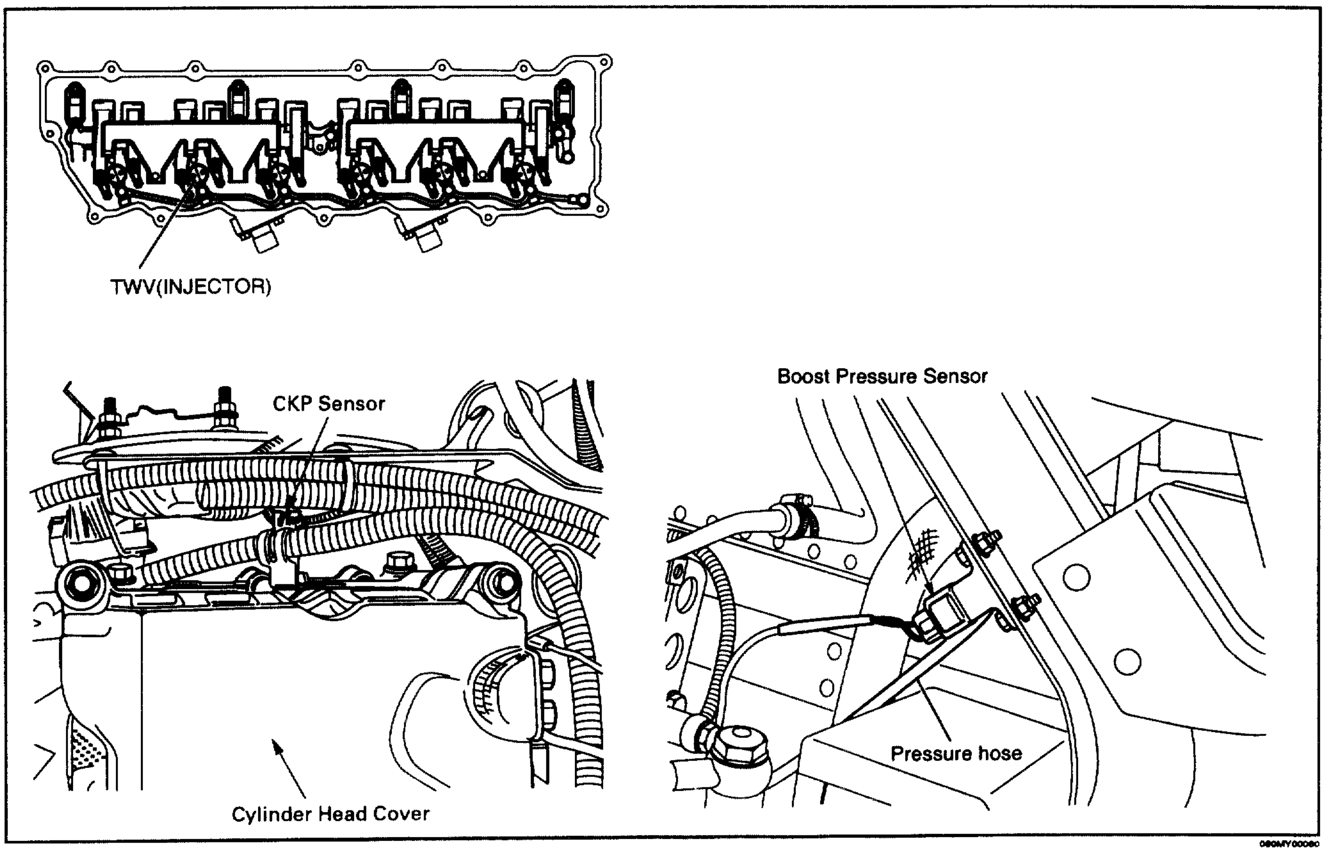
Location of Sensor and Switch



Transmission Type: M/T



Transmission Type: A/T



Location of the DLC (Data Link Connector)

The DLC is located under the inner part of left side instrument panel (Driver side).

Location of the memory clear switch

The memory clear switch is located under the inner part of left side instrument panel (Driver side).

Location of the PCV relay and MAIN relay

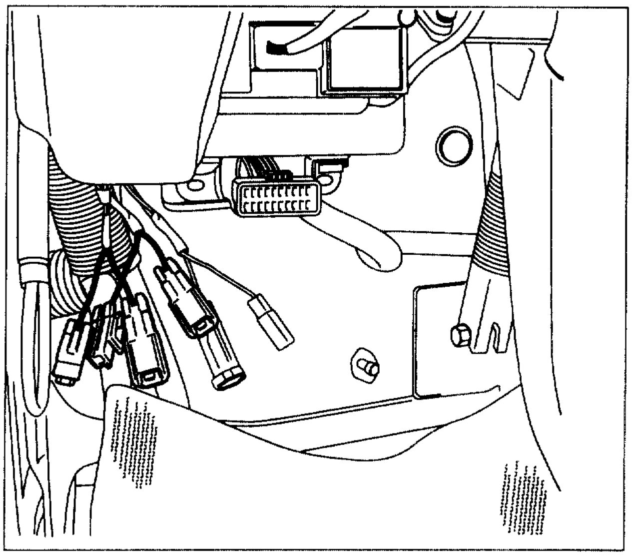
Both relay are located on upper the inner part of passenger seat side instrument panel.

Location of the AAT (Ambient Air temperature) sensor

The AAT sensor is located center of front on the dashpanel.

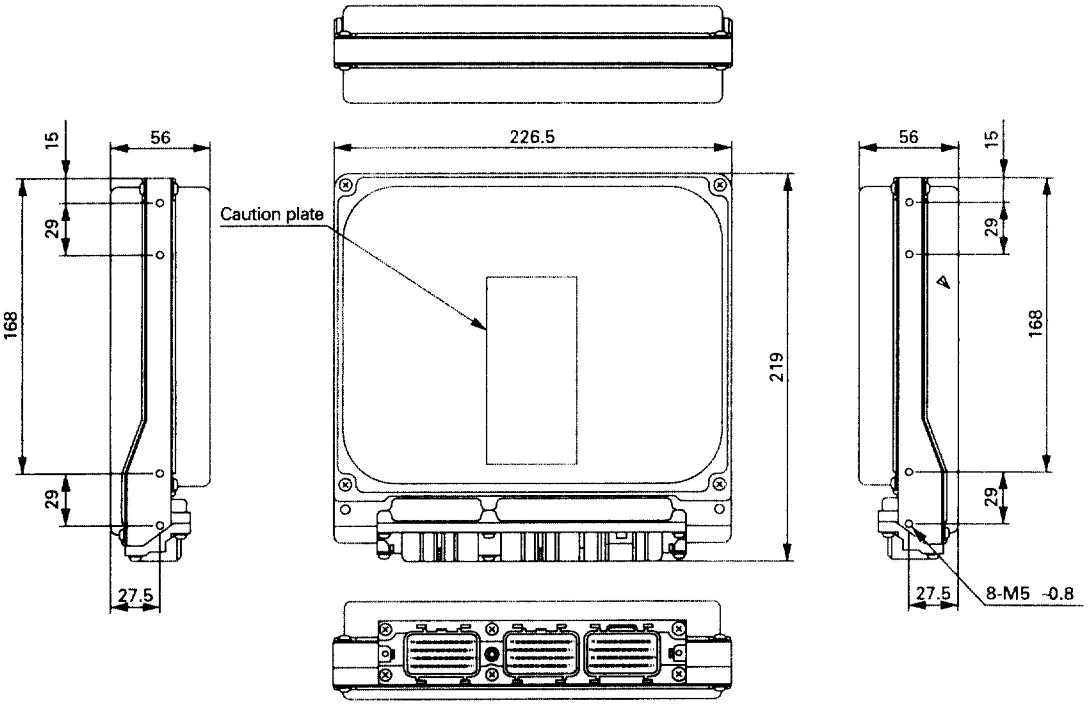
Location of the diagnosis switch

The diagnosis switch is located under the inner part of left side instrument panel (Driver side) and the switch is white color one pin connector.



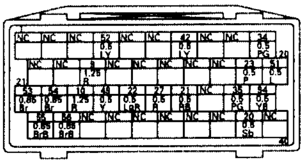
Engine Control Module (ECM)

Appearance of ECM



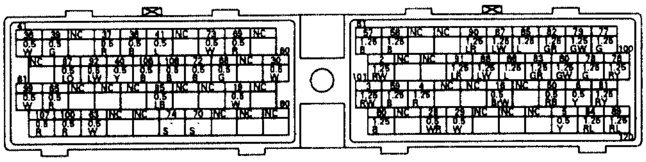
056MV030

Detail of 40 pin connector for Engine harness



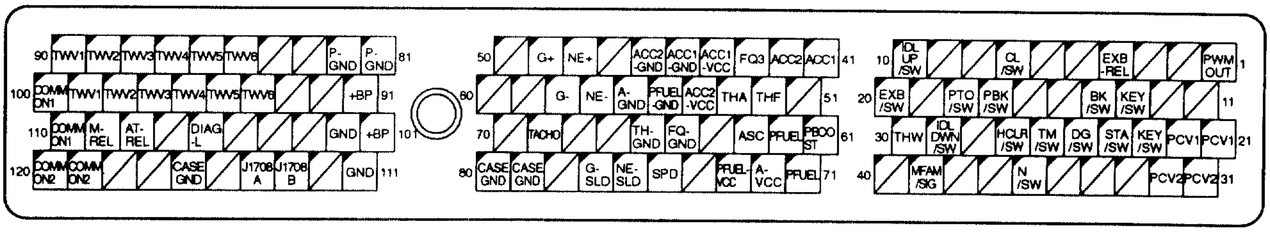
056MV021

Detail of 80 pin connector for Engine harness



056MV020

Chart of ECM INPUT/OUTPUT



Connector Pin Assignment

Connector	Connector Pin number	Connector pin assignment	
		Abbreviations	Assigned name
40 pin connector	1	PWMOUT	Accelerator PWM output
	2	——	Not used
	3	——	Not used
	4	EXB–REL	Exhaust brake relay
	10	IDLUP/SW	Idling up switch
	11	——	Not used
	12	——	Not used
	13	KEY/SW	Key switch
	14	BK/SW	Brake Switch
	15	——	Not used
	16	——	Not used
	17	PBK/SW	Parking brake switch
	18	PTO/SW	PTO switch
	19	——	Not used
	20	EXB/SW	Exhaust brake switch
	21	PCV1	Pressure control valve 1
	22	PCV1	Pressure control valve 1
	23	KEY/SW	Key switch
	24	STA/SW	Starter switch
	25	DG/SW	Diagnosis switch
	26	TM/SW	Transmission judgment switch
	27	MCLR/SW	Memory clear switch
	28	——	Not used
	29	IDLDWN/SW	Idling down switch
	30	THW (ECT)	Engine coolant temperature sensor
	31	PCV2	Pressure control valve 2
	32	PCV2	Pressure control valve 2

Connector	Connector Pin number	Connector pin assignment	
		Abbreviations	Assigned name
40 pin connector	33	——	Not used
	34	——	Not used
	35	——	Not used
	36	N/SW	Neutral switch
	37	——	Not used
	38	(MFAM/SIG)	Not used
	39	——	Not used
	40	——	Not used
80 pin connector	41	ACC1	Acceleration position sensor 1
	42	ACC2	Acceleration position sensor 2
	43	——	Not used
	44	ACC1–VCC	Acceleration position sensor 1 power source
	45	ACC1–GND	Acceleration position sensor 1 ground
	46	ACC2–GND	Acceleration position sensor 2 ground
	47	——	Not used
	48	CKP+	Crank position sensor positive
	49	CAM+	Pump position sensor positive
	50	——	Not used
	51	——	Not used
	52	THF	Fuel temperature sensor
	53	THA	Ambient Air temperature sensor
	54	ACC2–VCC	Acceleration position sensor 2 power source
	55	PFUEL–GND	Common rail pressure sensor ground
	56	A–GND	Sensor system ground
	57	CKP–	Crank position sensor negative
	58	CAM–	Pump position sensor negative
	59	——	Not used
	60	——	Not used
	61	PBOOST	Turbocharger Boost pressure sensor
	62	PFUEL	Common rail pressure sensor
	63	ASC	PTO position sensor acceleration
	64	——	Not used
	65	FQ–GND	Fuel quantity adjustment resistance common ground
	66	TH–GND	Temperature sensor ground
	67	——	Not used
	68	——	Not used
	69	TACHO	Tachometer output
	70	——	Not used

Connector	Connector Pin number	Connector pin assignment	
		Abbreviations	Assigned name
80 pin connector	71	PFUEL	Common rail pressure sensor
	72	A–VCC	Sensor system power source
	73	PFUEL–VCC	Common rail pressure sensor power source
	74	——	Not used
	75	SPD	Vehicle speed sensor
	76	CKP–SLD	Crank position sensor sealed
	77	CAM–SLD	Pump position sensor sealed
	78	——	Not used
	79	——	Not used
	80	CASE–GND	Common 1
	81	P–GND	Power ground
	82	P–GND	Power ground
	83	——	Not used
	84	——	Not used
	85	TWV6	Two way valve 6 (Cylinder #4)
	86	TWV5	Two way valve 5 (Cylinder #2)
	87	TWV4	Two way valve 4 (Cylinder #6)
	88	TWV3	Two way valve 3 (Cylinder #3)
	89	TWV2	Two way valve 2 (Cylinder #5)
	90	TWV1	Two way valve 1 (Cylinder #1)
	91	+BP	Battery positive (Main relay)
	92	——	Not used
	93	——	Not used
	94	TWV6	Two way valve 6 (Cylinder #4)
	95	TWV5	Two way valve 5 (Cylinder #2)
	96	TWV4	Two way valve 4 (Cylinder #6)
	97	TWV3	Two way valve 3 (Cylinder #3)
	98	TWV2	Two way valve 2 (Cylinder #5)
	99	TWV1	Two way valve 1 (Cylinder #1)
	100	COMMON1	Common 1
	101	+BP	Battery positive (Main relay)
	102	GND	ECM ground
	103	——	Not used
	104	——	Not used
	105	——	Not used
	106	DIAG–L	Diagnostic lamp
	107	——	Not used
	108	AT–REL	Automatic transmission relay
	109	M–REL	Main relay
	110	COMMON1	Common 1

Connector	Connector Pin number	Connector pin assignment	
		Abbreviations	Assigned name
80 pin connector	111	GND	ECM ground
	112	——	Not used
	113	Serial	Serial data (J1708B) Scan Tool
	114	Serial	Serial data (J1708A) Scan Tool
	115	——	Not used
	116	——	Not used
	117	——	Not used
	118	——	Not used
	119	COMMON2	Common 2
	120	COMMON2	Common 2

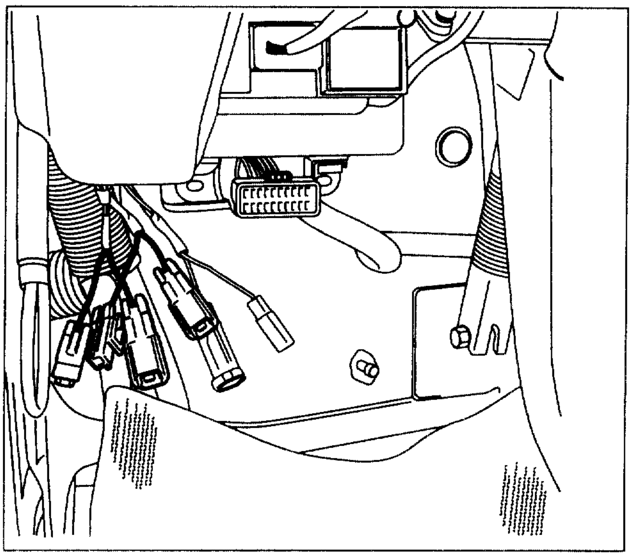
Method to confirm the self-diagnosis code (dealer mode)

The self-diagnosis code can be read from the flashing of the indicator lamp (service engine soon).

Operation:

When the diagnosis connector mentioned below is connected, the indicator lamp will start flashing. The self-diagnosis code can be read from the flashing of the indicator lamp.

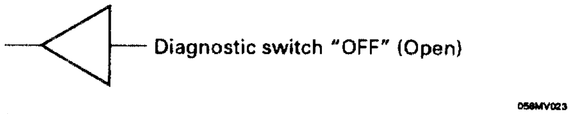
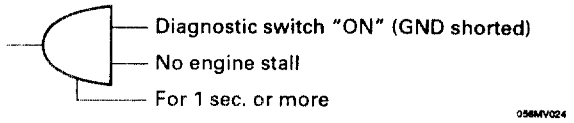
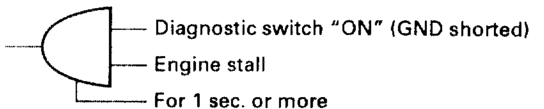
As to the method to read the self-diagnosis code, please refer to the 'How to Read the flashing of the indicator lamp' as mentioned later.



Diagnostic Indication

Contents of diagnostic indication

In accordance with the conditions of Diagnostic switch, the diagnostic lamp indications are changed over as follows:

Control mode	Diag. lamp indicator	Condition
User Mode	ON	 Diagnostic switch "OFF" (Open) 056MV023
Dealer Mode 1	DTC indication of current trouble only	 Diagnostic switch "ON" (GND shorted) No engine stall For 1 sec. or more 056MV024
Dealer Mode 2	DTC indication of current and past troubles	 Diagnostic switch "ON" (GND shorted) Engine stall For 1 sec. or more 056MV025

- Mode changeover between User mode, Dealer mode 1 and Dealer mode 2 is made immediately.
- Mode changeover between Dealer mode 1 and Dealer mode 2 is made after a round of DTC output.

Priority of indications

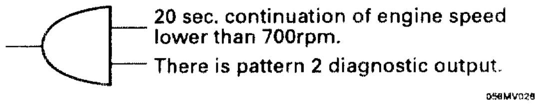
Lamp control by user mode, Dealer mode 1 and 2 > Lamp check control.

Diagnostic lamp patterns in User mode

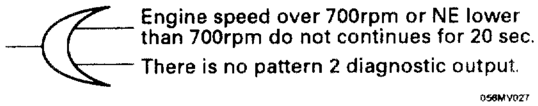
Pattern 1	Lighted all the time
Pattern 2	Lighted after 20 sec. continuation of engine speed lower than 700 rpm.
Pattern 3	Light goes out.

* Lighting condition of pattern 2

(1) Lighted by pattern 2 diagnostic.



(2) Not lighted by pattern 2 diagnostic.



Diagnostic code outputting in dealer mode

DTC indication is restarted after 2.4 sec. of light out.
The number of times of lighting/going out corresponding to the numeral in each figure are repeated.

Item	Light on time (Sec.)	Light out time (Sec.)
Figure of 100	0.3	0.6
Figure of 10	1.2	0.6
Figure of 1	0.3	0.6
Code intervals	—	2.4

Note: ***Tolerance of difference between light on and light out time is +0.3 to −0.1.***

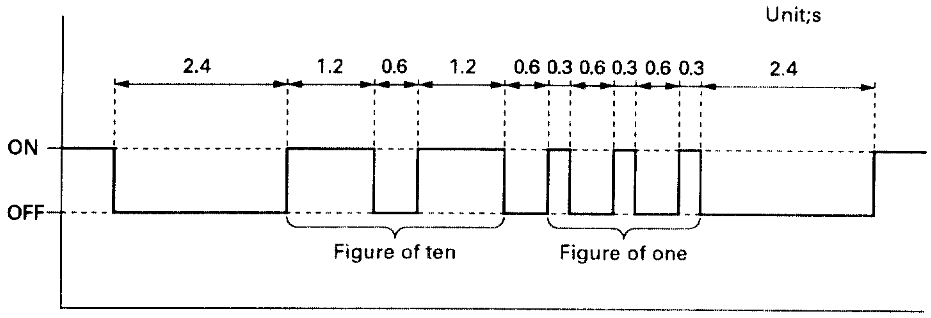
How to read flashing of the indicator lamp

The three-digit self-diagnosis code flashes starting from hundred's figure, while the two-digit self-diagnosis code flashes starting from ten's figure to indicate the self-diagnosis code.
Please read the self-diagnosis code from the flashing.
If the plural self-diagnosis codes are indicated, the same sefl-diagnosis code is flashed repeatedly in steps of three times. Please read it correctly.

- DTC outputting is done in decreasingly order of DTC number.
- Indication is changed over on completion of output DTC indication.
- DTC indicator is stopped with diagnostic switch being off.
- When there is no DTC output, "1" is outputted in normal DTC code.
- After indicating 3 times pear 1 DTC, shift is conducted to the next DTC. (After making a round, the indications are repeated again.)
- In case of the same diagnostic code, it is used 1 DTC (3 times indication.)

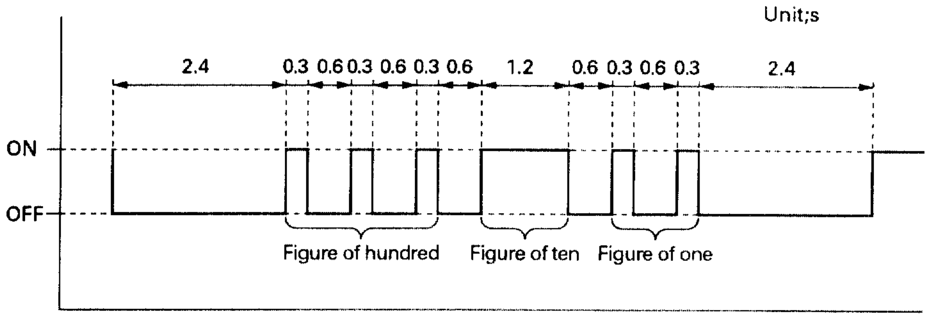
Example Diagnosis Trouble Code Output

(For example) In case of indicate two digits figure "DTC23"



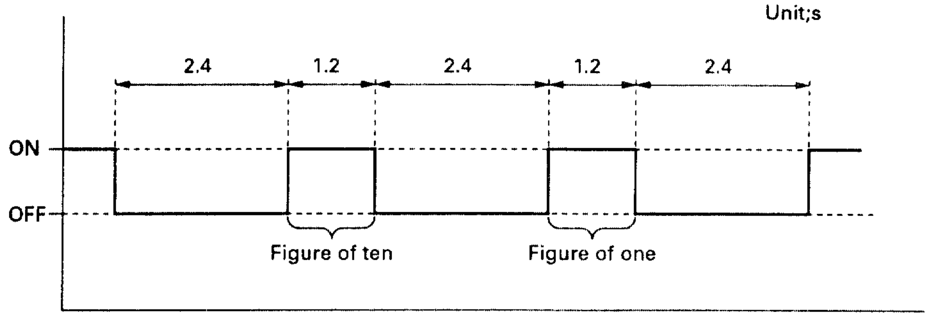
F06MV045

(For example) In case of indicate three digits figure "DTC312"



F06MV046

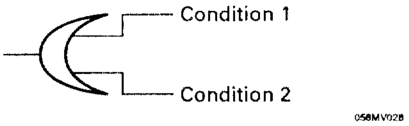
(For example) In case of indicate two digits figure "DTC10"



F06MV047

Clearing method of diagnosis trouble code

Under the following condition, the diagnosis code memorized in EEPROM is cleared.



Condition 1:

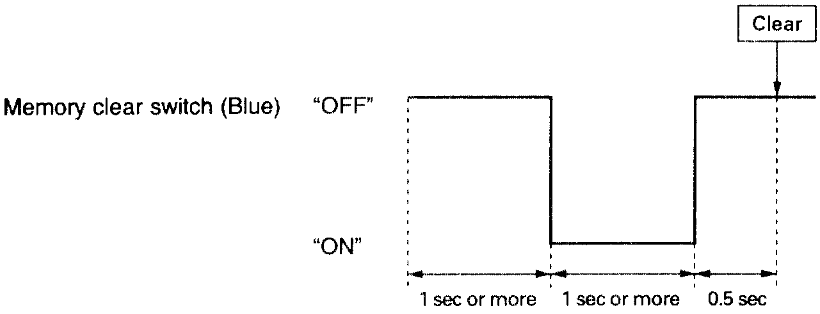
Memory clear switch (Blue) "OFF" continues 1 sec. or more.

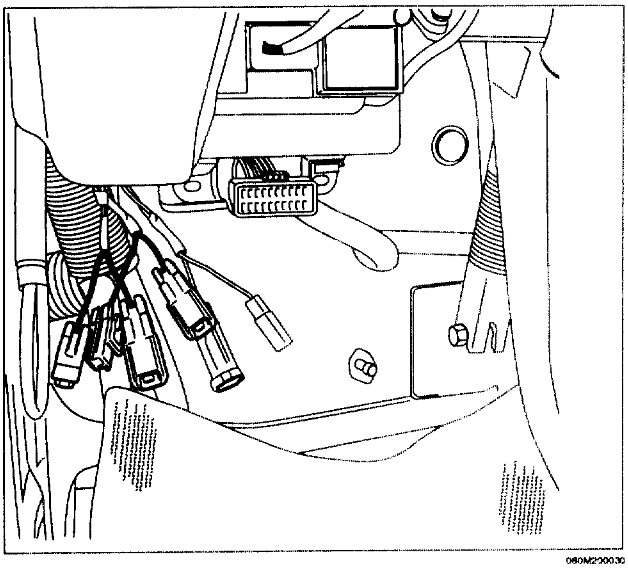
↓

Memory clear switch (Blue) "ON" continues 1 sec. or more.

↓

Memory clear switch (Blue) "OFF" continues 0.5 sec. or more.





Condition 2:

EEPROM data does not match its mirror data.

Typical Scan Data Values

Use the Typical Values Table only after the On-Board Diagnostic System Check has been completed, no DTC(s) were noted, and you have determined that the on-board diagnostics are functioning properly. Scan tool values from a properly-running engine may be used for comparison with the engine you are diagnosing. The typical scan data values represent values that would e seen on a normally-running engine.

NOTE: A scan tool that displays faulty data should not be used, and the problem should be reported to the scan tool manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary replacement of parts.

Scan Tool Parameter	Data List	Units Displayed	Engine Scan Tool Data List Values (Idle)
Engine Speed	Engine	RPM	630 ± 15 (✱1)
Desired Idle Speed	Engine	RPM	630 ± 15(✱1)
App Angle	Engine	%	0
APP Sensor	Engine	Volts	0.85 ~ 1.15
APP Sensor Learned Minimum	Engine	Volts	0.85 ~ 1.15
ECT Engine Coolant Temp.	Engine	°C (°F)	Less than 90 (194)
Fuel Temperature	Engine	°C (°F)	36 ~ 43 (96.8 ~ 109.4)
Maximum Fuel Temperature	Engine	°C (°F)	Less than 100 (212)
Ambient Air Temperature	Engine	°C (°F)	Actual ATM ±5°C
Boost Pressure Sensor	Engine	kPa	–2 ~ 2
Actual Fuel Rail	Engine	MPa	25 ~ 26
Desired Rail Pressure	Engine	MPa	25 ~ 26
PCV Closed Interval	Engine	°CA	120 ~ 180
PCV Feed Back	Engine	°CA	–50 ~ 20
BARO	Engine	kPa	98 ~ 102
Battery Voltage	Engine	Volts	14 ~ 15 V
Starter Switch	Engine	ON/OFF	ON
Neutral Switch	Engine	ON/OFF	ON
Clutch Switch	Engine	ON/OFF	ON
Exhaust Brake Switch	Engine	ON/OFF	OFF
Engine Stop Switch	Engine	ON/OFF	OFF
Diagnostic Switch	Engine	ON/OFF	OFF
Main Injection Timing	Engine	°CA	–3.0 ~ –2.0
Over Speed Number of Times	Engine		0
Overheat Number of Times	Engine		0
Flow Limiter 1	Engine		0
Flow Limiter 2	Engine		0
Flow Limiter 3	Engine		0
Flow Limiter 4	Engine		0
Flow Limiter 5	Engine		0
Flow Limiter 6	Engine		0
Balancing Rate Cyl. 1	Engine	mm^3	–5 ~ 5
Balancing Rate Cyl. 2	Engine	mm^3	–5 ~ 5
Balancing Rate Cyl. 3	Engine	mm^3	–5 ~ 5
Balancing Rate Cyl. 4	Engine	mm^3	–5 ~ 5

Scan Tool Parameter	Data List	Units Displayed	Engine Scan Tool Data List Values (Idle)
Balancing Rate Cyl. 5	Engine	mm^3	–5 ~ 5
Balancing Rate Cyl. 6	Engine	mm^3	–5 ~ 5
Final Fuel Rate	Engine	mm^3	9 ~ 10
Crank Signal Present	Engine	Yes/No	Yes
Injection Pump Signal Present	Engine	Yes/No	Yes
Cylinder Balance Mode	Engine	Yes/No	Yes
Injection Control Mode	Engine	Control stop/Normal	NORMAL INJ.
Pump Control Mode	Engine	Control stop/Normal	NORMAL
Engine Start Mode	Engine	Yes/No	No
Engine Running	Engine	Yes/No	Yes
Diagnostic Switch	Engine	ON/OFF	OFF
Engine Stop Switch	Engine	ON/OFF	OFF
Parking Brake Switch	Engine	ON/OFF	ON
PTO APP Angle	Engine	%	0 ~ 2
PTO APP Sensor	Engine	Volts	0.3 ~ 0.5
PTO Switch	Engine	ON/OFF	OFF
Vehicle Speed Sensor	Engine	km/h (MPH)	0 (0)
TDC Offset	Engine	°CA	–8 ~ 8
Transmission Type	Engine	–	ON (A/T)

NOTE:

(✱1) Make sure the desired idle speed and actual idle speed in the data list on the Tech2.
When the engine is at idle, the desired idle speed is applied lower creation by ECM, the result is displayed 615 rpm.
When the actual idle speed is displayed about 614 rpm, the result is normal at idle.

Engine Data Definitions

Data Display Engine 1

Engine Speed	Engine speed is computed by the ECM from the CKP sensor. It should remain close to desired idle under various engine loads with engine idling.
APP Angle	APP angle is computed by the ECM from APP sensor voltages. This should display 0% at idle and 100% at wide open throttle.
Boost Pressure Sensor	The boost pressure sensor measures the change in intake manifold pressure from the engine load.
BARO	The barometric pressure is used to compensate for altitude difference. The BARO is mounted in the ECM.
ECT	The ECT is displayed engine coolant temperature. The ECM applies 5 volts to the ECT circuit. The sensor is a thermistor which changes internal resistance as temperature changes When the sensor is cold (high resistance), the ECM monitors a high signal voltage and interprets that as a cold engine.
Ambient Air Temp.	The ambient air temp. is displayed ambient air temperature. The ECM applies 5 volts to the ambient air temperature sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes.
Fuel Temperature	5 volts to the fuel temperature sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes.
Battery Voltage	This represents the system voltage measure by the ECM at ignition feed.

Data Display Engine 2

Engine Speed	Engine speed is computed by the ECM from the CKP sensor. It should remain close to desired idle under various engine loads with engine idling.
Desired Idle Speed	The desired idle speed that the ECM is commanding. The ECM will compensate for various engine loads based on engine coolant temperature, to keep the engine at the desired speed.
APP Angle	APP angle is computed by the ECM from APP sensor voltages. This should display 0% at idle and 100% at wide open throttle.
ECT	The ECT is displayed engine coolant temperature. The ECM applies 5 volts to the ECT circuit. The sensor is a thermistor which changes internal resistance as temperature changes. When the sensor is cold (high resistance), the ECM monitors a high signal voltage and interprets that as a cold engine.
Fuel Temperature	5 volts to the fuel temperature sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes.
Actual Rail Pressure	This is displayed current rail pressure. The ECM will compensate for rail pressure to desired rail pressure.
Desired Rail Pressure	The desired rail pressure that the ECM is commanding. The ECM will compensate for rail pressure on APP angle.
Main Injection Timing	The main injection timing that the ECM is commanding. The ECM will compensate for main injection timing by APP angle and various sensor signals.
Basic Fuel Rate	The basic fuel rate that the ECM is commanding. The ECM will compute for the basic fuel rate by various sensor signals.
Final Fuel Rate	This is displayed current fuel rate. The ECM will compensate for fuel rate to basic fuel rate.
PC Valve Close Interval	This is displayed the PC valve operation interval. The ECM will compute for the PC valve operation by various sensor signals.

Engine Stop Switch	This is displayed operating status for the engine stop switch.
Diagnostic Switch	This is displayed operating status for the diagnostic switch.
Neutral Switch (Automatic Only)	This is displayed operating status for the neutral switch.
Clutch Switch (Manual Only)	This is displayed operating status for the clutch switch.
Starter Switch	This is displayed operating status for the engine starter switch.
Transmission Type	This is displayed type for transmission.
Vehicle Speed Sensor	Vehicle speed is computed by the ECM from the Vehicle speed sensor.

Data Display Engine 3

Engine speed	Engine speed is computed by the ECM from the CKP sensor. It should remain close to desired idle under various engine loads with engine idling.
Actual Rail Pressure	This is displayed current rail pressure. The ECM will compensate for rail pressure to desired rail pressure.
Basic Fuel Rate	The basic fuel rate that the ECM is commanding. The ECM will compute for the basic fuel rate by various sensor signals.
Final Fuel Rate	This is displayed current fuel rate. The ECM will compensate for fuel rate to basic fuel rate.
Fuel Rate at Start	This is displayed fuel rate at engine start.
Fuel Rate at Maximum Speed	This is displayed fuel rate at engine maximum speed in this ignition.
Fuel Rate Correction	This is displayed fuel rate correction. The ECM will compensate for fuel rate by APP sensor angle and various sensor signals.
ISC Fuel Rate Correction	This is displayed fuel rate correction for the engine idling. The ECM will compensate for fuel rate by various sensor signals.
ISC Fuel Rate Proportional	This is displayed fuel rate correction for the engine idling. The ECM will compensate for fuel rate by various sensor signals.
ISC Fuel Rate Integral	This is displayed integral fuel rate for the engine idling. The ECM will compensate for fuel rate by various sensor signals.
Split Fuel Rate	This is displayed split fuel rate.
Balancing Rate Cyl. 1	This is displayed fuel rate at engine idling. The ECM will compensate for cylinder balancing fuel rate by various sensor signals.
Balancing Rate Cyl. 2	This is displayed fuel rate at engine idling. The ECM will compensate for cylinder balancing fuel rate by various sensor signals.
Balancing Rate Cyl. 3	This is displayed fuel rate at engine idling. The ECM will compensate for cylinder balancing fuel rate by various sensor signals.
Balancing Rate Cyl. 4	This is displayed fuel rate at engine idling. The ECM will compensate for cylinder balancing fuel rate by various sensor signals.
Balancing Rate Cyl. 5	This is displayed fuel rate at engine idling. The ECM will compensate for cylinder balancing fuel rate by various sensor signals.
Balancing Rate Cyl. 6	This is displayed fuel rate at engine idling. The ECM will compensate for cylinder balancing fuel rate by various sensor signals.
Injection Control Mode	This is displayed control mode for fuel injection.

Data Display Engine 4

Engine speed	Engine speed is computed by the ECM from the CKP sensor. It should remain close to desired idle under various engine loads with engine idling.
APP Angle	APP angle is computed by the ECM from APP sensor voltages. This should display 0% at idle and 100% at wide open throttle.
TDC Offset	This is displayed offset for supply pump attachment angle.
Main Injection Timing	The main injection timing that the ECM is commanding. The ECM will compensate for main injection timing by APP angle and various sensor signals.
Fuel Temperature	5 volts to the fuel temperature sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes.
Actual Rail Pressure	This is displayed current rail pressure. The ECM will compensate for rail pressure to desired rail pressure.
Desired Rail Pressure	The desired rail pressure that the ECM is commanding. The ECM will compensate for rail pressure on APP angle.
PC Valve On Time	This is displayed the PC valve On time. The ECM will compute for PC valve operating by various sensor signals.
Flow Limiter 1	This is displayed operation times for the flow damper. The ECM will operate the flow damper by various sensor signals.
Flow Limiter 2	This is displayed operation times for the flow damper. The ECM will operate the flow damper by various sensor signals.
Flow Limiter 3	This is displayed operation times for the flow damper. The ECM will operate the flow damper by various sensor signals.
Flow Limiter 4	This is displayed operation times for the flow damper. The ECM will operate the flow damper by various sensor signals.
Flow Limiter 5	This is displayed operation times for the flow damper. The ECM will operate the flow damper by various sensor signals.
Flow Limiter 6	This is displayed operation times for the flow damper. The ECM will operate the flow damper by various sensor signals.
Injection Pump Signal Present	This is displayed input signal status by the CMP sensor.
Cylinder Balance Mode	This is displayed cylinder balance mode by the ECM.
Pump Control Mode	This is displayed mode the fuel pump control. Operate the flow damper by various sensor signals.
Injection Control Mode	This is displayed control mode for fuel injection.

Data Display Engine 5

Engine speed	Engine speed is computed by the ECM from the CKP sensor. It should remain close to desired idle under various engine loads with engine idling.
APP Angle	APP angle is computed by the ECM from APP sensor voltages. This should display 0% at idle and 100% at wide open throttle.
APP Sensor	The voltage being monitored by the ECM on the APP sensor signal circuit.
APP Sensor Learned Minimum	This is displayed voltage for APP sensor idle position signal.
Actual Rail Pressure	This is displayed current rail pressure. The ECM will compensate for rail pressure to desired rail pressure.
Desired Rail Pressure	The desired rail pressure that the ECM is commanding. The ECM will compensate for rail pressure on APP angle.
Main Injection Timing	The main injection timing that the ECM is commanding. The ECM will compensate for main injection timing by APP angle and various sensor signals.
PTO APP Angle	PTO APP angle is computed by the ECM from PTO APP sensor voltage. This should display 0% at 100% at idle and 100% full position.
PTO APP Sensor	The voltage being monitored by the ECM on the PTO APP sensor signal circuit.
PTO Switch	This is displayed operating status for the PTO switch.
PC Valve On Time	This is displayed the PC valve On time. The ECM will compute for PC valve operating by various sensor signals.
PC Valve Close Interval	This is displayed the PC valve operation interval. The ECM will compute for the PC valve operation by various sensor signals.
Basic PC Valve On Time	The basic PC valve On time that the ECM is commanding. The ECM will compute for the basic PC valve On time by various sensor signals.
Battery Voltage	This represents the system voltage measure by the ECM at ignition feed.
Fuel Temperature	5 volts to the fuel temperature sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes.
Maximum Fuel Temperature	ECM applies 5 volts to the fuel temperature sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes. The highest fuel temperature which ECM memorized is displayed.
Injection Control Mode	This is displayed control mode for fuel injection.
Pump Control Mode	This is displayed mode the fuel pump control. Operate the flow damper by various sensor signals.
Overheat Number of Times	This is displayed times for engine overheat.
Over Speed Number of Times	This is displayed times for engine over speed.

Data Display Engine 6

Engine speed	Engine speed is computed by the ECM from the CKP sensor. It should remain close to desired idle under various engine loads with engine idling.
Actual Rail Pressure	This is displayed current rail pressure. The ECM will compensate for rail pressure to desired rail pressure.
Fuel Temperature	5 volts to the fuel temperature sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes.
Main Injection Timing	The main injection timing that the ECM is commanding. The ECM will compensate for main injection timing by APP angle and various sensor signals.
Main Injection Interval	The main injection interval that the ECM is commanding. The ECM will compensate for main injection interval by APP angle and various sensor signals.
Pilot Injection Interval	This is displayed the pilot injection interval. The ECM will compute for the pilot injection interval by various sensor signals.
Split Injection Interval	This is displayed the split injection interval. The ECM will compute for the split injection interval by various sensor signals.
End of Split Injection	This is displayed the engine speed for end of split injection interval in this ignition.
PC Valve On Time	This is displayed the PC valve On time. The ECM will compute for PC valve operating by various sensor signals.
PC Valve On Feedback	ECM will compute for PC valve operating by various sensor signals.
PC Valve On Length	This is displayed the PC valve ON length. The ECM will compute for PC valve operating by various sensor signals.
PC Valve Delay Time	This is displayed the PC valve delay time.
Crank Signal Present	This is displayed input signal status by the CKP sensor.
Injection Pump Signal Present	This is displayed input signal status by the CMP sensor.
Parking Brake Switch	This is displayed operating status for the Parking brake switch.
Exhaust Brake Switch	This is displayed operating status for the Exhaust brake switch.
Engine Start Mode	This is displayed engine start mode by the ECM.
Engine Running	This is displayed engine running mode by the ECM.

Symptom Diagnosis

PRELIMINARY CHECKS

Before using this section, perform the "On-Board Diagnostic (OBD) System Check" and verify all of the following items:

- The engine control module (ECM) and malfunction indicator lamp (MIL) (Check Engine lamp) are operating correctly.
- There are no DTC(s) stored.
- scan tool data is within normal operating range. Refer to Typical Scan Data Values.
- Verify the customer complaint and locate the correct symptom in the table of contents.Perform the procedure included in the symptom chart.

VISUAL CHECK

Several of the symptom procedures call for a careful visual check. This can lead to correcting a problem without further checks and can save valuable time. This check should include the following items:

- ECM grounds for cleanliness, tightness and proper location.
- Vacuum hoses for splits, kinks, and proper connections, as shown on the "Vehicle Emission Control Information" label. Check thoroughly for any type of leak or restriction.
- Air intake ducts for collapsed or damaged areas.
- Ignition component for cracking, hardness, and carbon tracking.
- Wiring for proper connections, pinches and cuts.

INTERMITTENTS

An intermittent problem may or may not turn on the malfunction indicator lamp (MIL) or store a Diagnostic Trouble Code. DO NOT use the Diagnostic Trouble Code (DTC) charts for intermittent problems. The fault must be present to locate the problem.

Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual/physical check for the following conditions:

- Poor mating of the connector halves or a terminal not fully seated in the connector (backed out).
- Improperly formed or damaged terminal.
- All connector terminals in the problem circuit should be carefully checked for proper contact tension.
- Poor terminal-to-wire connection. This requires removing the terminal from the connector body to check.

Road test the vehicle with a J 39200 Digital Multimeter connected to a suspected circuit. An abnormal voltage when the malfunction occurs is a good indication that there is a fault in the circuit being monitors.

Use a scan tool to help detect intermittent conditions.

COMMON RAIL SYSTEM & SYMPTOM DIAGNOSIS MENU:

- Engine hard starting
- Engine stall
- Engine will not start and run
- Rough engine idling
- Engine hunting
- Surging, hesitation
- High idle engine speed
- Excessive white or blue smoke
- Excessive black smoke
- Lack of power
- Air bleed error
- Fuel leakage
- Tachometer output error
- Exhaust brake error
- PTO (Power Take Off) error
- Vehicle speed sensor error

The possibility DTCs with symptom diagnosis

Description	DTC(s)
Engine hard starting	14, 15, 118, 158, 159, 227, 23, 22, 245
Engine stall	35, 227, 158, 159, 118
Engine will not start and run (Refer to common rail system check)	14, 15, 217, 218, 247, 248, 271, 272, 273, 274, 275, 276, 158, 159, 115
Rough engine idling (Refer to common rail system check)	14, 15, 35, 115, 118, 151, 158, 159, 217, 218, 245, 247, 248, 261, 262, 263, 264, 265, 266, 271, 272, 273, 274, 275, 276, 23, 22
Engine hunting	25, 28, 115, 118, 151, 245, 15
Surging, Hesitation	211, 23, 22, 14, 15
High idle engine speed/ Engine starts but will not accelerate	24, 35, 217, 218, 226, 227, 245, 247, 248
Engine run steady (Refer to common rail system check)	416, 421
Excessive White or Blue Smoke	71, 22, 23, 35
Excessive Black Smoke	34, 115, 217, 218, 226, 245, 247, 248
Lack of Power	24, 25, 28, 32, 34, 35, 42, 65,115, 118, 158, 159, 217, 218, 226, 245, 247, 248, 261, 262, 263, 264, 265, 266, 271, 272, 273, 274, 275, 276
Tachometer Output Error	14, 15

Hard Start Symptom

STEP	ACTION	VALUE	YES	NO
1	**DEFINITION:** Engine cranks, but does not start for a long time. Does eventually run, or may start but immediately stalls. Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to step 3
3	Was a visual/physical check performed?	—	Go to step 4	Go to Visual/Physical Check
4	Following below the DTCs stored: DTC 14, 15, 23, 118, 158, 159, 227, 22, 245	—	Go to applicable DTC table	Go to step 5
5	Check the fuel leakage on the high fuel pressure line. If the fuel leakage is found, repair as necessary. Was the fuel leakage found?	—	Verify repair	Go to step 6
6	1. Check for water-or alcohol-contaminated fuel. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to step 7
7	1. Check the battery voltage. 2. If a problem is found, repair as necessary Was a problem found?	—	Verify repair	Go to step 8
8	Check the Glow System. Was a problem found?	—	Verify repair	Go to step 9
9	1. Check for the following engine mechanical problems (Refer to Engine Mechanical): • Low compression • Leaking cylinder head gaskets • Worn or incorrect camshaft • Camshaft drive belt slipped or stripped 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to step 10
10	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech2 data • All electrical connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Contact Technical Assistance

Engine Stall

STEP	ACTION	VALUE	YES	NO
1	**DEFINITION:** Engine cranks, but does not start. Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Was battery within specification?	More than 8V	System OK	Go to step 3
3	Check charging circuit and/or generator condition. Were they operate properly?	—	Go to step 4	Repair/replace problem part
4	Following below the DTCs stored: DTC 35, 227, 158, 159, 118	—	Go to applicable DTC table	Go to step 5
5	Was fuel used within specification?	See owner's manual	Go to step 6	Replace fuel with recommend specification
6	Did you find to contamination of diesel with gasoline, etc?	—	Replace fuel	Go to step 7
7	Did you find any leakage on the fuel pump, injection pipe etc.?	—	Repair problem part	Go to step 8
8	Had you bleed air from fuel line?	—	Go to step 9	Bleed air from fuel line
9	Was the air filter full of debris or other contaminants?	—	Repair/replace problem part	Go to step 10
10	Was fuel pre filter restricted?	—	Go to step 11	Repair/replace problem part
11	Was gauze filter restricted? (The gauze filter is fixed in suction eye bolt on the supply pump)	—	Go to step 12	Clean gauze filter or replace it.
12	Was fuel main filter normal condition? (Clog breakage etc.)		System OK	Replace fuel filter element

Engine Hunting

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) system check" performed?	—	Go to step 2	Go to OBD System Check
2	Is engine oil used within specification viscosity?	See owner's manual	Go to step 3	Replace engine oil
3	Did you find dilution of engine oil?	—	Replace engine oil and repair cause of dilution.	Go to step 4
4	Is fuel used within recommendation specification?	See owner's manual	Go to setp 5	Replace fuel with recommend specification.
5	Did you find gasoline contaminated with fuel?	—	Replace fuel	Go to step 6
6	Did you find any breakage on the fuel pump, injection pipe etc.?	—	Repair/replace problem part.	Go to step 7
7	Are fuel filters (prefilter, gauze filter and fuel main filter) normal condition? (The gauze filter is fixed in suction eye bolt on the supply pump.)	—	Go to step 8	Clean/replace problem fuel filter
8	Is air filter normal condition?	—	Go to step 9	Repair/replace problem part
9	Did you done bleeding air from fuel line? Refer to bleeding fuel system on section 6C2 in this manual.	—	Go to step 10	Bleed air from fuel line
10	Following below the DTCs stored: DTC 25, 28, 115, 118, 151, 245, 15	—	Go to applicable DTC table	Go to step 11
11	Was the "PTO (Power Take Off) system" check performed?		Go to step 12	Go to PTO error check
12	Check injection balance each for cylinder. Was injection balance of the normal?	—	System OK	Go to step 13
13	Check activity flow damper and/or fuel pipe condition. Did you find any problem on the above part?	—	Replace problem part.	Replace supply pump assembly.

Surging, Hesitation

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) system check" performed?	—	Go to step 2	Go to OBD System Check
2	Is engine oil used within specified viscosity?	See owner's manual	Go to step 3	Replace engine oil
3	Is the engine oil diluted?	—	Replace engine oil and repair cause of dilution.	Go to step 4
4	Is correct fuel used?	See owner's manual	Go to step 5	Replace fuel with recommend specification
5	Is the fuel contaminated with gasoline?	—	Replace fuel	Go to step 6
6	Did you find any damage on the fuel pump, injection pipe etc.?	—	Repair/replace problem part.	Go to step 7
7	Are fuel filters (prefilter, gauze filter and fuel main filter) normal condition? (The gauze filter is fixed in suction eye bolt on the supply pump)	—	Go to step 8	Clean/replace problem fuel filter
8	Is air filter normal condition?	—	Go to step 9	Repair/replace problem part
9	Have you bleed air from fuel line?	—	Go to step 10	Bleed air from fuel line
10	Following below the DTCs stored: DTC 211, 23, 22, 14, 15	—	Go to applicable DTC table	Go to step 11
11	Was the "PTO (Power Take Off) system" check performed?		Go to step 12	Go to PTO error check
12	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech2 data (CKP, CMP signal) • All electrical connections within a suspected circuit and/or system. 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Contact Technical Assistance

High Idle Engine Speed/Engine Starts But Will Not Accelerate

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) system check" performed?	—	Go to step 2	Go to OBD System Check
2	Following below the DTCs stored: DTC 24, 35, 217, 218, 226, 227, 245, 247, 248	—	Go to applicable DTC table	Go to step 3
3	Following below the switch condition. • Brake Switch • Idle Control Switch • Clutch Switch (M/T) • Neutral Switch (A/T)	—	Repair or Replace Go to step 1	Go to step 4
4	Check accelerator pedal condition. Was a problem found?	—	Repair or Replace Go to step 1	Replace ECM

IMPORTANT:** **The replacement ECM must be restored the capture fuel rate data by Tech 2.
Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

Excessive White or Blue Smoke

STEP	ACTION	VALUE	YES	NO
1	Was engine oil used within specified viscosity?	See owner's manual	Go to step 2	Replace engine oil.
2	Was fuel used within recommended specification? **NOTE: Low cetane number fuel is used, may caused white smoke.**	See owner's manual	Go to step 3	Replace fuel with recommend specification
3	Has gasoline contaminated the fuel?	—	Replace fuel	Go to step 4
4	Bleed air from the fuel lines?	—	Go to step 5	Bleed air from fuel line
5	Following below the DTCs stored: DTC 22, 71, 22, 23, 35		Go to applicable DTC table	Go to step 6
6	Check the mechanical fuel injection timing. Was the problem found?	—	Repair to fuel injection timing	Go to step 7
7	Was "Check Injectors (engine running)" performed?	—	Go to step 8	Go to "Check Injectors (engine running)" Diagnosis chart
8	Was compression normal?	More than 2157 kPa (313 psi)	Go to step 9	Repair/replace problem portion (Piston ring, valve stem seal etc.)
9	Was oil entering down turbocharger oil seal? (Blue smoke)	—		Go to step 10
10	Was oil entering down piston ring? (Blue smoke)	—	Go to step 8	Go to step 11
11	Was oil entering down valve stem? (Blue smoke)	—	Replace oil seal	Go to step 1

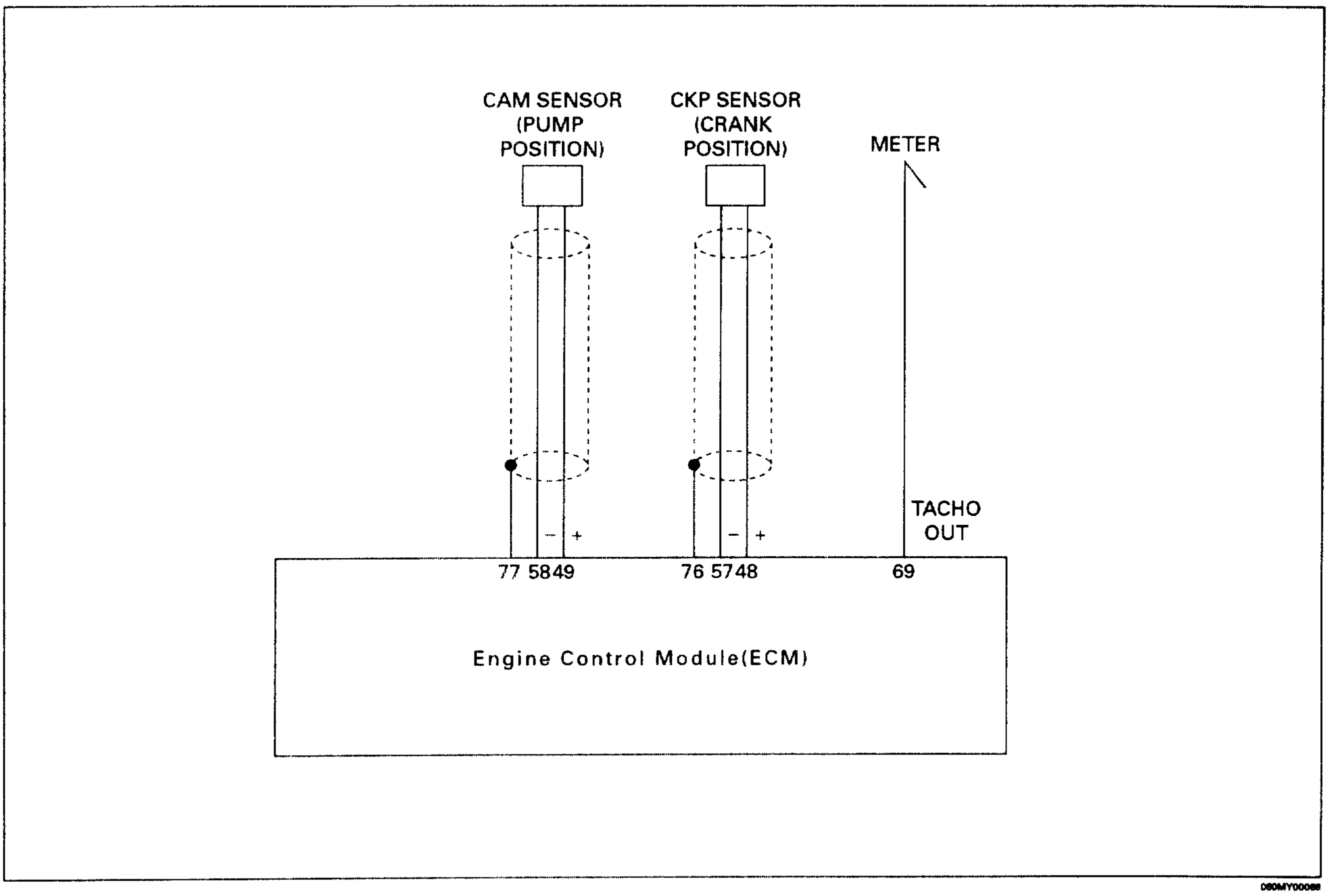
Excessive Black Smoke

STEP	ACTION	VALUE	YES	NO
1	Was engine oil used within specified viscosity?	See owner's manual	Go to step 2	Replace engine oil
2	Was fuel used within recommended specification?	See owner's manual	Go to step 3	Replace fuel with recommend specification
3	Following below the DTCs stored: DTC 34, 115, 217, 218, 226, 245, 247, 248	—	Go to applicable DTC table	Go to step4
4	Check the intake system. Was the problem found?	—	Repair/replace problem portion (Filter, Air duct, Pipe, Intercooler, etc.)	Go to step 5
5	Check the mechanical fuel injection timing. Was the problem found?	—	Repair to fuel injection timing	Go to step 6
6	Was compression normal?	More than 2157 kpa (313 psi)	Go to step 7	Repair/replace problem portion (Piston ring, value stem seal etc.)
7	Was there a restriction in the exhaust system? (Include exhaust brake system, option on M/T only)	—	Go to step 8	Repair/replace problem portion.
8	Did turbocharger operate properly?	—	Go to step 9	Repair/replace turbocharger
9	Was carbon build up on the tip of the injector?	—	Replace injector assembly	Go to step 10
10	Was there carbon build up or damage to piston or cylinder?	—	Repair/replace problem portion.	System OK

Lack of Power

STEP	ACTION	VALUE	YES	NO
1	**DEFINITION:** Engine delivers less than expected power. Little or no increase in speed when accelerator pedal is pushed down part-way. Was the "On-Board Diagnostic (OBD) System Check" performed ?		Go to step 2	Go to OBD System Check
2	Following below the DTCs stored: "Refer to "The possibility DTCs with symptom diagnosis".	—	Go to applicable DTC table	Go to step 3
3	1. Ignition "OFF". 2. Install Tech2. 3. Ignition "ON", engine is running. 4. Attempt to engine data with the Tech2. 5. Observe actual rail pressure on the engine data. 6. Check the value when the accelerator is opened slowly. If actual rail pressure didn't follow the desired rail pressure, replace a common pressure sensor. Did the actual rail pressure have a pressure reading above the specified value?	No Load More than 40 MPa Full Load More than 100 MPa	Go to step 4	Go to step 5
4	Replace the pressure limiter ASM. Was the action complete?	—	Go to step 5	—
5	Is oil level OK?	—	Go to step 6	Readjust oil level
6	Is engine oil used within specified viscosity?	—	Go to step 7	Replace engine oil
7	Check the below the filters: Air filter element Oil filter element Fuel filter element Fuel gauze filter (Supply pump)	—	Go to step 8	Clean or replace filter element
8	Is air intake system clogged?	—	Take out foreign material	Go to step 9
9	"Did you find any damage on the fuel pump," "injection pump, etc.?"	—	Repair or replace problem part	Go to step 10
10	Is exhaust brake system OK?	—	Repair or replace problem part	Go to step 11
11	Is PTO (Power Take Off) system OK?	—	Repair or replace problem part	Go to step12
12	Is engine static timing correct?	—	System OK	Readjust correct timing

TACHOMETER OUTPUT ERROR (No available DTC)



Circuit Description

When CKP sensor and CAM sensor instable (DTC not indicated), tachometer output becomes abnormal. If vehicle running performance is adversely affected, repair the abnormality first.

Unless CKP sensor and CAM sensor signal both normal, tachometer output not produced.

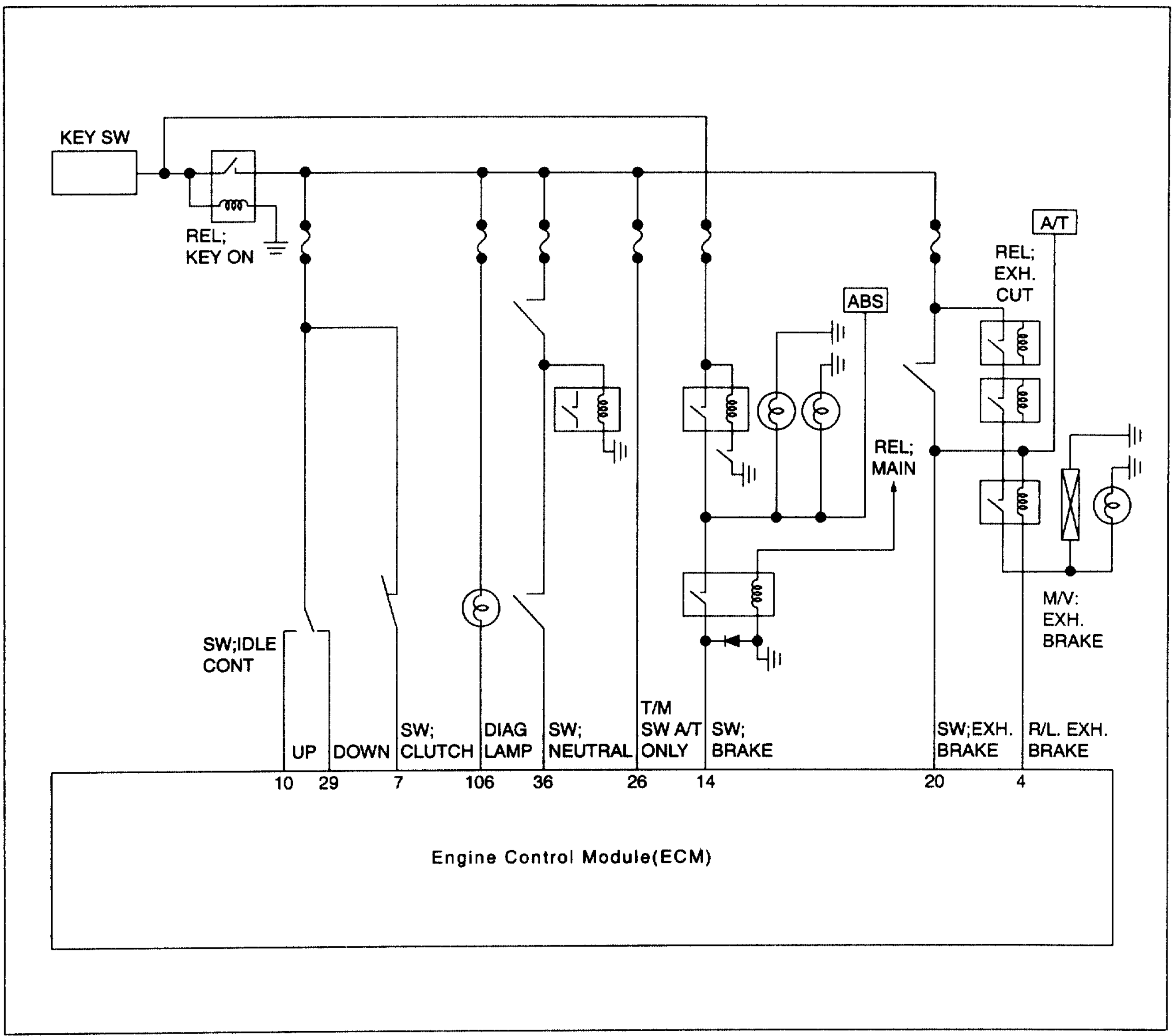
- ECM delivers shortwave of 17.5 pulse (0 – 5V) per a rotation to tachometer.
- Tachometer do not produce output at 230 rpm or less.
- If checking by voltage, digital multimeter reads around 2.5V under engine idling, and 5V or 0V for output abnormality.

Tachometer Output Error (No available DTC)

STEP	ACTION	VALUE	YES	NO
1	Did tachometer output error appear without CKP sensor error and CAM sensor error indication during engine in operation? Note: **When CKP sensor and CAM sensor instable (DTC not indicated), tachometer output become abnormal.** **If vehicle running performance adversely affected, repair the abnormality first.** **Unless CKP sensor and CAM sensor signal both normal, tachometer output is not produced.**	—	Go to step 2	• While engine running, CKP sensor NG: Indication abnormal. CAM sensor NG: can be indicated. • After key "OFF", it either CKP sensor or CAM sensor damaged, indication became abnormal.
2	Measure waveform between pin number 69 (TACH) and pin number 102 (ECM–GND) at ECM side. Did the pulse appear?	184Hz	Replace tachometer and/or repair tachometer wire harness.	Go to step 3
3	1. Disconnect connector tachometer side or intermediate connector. (Disconnect tachometer) 2. Measure waveform same as step 2. Did appear the pulse?	184Hz	System OK	Replace ECM
	Note: • **ECM delivers shortwave of 17.5 pulse (0 – 5V) per a rotation to tachometer.** • **Tachometer does not produce output at 230 rpm or less.** • **If checking by voltage, digital multimeter reads around 2.5V under engine idling, and 5V or 0V for output abnormality.**			

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

EXHAUST BRAKE ERROR (No DTC set)

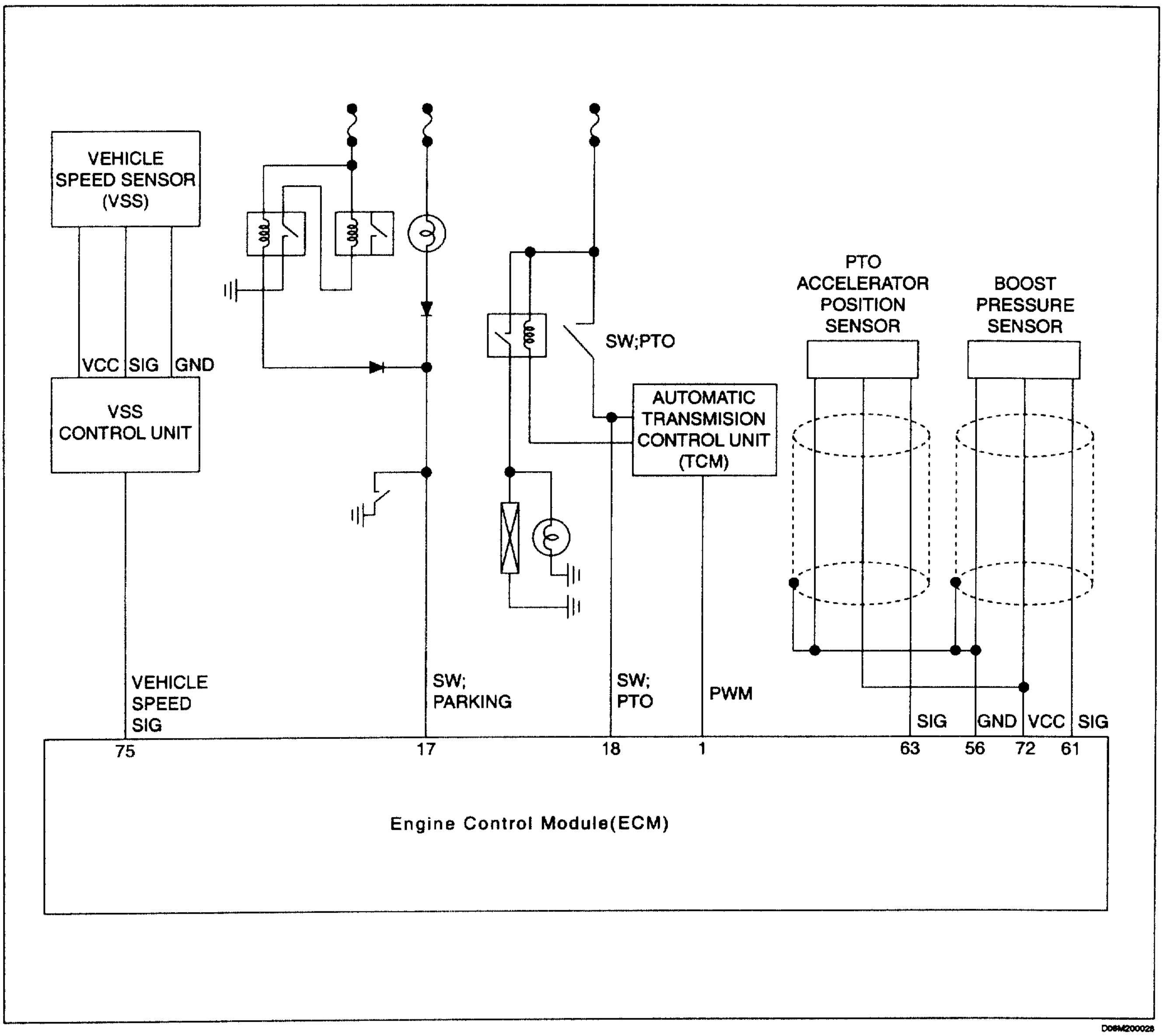


Exhaust Brake Error (No DTC set)

STEP	ACTION	VALUE	YES	NO
1	Did exhaust brake relay turn "ON" and turn "OFF"?	—	—	Go to step 2
2	Did you find DTC 0024?	—	Repair DTC 0024 first	Go to step 3
3	Measure voltage following points during acceleration "OFF" at ECM ACC1 or ECM ACC2. • Between pin number 41 (ACC1) and pin number 45 (ACC1-GND). • Between pin number 42 (ACC2) and pin number 46 (ACC2-GND). Was voltage within value?	Between 0.85 and 1.15V	Go to step 5	Go to step 4
4	Check Acceleration position pedal linkage lever condition and/or check sensor adjustment. Was a problem found?	—	Go to step 5	Repair/ readjustment
5	Measure voltage between pin number 20 (EXB/SW) and pin number 111 (GND) during key switch "ON", exhaust brake switch "ON" at ECM side connector. Was voltage within value?	12V	Go to step 6	Replace exhaust brake switch or repair wire harness.
6	Check the type for transmission. Is the manual transmission?	—	Go to step 7	Go to step 11
7	Measure voltage between pin number 7 (CL/SW) and pin number 111 (GND) during key switch "ON" and clutch pedal not depressed at ECM side connector. Was voltage within value?	12V	Go to step 8	Replace clutch switch or repair wire harness.
8	Check the exhaust brake relay circuit. • Between exhaust brake relay and ECM (pin number 4) • Between exhaust brake relay and exhaust brake switch • Between exhaust brake relay and exhaust brake magnetic valve • Between exhaust brake relay and battery (fuse) Was a problem found?		Replace Exh R/L Go to step 9	Repair wire harness.
9	Measure voltage between pin number 20 (EXB/SW) and pin number 111 (GND) during key switch "ON", exhaust brake switch "ON" at ECM side connector. Was voltage within value?	12V	Go to step 10	Replace exhaust brake switch or repair wire harness.
10	Install all parts and harness. Use scan tool test mode to check exhaust brake relay activation when key switch "ON" but engine does not run. Did trouble continue?	—	Replace ECM	System OK
11	Check the Automatic transmission system. Did trouble continue? Transmission Switch (ECM Pin Number 26), Exhaust Brake Cut Relay, Neutral Switch, etc.)	—	Repair/ Replace Automatic transmission system	Go to step 8

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

PTO (POWER TAKE OFF) ERROR (No DTC Set)

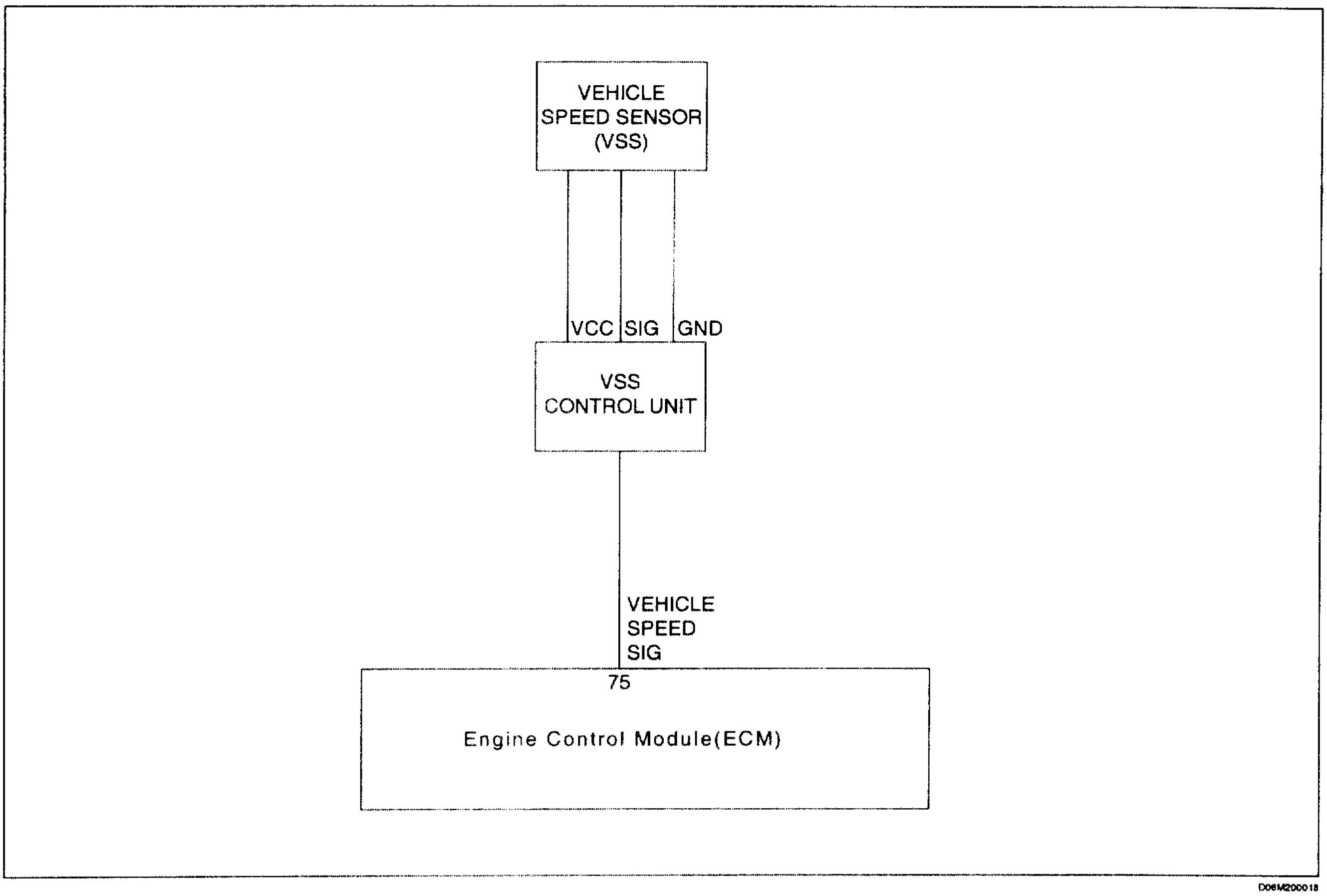


PTO (Power Take Off) Error (No DTC Set)

STEP	ACTION	VALUE	YES	NO
1	Did PTO relay turn "ON" and turn "OFF"?	—	—	Go to step 2
2	Did you find DTCs 0014, 0015, 0024, 0025, 0035, 0115, 0118, 0151, 0158, 0159, 0217, 0218, 0226, 0227, 0245, 0247, 0248, 271 to 276?	—	Repair DTCs table first	Go to step 3
3	Check the position for accelerator pedal. Is the idle position?	—	Go to step 4	—
4	Check the position for PTO accelerator. Is the idle position?	—	Go to step 5	—
5	Check the position for transmission gear position change lever. Change lever position is neutral?	—	Go to step 6	—
6	Measure voltage between pin number 18 (PTO/SW) and pin number 111 (GND) during key switch "ON" and PTO switch pressed at ECM side connector. Was voltage within value?	12V	Go to step 7	Replace PTO switch or repair wire harness.
7	Measure voltage between pin number 17 (PBK/SW) and pin number 111 (GND) during key switch "ON" and Parking brake lever pulled at ECM side connector. Was voltage within value?	12V	Go to step 8	Replace parking brake switch or repair wire harness.
8	Check the type for transmission. Is the manual transmission?	—	Go to step 9	Go to step 12
9	Check the PTO relay and PTO magnetic valve circuit. • Between PTO relay and battry(fuse) • Between PTO relay and PTO magnetic valve • Between PTO relay and TCM • Between magnetic valve and GND Was a problem found?	—	Go to step 10	Repair wire harness.
10	Check the PTO magnetic valve and PTO relay. Was a problem found?	—	Go step 11	Replace PTO magnetic valve and/or PTO relay
11	Install all parts and harness. Use scan tool test mode to check exhaust brake relay activation when key switch "ON" but engine does not run. Did trouble continue?	—	Replace ECM	System OK
12	Check the Automatic transmission system. Did trouble continue?	—	Repair/ Replace Automatic transmission system	Go to step 7

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

VEHICLE SPEED SENSOR ERROR (No DTC Set)



Vehicle Speed Sensor Error (No DTC Set)

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System check
2	PTO mode is canceled. Was the action complete?	—	Go to step 3	—
3	Check the DTC stored. 1. Ignition "OFF". 2. Install the scan tool. 3. Ignition "ON". Was DTC P0025 displayed?	—	Go to DTC table	Go to step 4
4	Following below the switch condition. (When the switch applicable to the item currently displayed is operated with reference to the item of each switch currently displayed on the scan tool (inside of engine data), it checks whether an operation display (OFF /ON) of each switch switches.) • Parking brake switch and circuit • Neutral switch and circuit (Automatic transmission) • Clutch switch and circuit (Manual transmission) Was a problem found?	—	Repair/Replace switch or circuit	Go to step 5 (Automatic transmission) Go to step 6 (Manual transmission)
5	Check the transmission switch circuit. Check the various harness whether an open or short. Between GND and ECM. Was a circuit normal?	—	Go to step 6	Repair/Replace circuit
6	Check the VS Sensor circuit. 1. Starter switch "OFF". 2. Disconnect the harness from ECM. 3. Disconnect the harness from the VS Sensor control unit. 4. Disconnect the harness from VS Sensor.	—	Go to step 7	—
7	Check the various harness whether an open or short. Between VS Sensor control unit and VS Sensor. Between ECM and VS Sensor control unit. Was a circuit normal?	—	Go to step 9	Go to step 8
8	Repair the VS Sensor circuit. Was the action complete?	—	Go to step 9	—
9	Check the VS Sensor and VS Sensor control unit with the scan tool. 1. Connect the harness. 2. Connect the scan tool. 3. Engine start. 4. Test run is performed. 5. Check the "Vehicle Speed" by the date list of scan tool. Is "Vehicle Speed" show normal value?"	—	Verify repair	Go to step 10
10	Check the circuit of VS Sensor control unit. Was a circuit normal? Was the VS Sensor control unit normal?	—	Go to step 12	Go to step 11
11	Replace the speed sensor control unit. Was the action complete?	—	Go to step 13	—

Vehicle Speed Sensor Error (No DTC Set) (Cont.)

STEP	ACTION	VALUE	YES	NO
12	Replace the speed sensor. Was the action complete?	—	Go to step 13	—
13	Check the VS Sensor and VS Sensor control unit with the scan tool. 1. Connect the harness. 2. Connect the scan tool. 3. Engine start. 4. Test run is performed. 5. Check the "Vehicle Speed" by the date list of scan tool. Is "Vehicle Speed" show normal value?	—	Verify repair	Go to step 14
14	Replace the ECM. Was the action complete?	—	Verify repair	—

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

COMMON RAIL SYSTEM DIAGNOSTIC CHECK

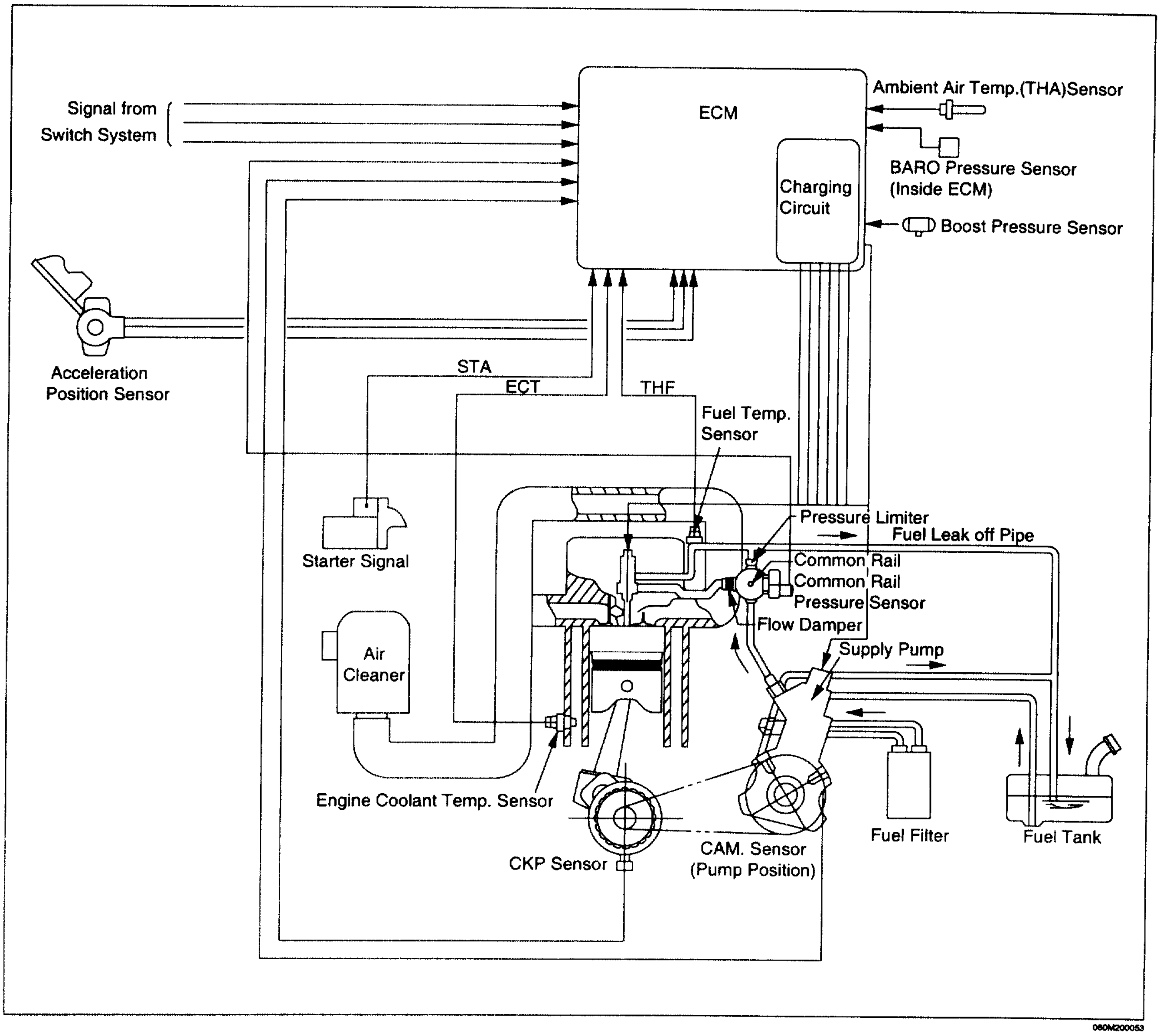
Caution taken in inspecting

(1) In inspecting the OBD system, write down self-diagnosis code to be indicated. (especially, when multiple self-diagnosis codes are indicated.)

(2) Before eliminating the indicated self-diagnosis codes by a memory clear switch, doubly inspect abnormal places as indicated in self-diagnosis code.
(Self-diagnosis code means 'Warning.' Make sure to inspect abnormal section.)

System check diagnostic charts	Possible Conditions
OBD System check	DTC261 to 266, (226, 227), 35, Scan tool (Air bleed, Flow damper, Common rail)
No MIL	Power supply, Ground, Lamp, ECM
MIL will not flash	Power supply, Ground, Lamp, ECM
Engine will not start	DTC 417 (Starter SW), 158, 159 (Injector)
Check fuel injection and Timing relation (Engine OFF)	DTC 14, 15 (CKP, CAM sensor)
Check supply pump (Engine OFF)	DTC 421, 217, 218, 247, 248 (PCV)
Check injector (Engine OFF)	DTC 271 to 276, 158, 159 (Injector)
Check fuel pressure in common rail (Engine OFF)	DTC 115, 245, Supply pump
System operation check	Air cleaner, Engine oil, Idle control SW
Check fuel injection and Timing relation (Engine running)	DTC 14, 15 (CKP, CAM sensor)
Check supply pump (Engine running)	DTC 421, 217, 218, 247, 248, 226, 227 (PCV, Relay)
Check fuel pressure in common rail (Engine running)	DTC 118, 151 (24), 115, 245 (Common rail, PC)
Check injector [Flow damper/Fuel leak] (Engine running)	DTC 271 to 276, 158, 159 (Injector)
Check fuel system	DTC 226, 227, 118, 151 (Common rail, Fuel line)
Multiple DTCs stored	Common ground, Common power supply

OBD SYSTEM CHECK DIAGNOSIS CHART



Circuit Description

The Common rail system comprises fuel pump, pump control valve (PCV), common rail, two way valve (TWV), injection, flow dumper, pressure limiter, common rail pressure sensor, CAM sensor (Pump Positin), crank position sensor (CKP sensor) and etc.

This system will be clean emission. Because it make high presser fuel.

The fuel press at the fuel pump is send the common rail. PCV is regulated pressure in common rail.

The flow dumper will absorb pressure change in common rail. When Common rail pressure will be maximum, the pressure limiter will open.

Injector is inject fuel into a combustion chamber. And Fuel injection is controlled TWV. This timing is regulated ECM at CAM and CKP sensor.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed – through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

OBD System Check Diagnosis Chart

Test Description

1. This is ECM check. Check warning lamp. When the lamp turn on keeping, it is series trouble.
2. This is self diagnosis of ECM. Connect diagnosis switch (White).
5. Engine idling will fined condition of the common rail system.
7. This check is Tech2 and ECM. Ignore engine date in this check.
9. ECM system error (DTC35) don't detect other DTCs.

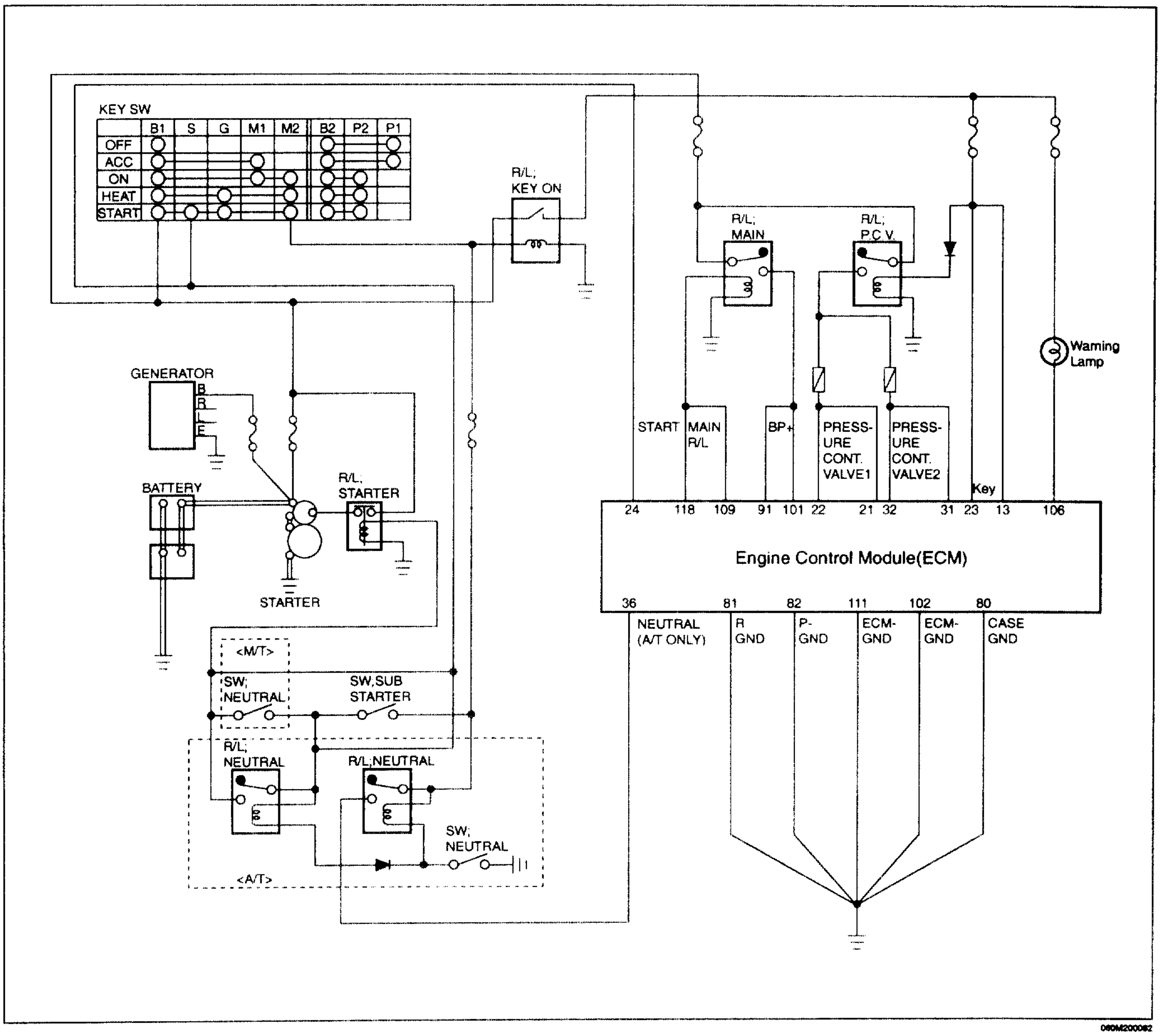
STEP	ACTION	VALUE	YES	NO
1	1. Ignition "OFF". 2. Ignition "ON", engine "OFF". 3. Check MIL lamp "ON" Did the MIL lamp stay "ON" for five seconds, then turn "OFF"?	5 sec.	Go to step 2	Go to "No MIL" Diagnosis chart
2	Connect the Diagnostic switch. Did the MIL flash?	—	Go to step 3	Go to "Will Not Flash" Diagnosis chart
3	Ignition "ON",engine "ON" Did the engine start and run?	—	Go to step 4	Go to "Engine will not start" Diagnosis chart
4	Engine "ON" Was "Check system operation check" performed?	—	Go to step 5	Go to "System operation check" Diagnosis chart
5	Was "Check the fuel system check" performed?	—	Go to step 6	Go to "Check the Fuel system" Diagnosis chart
6	1. Ignition "OFF". 2. Connect the scan tool. 3. Ignition "ON". Was the power supply "ON" and engine data indicated on the Scan tool ?	—	Go to step 7	Go to step 11
7	Check engine data at the scan tool data. Did the engine data normally?	—	Verify repair Go to step 8	Go to step 10
8	Check DTCs stored and record. If DTC "35" was stored, replace ECM as necessary. Was the ECM replaced?	—	Verify repair Go to step 1	Go to step 9
9	1. Engine "ON" 2. Check DTCs stored and record . Was DTC stored?	—	More 2 stored: Go to "Multiple DTCs stored" One stored: Go to "Applicable DTC table"	System OK

OBD System Check Diagnosis Chart (Cont.)

STEP	ACTION	VALUE	YES	NO
10	1. Probe applicable parts for an open to ground and short to voltage 2. Probe a sensor simple substance. If a problem was found, repair as necessary. Did the problem found ?	—	Verify repair Go to step 6	Intermittent Problem, Verify "Customer problem analysis check" Go to step 6
11	Probe DLC circuit for an open or close to ground and short to voltage. If a problem was found, repair as necessary. Did the problem found ?	—	Verify repair Go to step 6	Go to step 12
12	1. Check the program on the scan tool. 2. Check the scan tool. If a ploblem was found, repair or replace as necessary. Was a problem found ?	—	Verify repair Go to step 6	Go to step 13
13	Replace ECM.	—	Go to step 6	—

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2.
Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

NO MIL DIAGNOSIS CHART



Circuit Description

The Common rail system comprises fuel pump, pump control valve (PCV), common rail, two way valve (TWV), injection, flow dumper, pressure limiter, common rail pressure sensor, CAM sensor (Pump Position), crank position sensor (CKP sensor) and etc.

This system will be clean emission. Because it make high presser fuel.

The fuel press at the fuel pump is send the common rail. PCV is regulated pressure in common rail.

The flow dumper will absorb pressure change in common rail. When Common rail pressure will be maximum, the pressure limiter will open.

Injector is inject fuel into a combustion chamber. And Fuel injection is controlled TWV. This timing is regulated ECM at CAM and CKP sensor.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed – through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

No MIL Diagnosis Chart

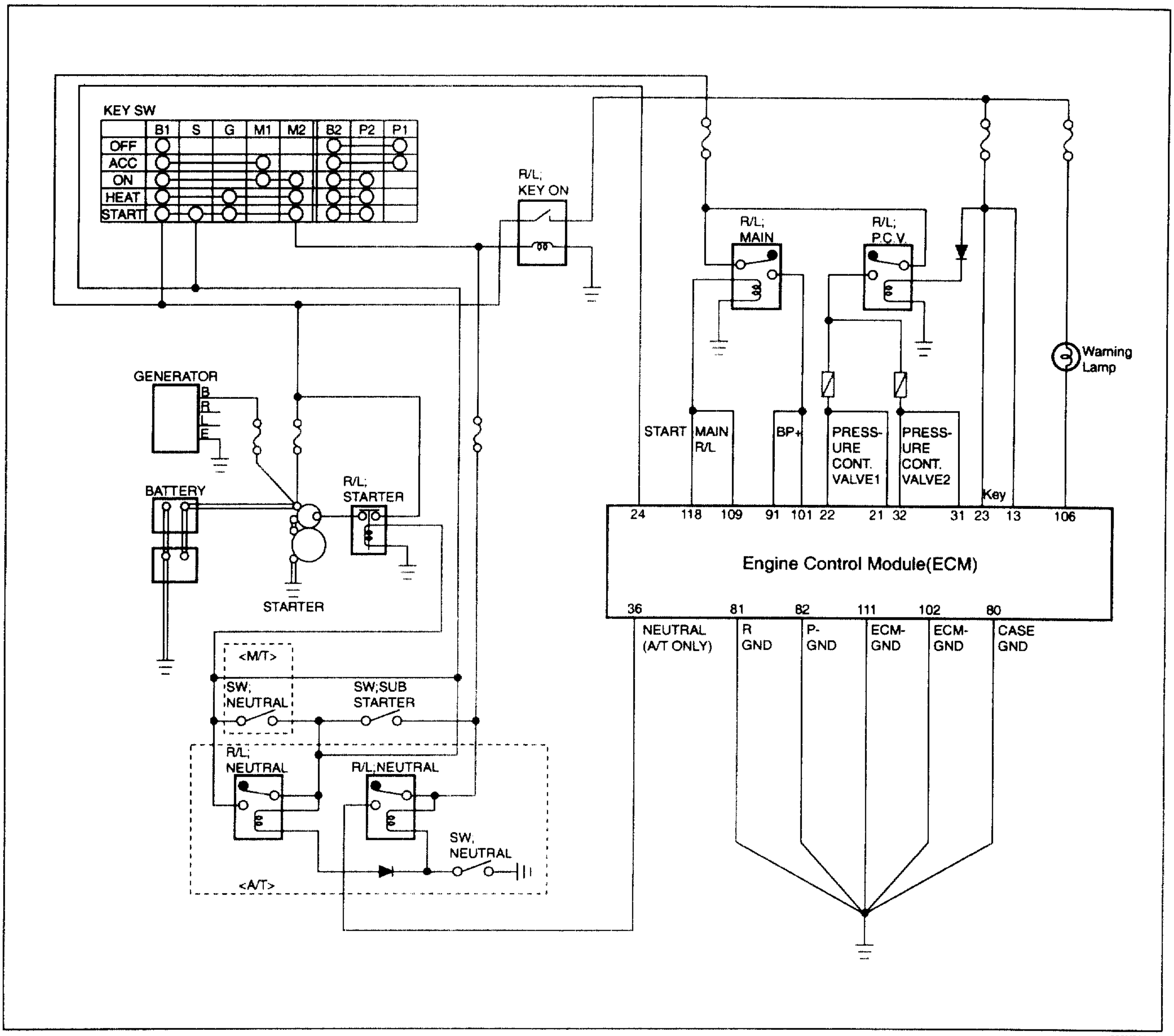
STEP	ACTION	VALUE	YES	NO
1	Was the MIL "OFF" steady?	—	Go to step 2	—
2	1. Ignition "ON", engine "OFF". 2. Check following fuses. (Main, PCV, Warning lamp, meter) If a problem was found, replace the fuse. Was a problem found ?	—	Verify repair	Go to step 3
3	1. Ignition "OFF". 2. Disconnect following fuses. (Main, PCV, Warning lamp, meter) 3. Probe circuits for an open or short. If a problem was found, repair as necessary. Was a problem found ?	—	Verify repair Go to "OBD system check" Diagnosis chart	Go to step 4
4	Check power supply circuit at fuses. If a problem was found, repair as necessary. Was a problem found ?	—	Go to "OBD system check" Diagnosis chart	Go to step 5
5	1. Ignition "ON" . 2. Check voltage at fuse. If a problem was found, repair as necessary. Was a problem found ?	—	Go to "OBD system check" Diagnosis chart Verify repair	Go to step 6
6	1. Ignition "OFF". 2. Check main relay. If a problem was found, replace a relay. Was a problem found ?	—	Verify repair Go to "OBD system check" Diagnosis chart	Go to step 7
7	1. Ignition "OFF". 2. Disconnect main relay. 3. Disconnect following fuses. • Main, PCV, Warning lamp, meter 4. Probe flowing point for an open to ground and short to voltage. • Between fuse and main relay • Between main relay and ECU If a problem was found, repair as necessary. Was a problem found?	—	Verify repair Go to "OBD system check" Diagnosis chart	Go to step 8
8	Check ground circuit. Probe following ground circuit. • ECM case • Power supply for the ECM If a problem was found, repair as necessary. Was a problem found ?	—	Verify repair Go to "OBD system check" Diagnosis chart	Go to step 9
9	Check a bulb for Warning lamp. If a problem was found, replace a bulb. Was a problem found ?	—	Verify repair Go to "OBD system check" Diagnosis chart	Go to step 10
10	1. Probe for an open or short between meter and ECM." If a problem was found, repair as necessary Was a problem found ?	—	Verify repair Go to "OBD system check" Diagnosis chart	Go to step 11

No MIL Diagnosis Chart (Cont.)

STEP	ACTION	VALUE	YES	NO
11	1. Probe for an open or short between meter and fuse. If a problem was found, replace ECM. Was a problem replace the ECM ?	—	Verify repair Go to "OBD system check" Diagnosis chart	Go to step 12
12	1. Ignition "ON", engine "OFF". 2. Check warning lamp "ON". Was the MIL "ON" for five seconds, then time "OFF"?	—	Verify repair Go to "OBD system check" Diagnosis chart	Go to step 13
13	1. Ignition "OFF" 2. Repair or replace meter assembly. Was the meter repaired/replaced?	—	Verify repair Go to "OBD system check" Diagnosis chart	—

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

MIL WILL NOT FLASH DIAGNOSIS CHART



Circuit Description

It comprises diagnosis switch, ECM, fuses, relays, bulb, battery and etc.

There is Warning lamp on the instrument panel. Diagnosis switch prepare under side of the passenger sheet.

This is check, when self diagnosis isn't operation.

Diagnosis switch connect. If the warning lamp isn't turned on, Excite this checking circuit.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed–through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Test Description

1 This is lamp check. When ground circuit was abnormal, it isn't flashing.

3 This check is meter circuit .

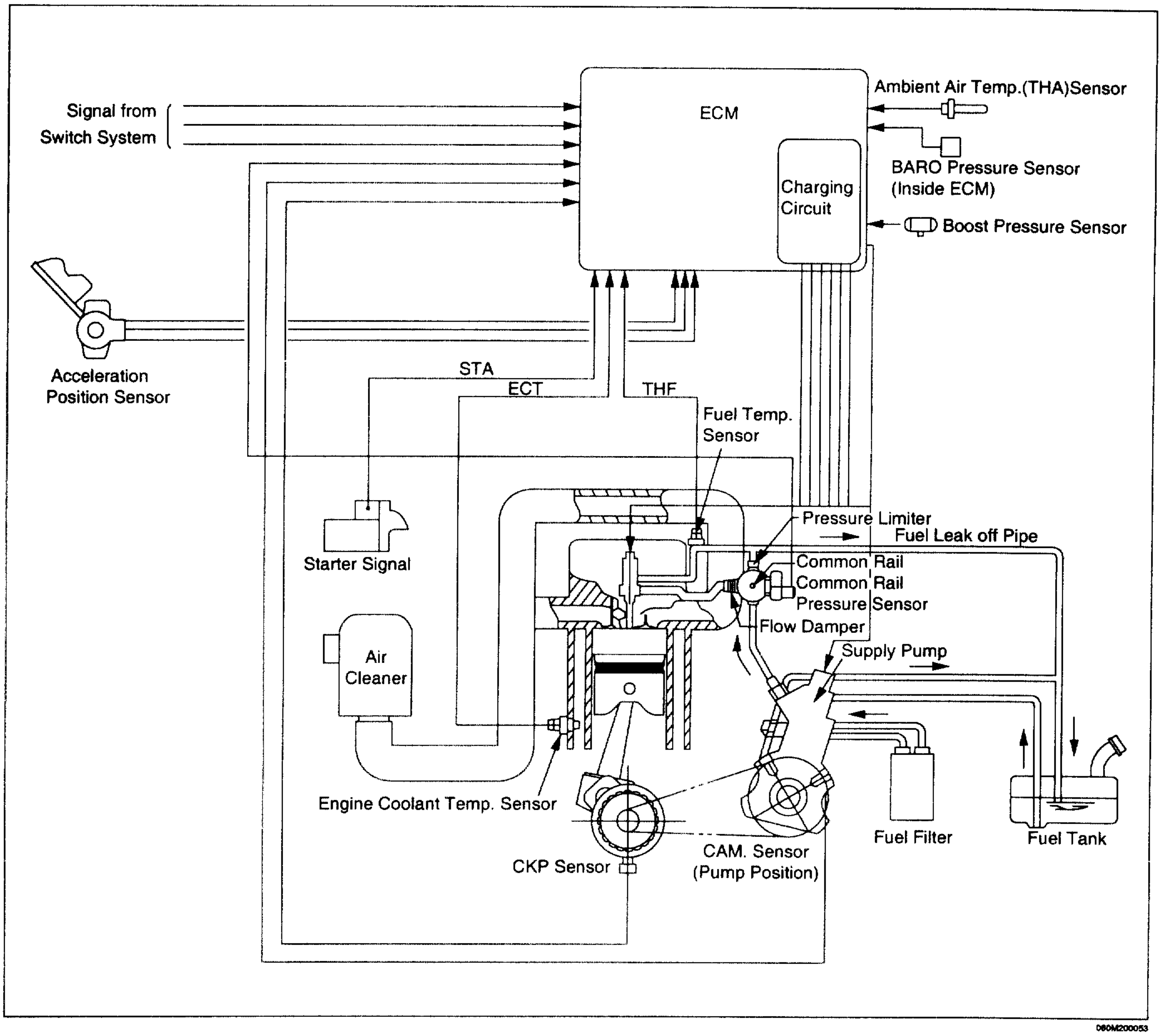
5 This is ground check. Probe any circuits.

MIL Will Not Flash Diagnosis Chart

STEP	ACTION	VALUE	YES	NO
1	1. Diag switch "OFF". 2. Ignition "ON". 3. Check MIL. Is MIL "ON" for 5 seconds, then turn "OFF"?	5 sec.	Go to OBD System check	Go to step 2
2	1. Ignition "OFF". 2. Disconnect ECM. 3. Probe lamp circuit between lamp and ECM for an open or short. If a problem was found, repair as necessary. Was a problem found ?	—	Verify repair Go to OBD System check	Go to step 3
3	1. Ignition "ON". 2. If NO lamp, repair meter and fuse. If a problem was found, repair as necessary. Was a problem found?	—	Verify repair Go to OBD System check	Go to step 4
4	1. Ignition "OFF". 2. Connect ECM. 3. Ignition "ON". 4. Diag switch "ON". 5. Check to see if MIL lamp is flashing. Is the MIL lamp flashing?	—	Go to step 5	Go to step 7
5	1. Ignition "OFF". 2. Check following circuit for open or short. • Between ECU and diag switch • Between diag switch and GND If a problem was found, repair diag switch circuit. Was a problem found?	—	Verify repair Go to OBD System check	Go to step 6
6	1. Ignition "ON". 2. Diag switch "ON". 3. Check to see if MIL lamp is flashing. Is the MIL lamp flashing?	—	Replace ECM Verify repair Go to OBD System check	Go to step 7
7	1. Check DTCs Was a DTC displayed?	—	Go to specific DTC Diagnosis chart	Go to OBD System check

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

ENGINE WILL NOT START DIAGNOSIS CHART



Circuit Description

Fuel system comprises fuel, fuel filter, starter switch, injectors, supply pump, sensors, ECM and etc.

There are any causes. It is fuel quality, fuel filter, and other. Refer to any section.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed–through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

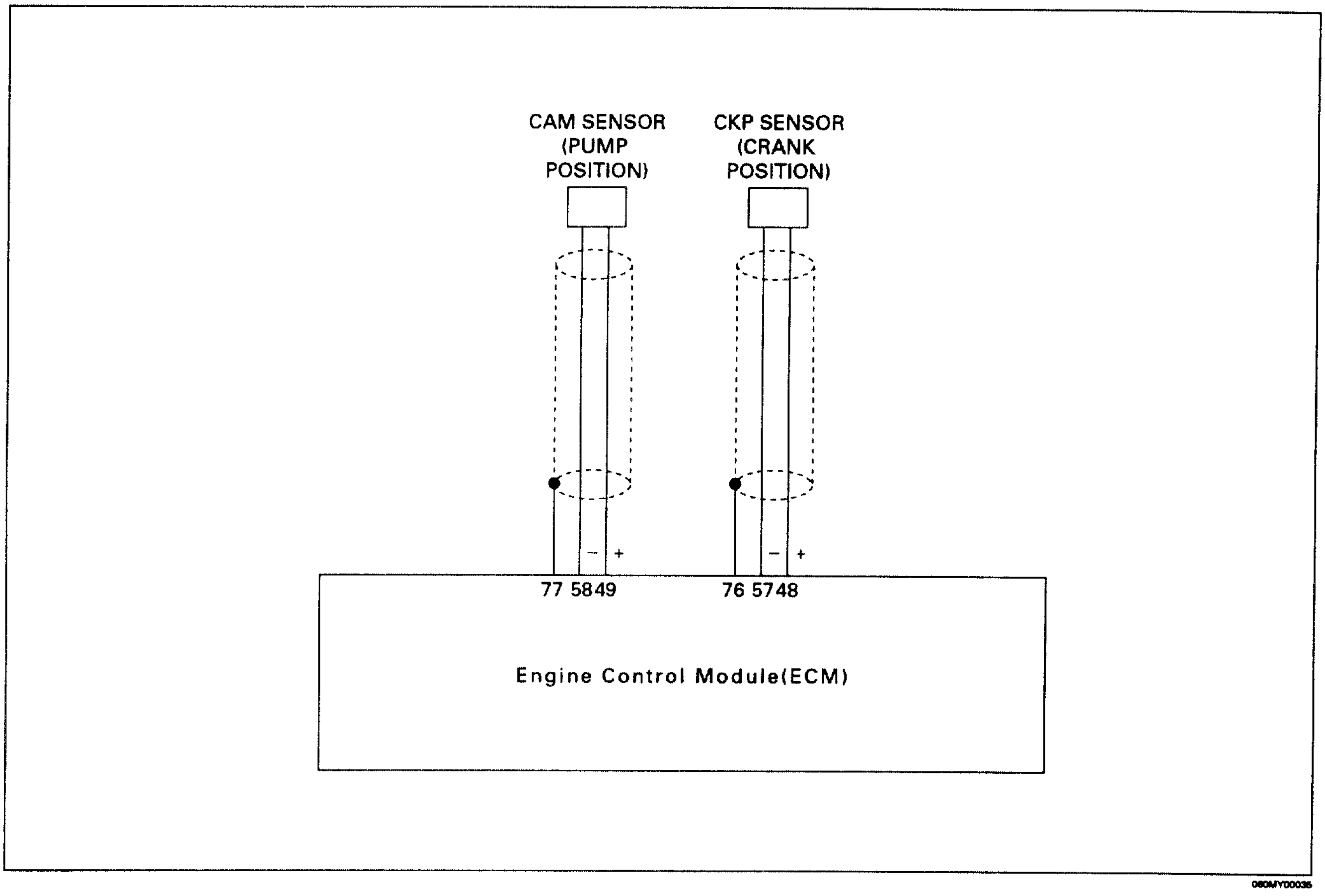
Test Description

5. Check the fuel injection timing relations.
6. Check the supply pump.
7. Check the Injectors.
8. Check the fuel pressure.

Engine Will Not Start Diagnosis Chart

STEP	ACTION	VALUE	YES	NO
1	1. Check vehicle condition. 2. Chack quantity of fuel in fuel tank. If the fuel is low in the fuel tank, add the fuel in the tank. Was a problem found?	—	Verify repair Go to OBD System check	Go to step 2
2	1. Check for water or - contaminated fuel. 2. If a problem is found, repair as necessary. Was a problem found ?	—	Verify repair Go to OBD System check	Go to step 3
3	Check the fuel filter. If a problem was found, repair as necessary. Was a problem found ?	—	Verify repair Go to OBD System check	Go to step 4
4	1. Perform air bleed. Bleed air from fuel system. 2. Ignition "ON", engine "ON". Did the engine start and run?	—	Verify repair Go to OBD System check	Go to step 5
5	Was the "Fuel injection and timing relation (engine off)" check performed?	—	Go to step 6	Go to "Fuel Injection and Timing Relation (engine off)" Diagnosis chart
6	Was the "Check supply pump (engine off)" check performed?	—	Go to step 7	Go to "Check supply pump (engine off)" Diagnosis chart
7	Was the "Check Injectors (engine off)" check performed?	—	Go to step 8	Go to "Check Injectors (engine off)" Diagnosis chart
8	Was the "Check the fuel pressure in common rail (engine off)" check performed?	—	Go to step 9	Go to "Check the fuel pressure (engine off)" Diagnosis chart
9	Refer to Engine Mechanical Diagnosis to diagnose the following conditions: • Faulty or incorrect camshaft drive gears • Leaking or sticky valves or rings • Excessive valve deposits • Weak valve springs • Incorrect valve timing • Leaking head gasket Was a problem found?	—	Verify repair Go to OBD System check	Go to step 4

CHECK FUEL INJECTION AND TIMING RELATION (ENGINE OFF) DIAGNOSIS CHART



Circuit Description

It comprises crank position sensor (CKP sensor), Pump position sensor (CAM position), supply pump, ECM and etc. CKP sensor is sensing speed of engine crank. CAM sensor is sensing speed of 3-rob cam. It send each of signal to ECM.

An engine don't start sometimes. One of causes, there is this trouble. Injection timing is serious.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed–through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Test Description

1 Check fuel injection timing. There are two timing marks. One is marked on the crank case, another one is marked coupling at the supply pump. If timing mark don't adjust, injection timing will be shift.

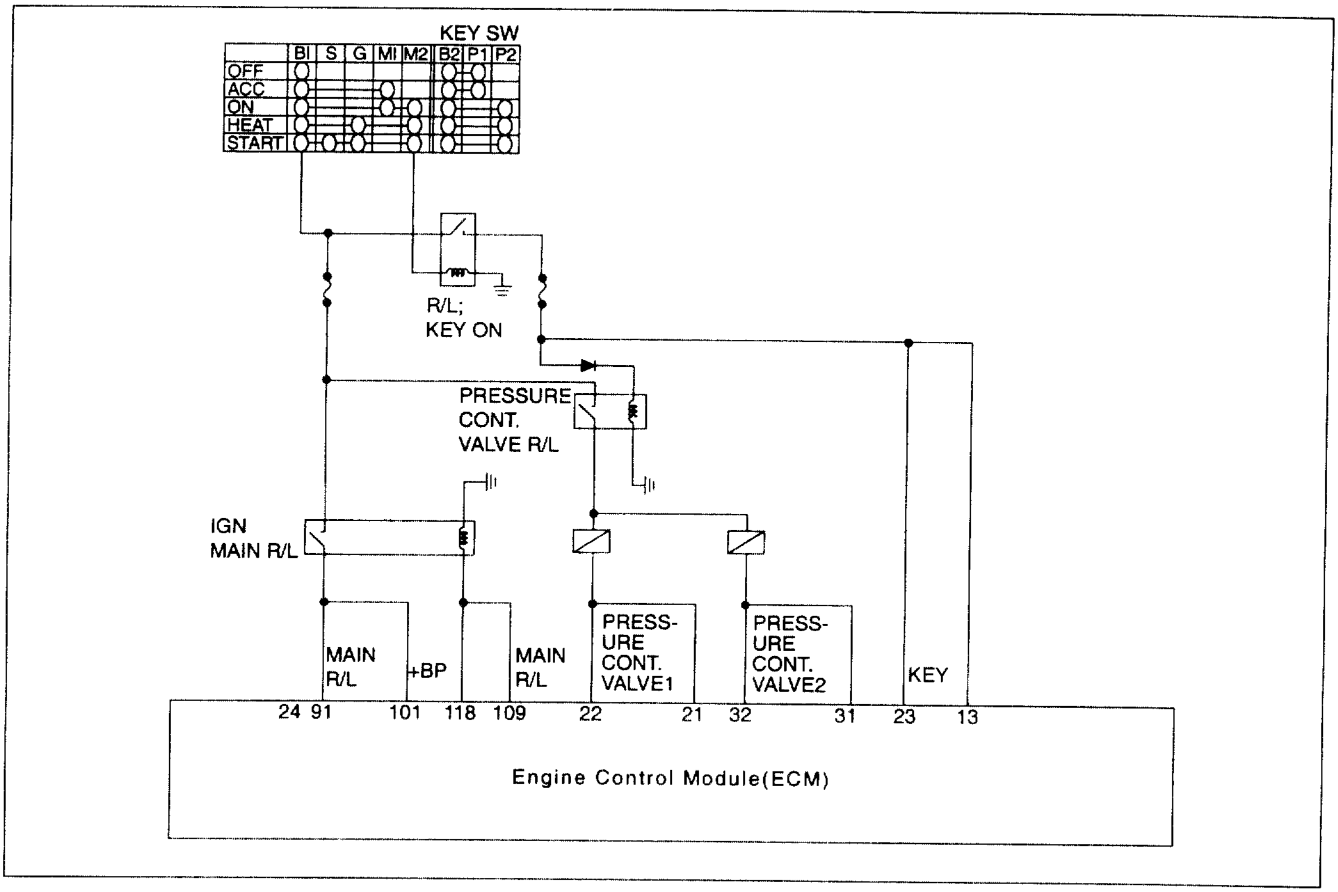
2 It is possibility the sensor don't take a voltage and the engine won't run.

3 It is possibility the sensor is broken.

Check Fuel Injection And Timing Relation (Engine OFF) Diagnosis Chart

STEP	ACTION	VALUE	YES	NO
1	Check fuel injection timing. Refer to the timing mark in 6A and 6B sections. If timing was in correct adjust as necessary. Was a problem found?	—	Verify repair Go to OBD System check	Go to step 2
2	Check the installation condition for CKP sensor and CAM sensor. If the installation condition of the sensors is abnormal, repair as necessary. Was a problem found?	—	Verify repair Go to OBD System check	Go to step 3
3	Check the CKP sensor and CAM sensor performance. Probe resistance between the terminal of the sensor and the other terminal. If a problem was found, repair as necessary. Was a problem found? **NOTE:When CAM-Sensor Is replaced, the supply pump assembly must be replaced.**	CKP sensor 109 – 143Ω (about 20°C) CAM sensor 1850 – 2450Ω (about 20°C)	Verify repair Go to OBD System check	Go to step 4
4	Check the sensor resistance. Probe resistance between each of the terminals of the sensor and the sensor body. If a problem was found, repair as necessary. Was a problem found? **NOTE:When CAM-Sensor Is replaced, the supply pump assembly must be replaced.**	∞ Ω	Verify repair Go to OBD System check	Go to step 5
5	1. Disconnect the harness from ECM. 2. Probe the circuit between ECM and the sensor for an open or short. If a problem was found, repair as necessary. Was a problem found?	—	Verify repair Go to OBD System check	Go to step 6
6	Ignition "ON", engine "ON" Did the engine start and run?	—	Verify repair Go to OBD System check	Return to "Engine Will Not Start" Diagnosis chart

CHECK SUPPLY PUMP (ENGINE OFF) DIAGNOSIS CHART



Circuit Description

It comprises fuses, relays, supply pump, goesfilter and etc. Goesfilter is fuel filter.

It conform supply pump operating. When it broke, fuel don't supply at injectors. According to engine won't start.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed–through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Test Description

10 This check is mechanical check.

11 PCV1 harness and PCV2 harness don't connect conversely. Because injection timing different PCV1 and PCV2.

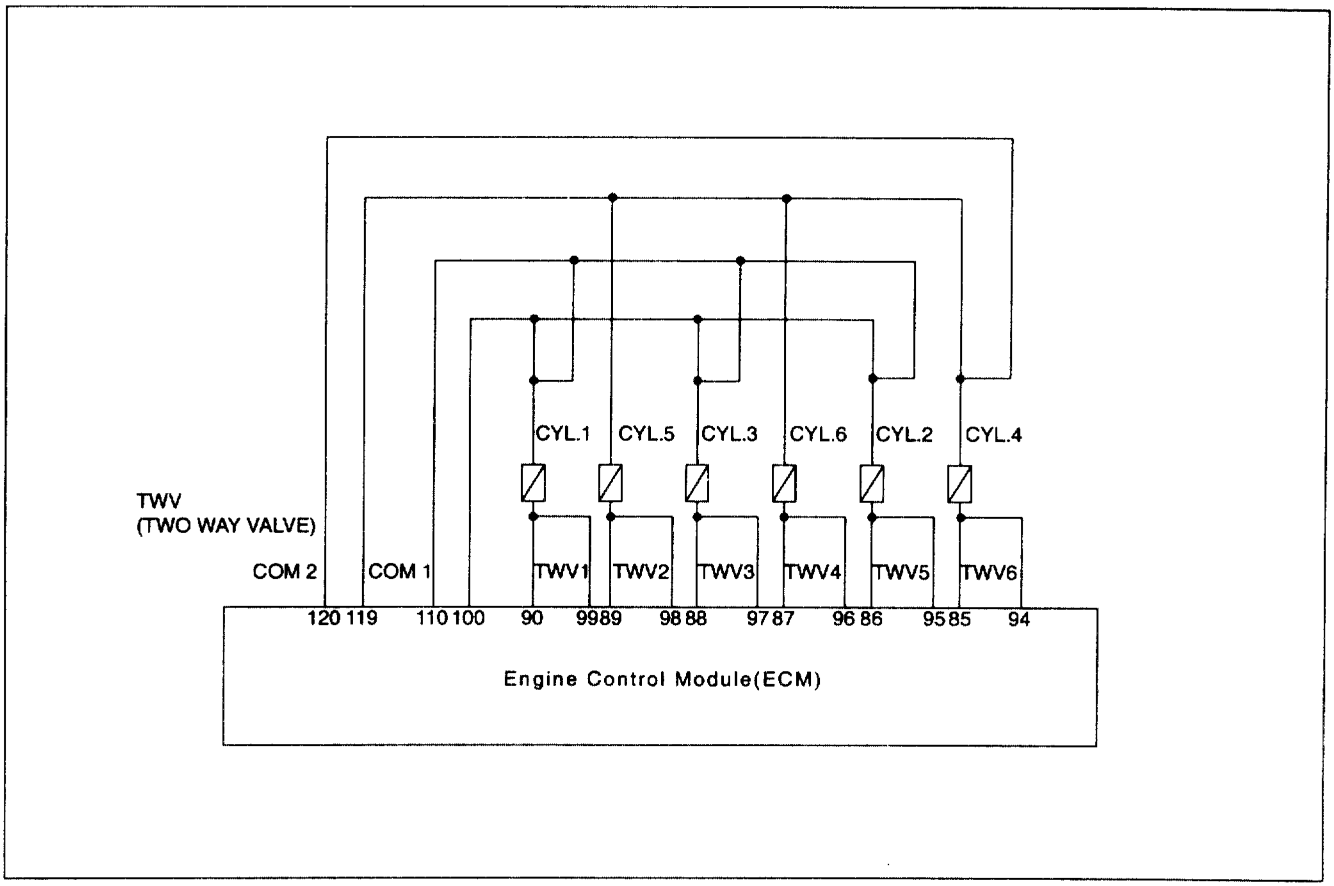
Check Supply Pump (Engine OFF) Diagnosis Chart

STEP	ACTION	VALUE	YES	NO
1	Check following fuses. • Main, PCV fuses If a blown fuse was found, replace as necessary. Was a problem found ?	—	Verify repair Go to OBD System check	Go to step 2
2	1. Disconnect following fuses and relays. • Main, PCV fuses 2. Probe the power supply circuit for an open or short. • Main, PCV circuit If a problem was found, repair as necessary. Was a problem found ?	—	Verify repair Go to OBD System check	Go to step 3
3	Probe a circuit between the relays and fuses for an open or short. If a problem was found, repair as necessary. Was a problem found ?	—	Verify repair Go to OBD System check	Go to step 4
4	Check the pump relays. • Main, PCV relays If a problem was found, replace as necessary. Was a problem found ?	—	Verify repair Go to OBD System check	Go to step 5
5	Probe a circuit between the pump relay and PCV for an open to ground and short to voltage. If a problem was found, repair as necessary. Was a problem found ?	—	Verify repair Go to OBD System check	Go to step 6
6	1. Disconnect the harness from ECM. 2. Probe a circuit between ECM and PCV for an open or short. If a problem was found, repair as necessary. Was a problem found ?	—	Verify repair Go to OBD System check	Go to step 7
7	Probe resistance between the terminal of the PCV and the other terminal. If a problem was found, replace the supply pump ASM. Was a problem found ?	0.9 – 1.3Ω	Verify repair Go to OBD System check	Go to step 8
8	Probe resistance between the each terminals of the PCV and the supply pump body. If a problem was found, replace the supply pump assembly. Was a problem found ?	∞ Ω	Verify repair Go to OBD System check	Go to step 9
9	1. Check the supply pump. 2. Be worked the priming pump and the check following points. • A different working noise from the pump • Raised fuel to the fuel filter • Working (smoothly of the priming pump) If a problem was found, replace the supply pump assembly. Was a problem found ?	—	Verify repair Go to OBD System check	Go to step 10
10	1. Remove the pipe between the fuel filter and the supply pump. 2. Check the gauze filter If a problem was found, clean up the filter. Was a problem found ?	—	Verify repair Go to OBD System check	Go to step 11

Check Supply Pump (Engine OFF) Diagnosis Chart (Cont.)

STEP	ACTION	VALUE	YES	NO
11	1. Reconnect all pump harness connectors. 2. Check for proper connection. Make sure not to switch the connectors between PCV1 and PCV2. If a problem was found, wake proper connections. Was a problem found ?	—	Verify repair Go to OBD System check	Go to step 12
12	1. Perform air bleeding procedure from fuel system. 2. Ignition "ON", engine "ON". Did the engine start and run?	—	Verify repair Go to OBD System check	Go to "Engine Will Not Start and Run" Diagnosis chart

CHECK INJECTOR (ENGINE OFF) DIAGNOSIS CHART



D06M200013

Circuit Description

It comprises circuit of injector, injector, ECM and etc.

There are two way valves (TWV) in injector. TWVs control fuel supply at injectors.

That possibility is high. The circuit is broken. And It is careful, if air be mixed fuel, you can bleed air.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed–through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Test Description

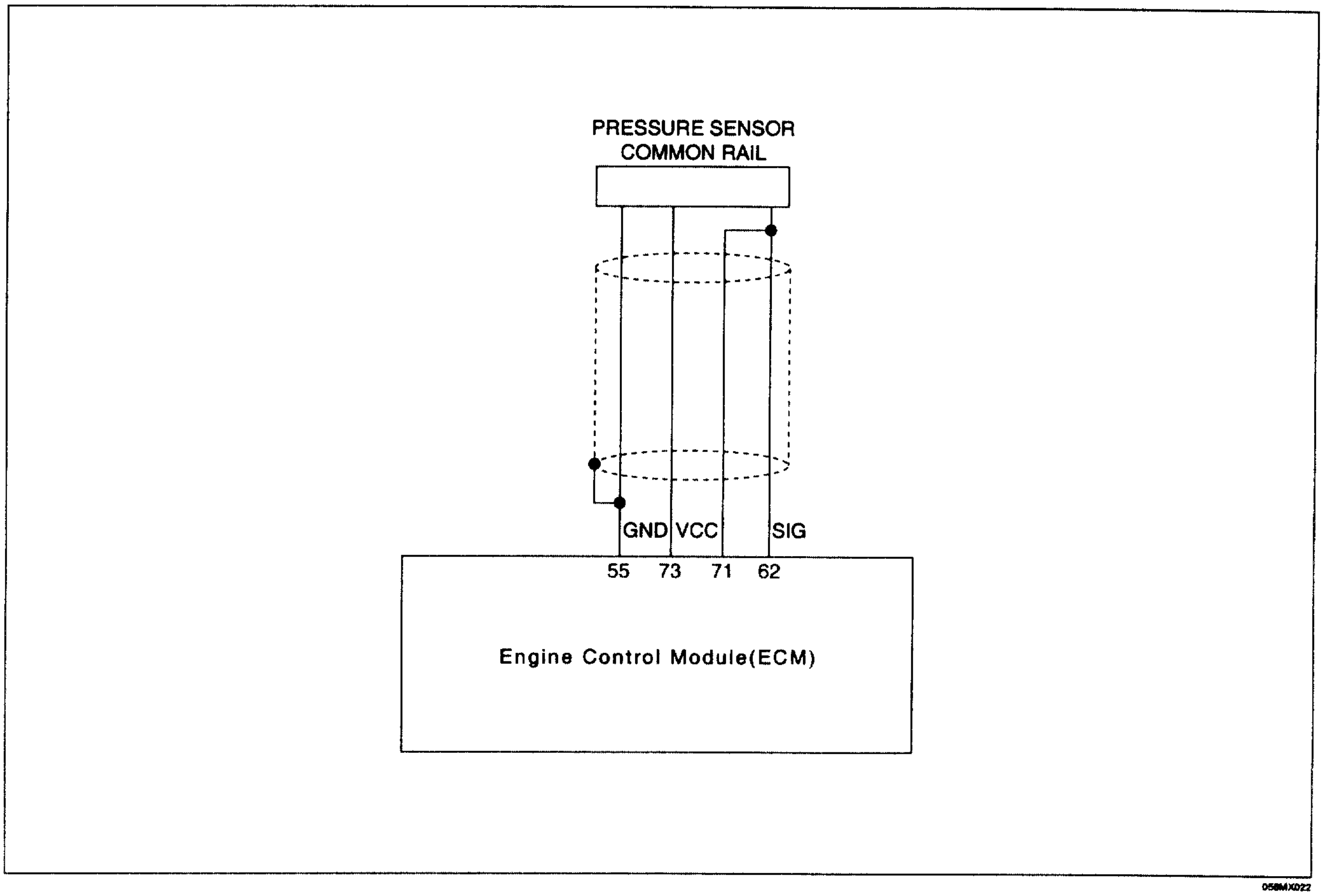
3 This check is injector assemblies. Because injectors driving circuit was normally.
4 Air bleed operating will teach us the injectors is normal.

Check Injector (Engine OFF) Diagnosis Chart

STEP	ACTION	VALUE	YES	NO
1	1. Disconnect following: • The harnesses of ECM • The injector connector of the cylinder head. 2. Probe the circuit for an open or short. If a problem was found, repair as necessary. Was a problem found ?	—	Verify repair Go to OBD System check	Go to step 2
2	1. Probe the Injector circuit at the connector of engine head. 2. Probe the common circuit and TWV circuit for an open or short. (Refer to circuit diagram) If a problem was found, repair as necessary. Was a problem repair ?	Resistance 0.3 – 1.3 Ω (about 20°C)	Go to step 3	Go to step 4
3	1. Remove the engine head cover. 2. Disconnect the harness from the injectors. 3. Probe the injector harness for an open or short. 4. Repair circuit as necessary. 5. Probe resistance between the each terminals and between the terminals and injector body. If a problem was found, replace injectors. Was a problem found ?	0.3 – 1.3/∞ Ω (between each terminal/injector body)	Verify repair Go to OBD System check	Go to step 4
4	1. Reconnect all the harnesses. 2. Bleed Fuel system. 3. Ignition "ON", engine "ON". Did the engine start and run?	—	Verify repair Go to OBD System check	Go to step 5
5	1. Ignition "OFF", engine "OFF". 2. Replace the ECM. 3. Ignition "ON", engine "ON". Did the engine start and run?	—	Verify repair Go to OBD System check	Go to "Engine Will Not Start" Diagnosis chart

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2.
Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

CHECK FUEL PRESSURE IN COMMON RAIL (ENGINE OFF) DIAGNOSIS CHART



Circuit Description

It comprises common rail pressure sensor, priming pump on the supply pump, ECM and etc.

The common pressure sensor is sensing pressure of common rail. It send signal to ECM.

This case, supply pump is working but fuel pressure is poorer than usual. According to Fuel supply isn't enough. Common rail pressure sensor is gauged pressure in common rail.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed–through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Test Description

2 It conform the ECM operation.

4 Residual pressure depend time after engine stopped.

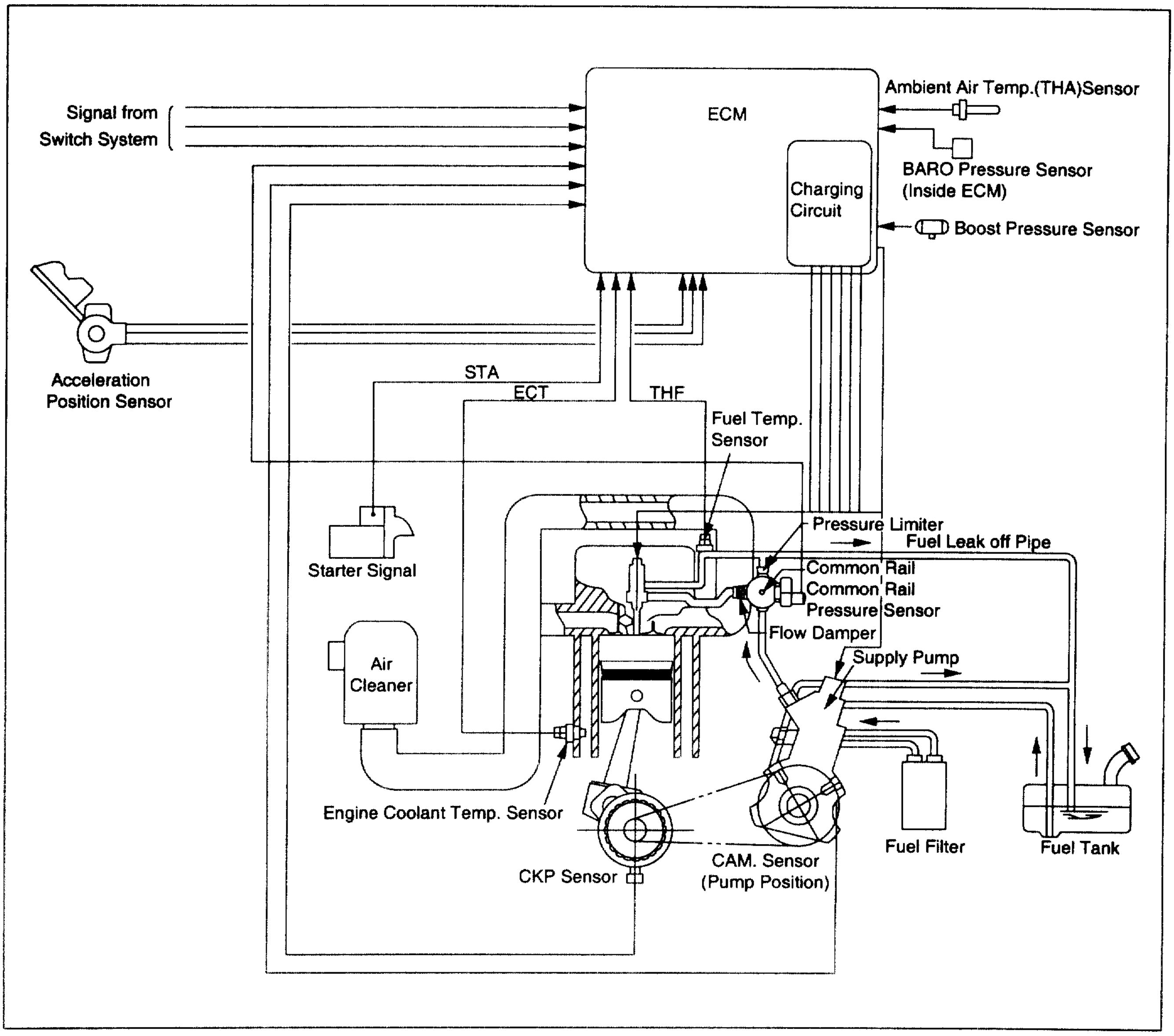
6 It conform fuel line, it is between priming pump to common rail. If fuel don't send common rail, air will be mixed the fuel.

Check Fuel Pressure in Common Rail (Engine Off) Diagnosis Chart

STEP	ACTION	VALUE	YES	NO
1	1. Disconnect the harness from ECM: 2. Probe the circuit between the ECM and fuel pressure sensor for an open or short. If a problem was found, repair as necessary. Was a problem repair ?	—	Verify repair Go to OBD System check	Go to step 2
2	1. Reconnect harness to ECM. 2. Ignition "ON" 3. Probe for voltage on the sensor side and the harness terminal from ECM Was voltage within specified value?	5V	Go to step 4	Go to step 3
3	Replace ECM. Was the action complete ?	—	Go to step 4	Go to step 3
4	1. Ignition "OFF". 2. Reconnect the harness at the pressure sensor. 3. Connect the scan tool. 4. Ignition "ON". Check "Rail Pressure in common Rail" in Section "ENGINE DATA", using the scan tool. **NOTE: When Engine stopped, there is residual pressure.** Is the pressure in the specified range?	0 – 1.5 MPa	Go to step 6	Go to step 5
5	1. Replace the fuel pressure sensor. 2. Bleed fuel system. Was the action complete ?	—	Go to step 4	—
6	1. Operate the priming pump. 2. Check "Actual Pressure in common Rail" in Section "ENGINE DATA", using the scan tool. Was the pressure reading raised while the priming pump was operated?	—	Go to step 7	Go to step 5
7	1. Ignition "ON", Engine "ON" Did the engine start and run?	—	Verify repair Go to OBD System check	Go to "Engine Will Not Start and Run" Diagnosis chart

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

SYSTEM OPERATION CHECK DIAGNOSIS CHART



Circuit Description

It comprises fuel system, air cleaner, engine oil, engine, clutch, transmission, and etc.

It conform idling revolution. If it is abnormal, it conform air cleaner, engine oil.

And refer to each of sections.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed–through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

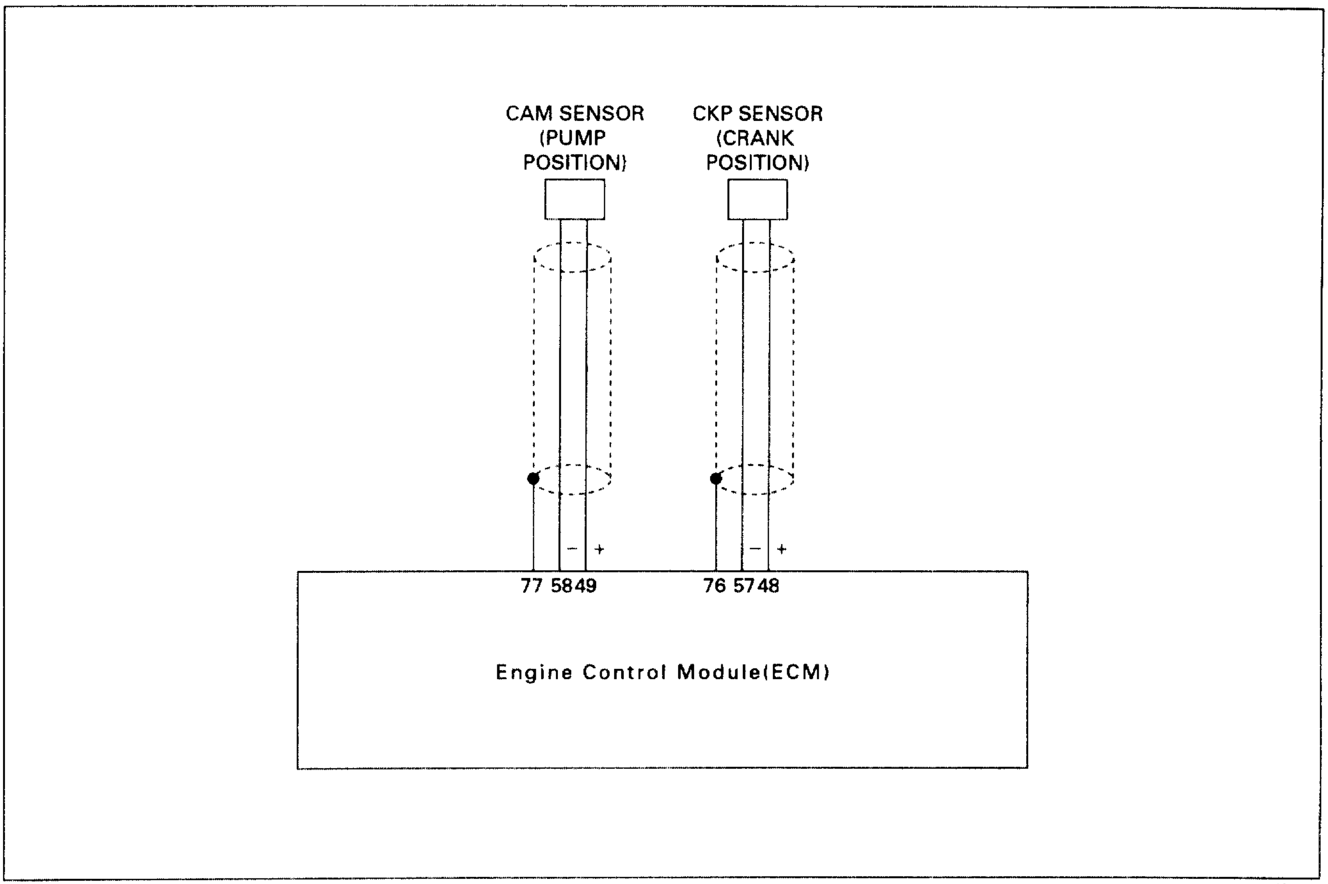
Test Description

3
- Check the Fuel Injection and Timing Relation.
- Check the supply pump.
- Check the fuel pressure in a common rail.
- Check the Injector .

System Operation Check Diagnosis Chart

STEP	ACTION	VALUE	YES	NO
1	Check the air cleaner element. If a problem was found, clean or replace air cleaner element. Was a problem found?	—	Clean or Replace Go to OBD System check	Go to step 2
2	Check the engine oil. If a problem was found, change engine oil. Was a problem found?	—	Change Oil. Go to OBD System check	Go to step 3
3	Check following diagnostic charts. • Check Fuel Injection and Timing Relation (engine running) • Check supply pump (engine running) • Check fuel pressure in common rail (engine running) • Check Injector (engine running) Did you check the listed Diagnosis charts?	—	Go to step 4	Check Appropriate Diagnosis chart
4	Check the manual idle control switch circuit for an open or short. If a problem was found, repair or replace as necessary. Was a problem found ?	—	Repair or Replace. Go to OBD System check	Go to step 5
5	1. Check for the following engine mechanical items. Refer to 6A section in this manual. • Low compression • Sticking or leaking valves • Worn camshaft lobe(s) • Camshaft gear damage. • Incorrect valve timing • Worn rocker arms • Broken valve springs 2. If a problem is found, repair as necessary. Was a problem found?	—	Repair or Replace. Go to OBD System check	Go to step 6
6	Bleed the fuel system. Was the fuel system bleed ?	—	Verify repair Go to OBD System check	Bleed the Fuel system

CHECK FUEL INJECTION AND TIMING RELATION (ENGINE RUNNING) DIAGNOSIS CHART



Circuit Description

It comprises crank position sensor (CKP sensor), Pump position sensor (CAM sensor), supply pump and etc.

CKP sensor is sensing speed of engine crank. CAM sensor is sensing speed of 3-rob cam (There is it in priming pump). It send each of signal to ECM.

An engine idling is abnormal sometimes. One of causes, there is bad condition of sensors.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed–through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Test Description

1 It is sensor check. The indication will be clear normal signals from it.

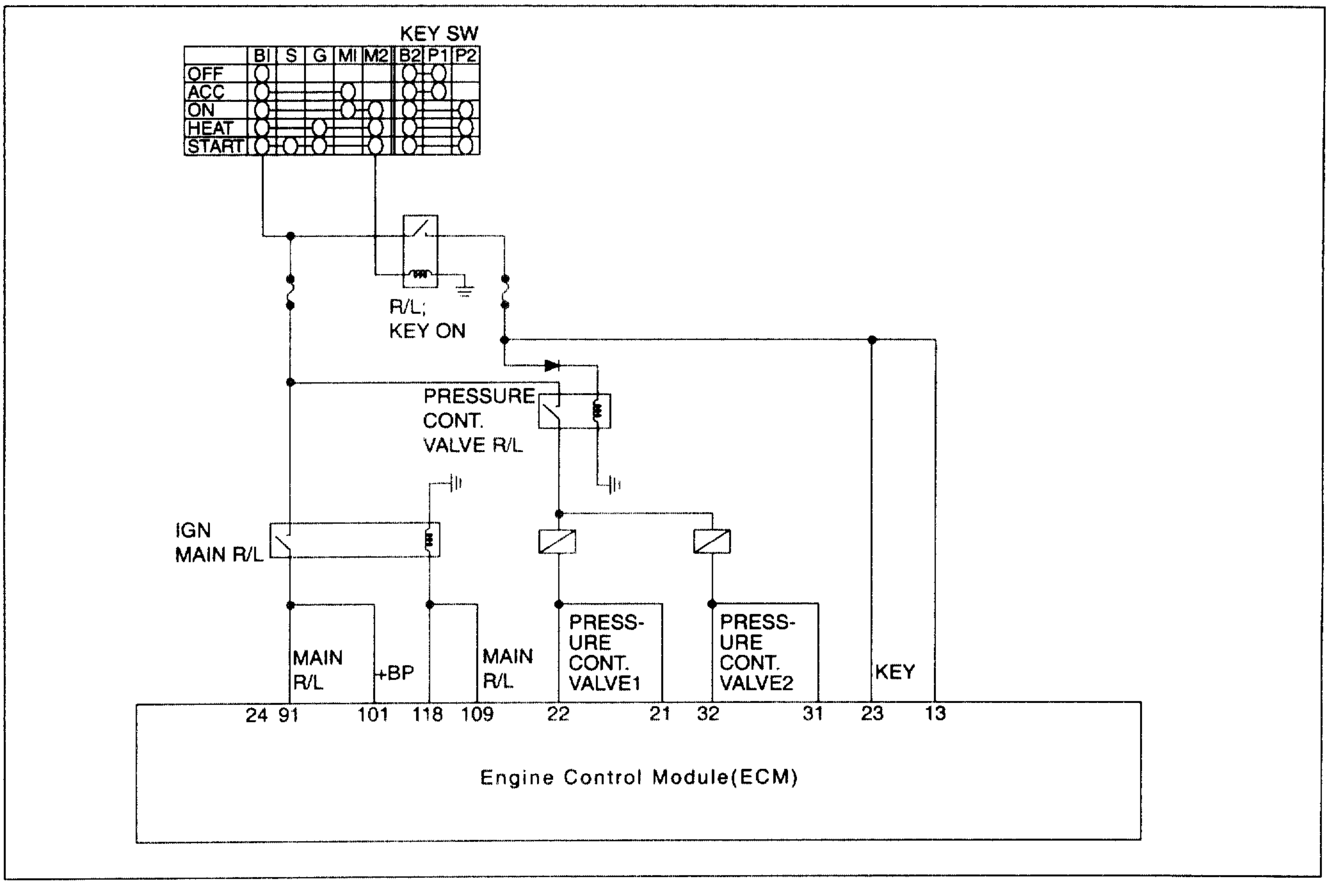
2 Instration condition have a influence sensors signals.

4 When The indication was flashing, it is influence signal noise and missing.

Check Fuel Injection and Timing Relation (Engine Running) Diagnosis Chart

STEP	ACTION	VALUE	YES	NO
1	Check following engine data on the scan tool. •crank position (crank signal present) •pump position (pump signal present) Did scan tool indicate "YES"?	—	Go to step 6	Go to step 2
2	1. Check installation condition for CKP sensor and CAM sensor. 2. If the installation condition of the sensors is abnormal, repair as necessary. If a problem was found, repair as necessary. Was a problem found?	—	Verify Repair Go to step 6	Go to step 3
3	1. Disconnect harnesses of the ECM. 2. Disconnect harnesses of the sensors. 3. Probe resistance between the each terminals of the sensors and the ECM. If a problem was found, repair as necessary. Was a problem found?	—	Verify Repair Go to step 6	Go to step 4
4	Check following engine data on the scan tool. •crank position •pump position Did scan tool indicate "YES"?	—	Go to step 6	Go to step 5
5	•CKP Sensor 1. Check flywheel condition. (Distortion, scratch, etc.) 2. Clean up 3. If a problem was found, repair or replace as necessary. • CAM Sensor 1.Replace supply pump. Did you check the CKP and CAM sensors ?	—	Go to step 6	Check the CKP and CAM sensors
6	Check idling condition. Is Engine idling normal ?	—	Verify repair	Go to "System operation check" Diagnosis chart

CHECK SUPPLY PUMP (ENGINE RUNNING) DIAGNOSIS CHART



Circuit Description

It comprises fuses, relays, supply pump, goesfilter and etc.This case, It conform stopped supply pump. There are two PCV. When One PCV is stopped, Engine will run steady. Because another one is working. Fuel supply to injector. If it broke, it will be stop engine.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed–through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

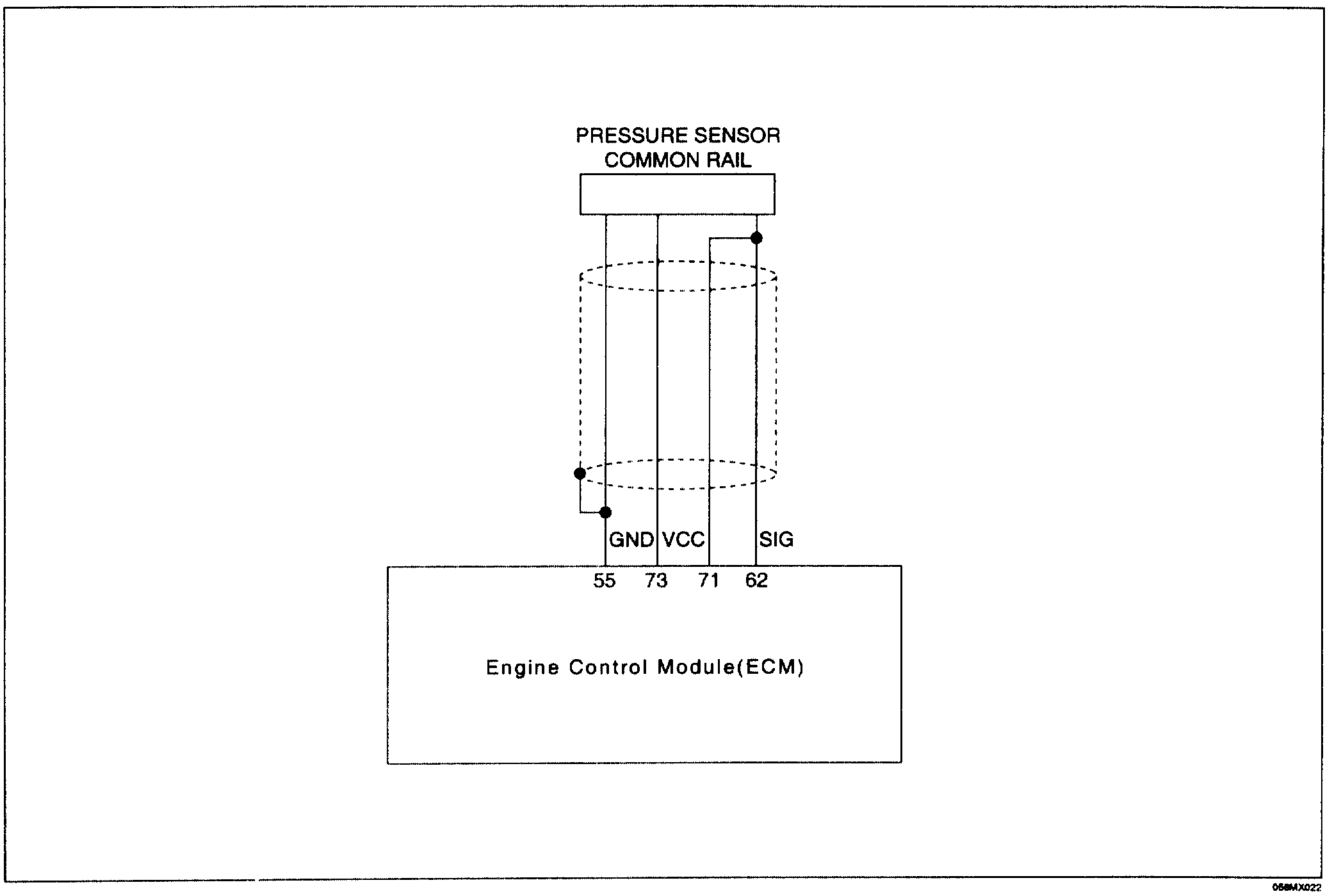
Test Description

1 It will be clear, which is broken PCV1 or PCV2. It is disconnected harness from PCV1. If PCV2 was broken, Fuel supply will be stopped. The engine won't run.

Check Supply Pump (Engine Running) Diagnosis Chart

STEP	ACTION	VALUE	YES	NO
1	1. Tilt up the CAB on the vehicle. 2. Disconnect the harness from the PCV1. 3. Engine "ON". If the engine didn't run, replace supply pump. Was a problem found?	—	Verify Repair Go to OBD System check	Go to step 2
2	1. Reconnect the harness at the PCV1. 2. Disconnect the harness from the PCV2. If the engine didn't run, replace supply pump. Was a problem found?	—	Verify Repair Go to OBD System check	Go to step 3
3	1. Reconnect the harness at the PCV2. 2. Check the idle condition of engine. Is the engine idling Normal ?	—	Go to OBD System check	Go to "System Operation check" Diagnosis chart

CHECK FUEL PRESSURE IN COMMON RAIL (ENGINE RUNNING) DIAGNOSIS CHART



Circuit Description

The common pressure sensor is sensing pressure of common rail. It send signal to ECM.

This case, supply pump is working but fuel pressure is poorer than usual. According to Fuel supply isn't enough. Common rail pressure sensor is gauged pressure in common rail.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed–through wire insulation or a wire broken inside the insulation. Check for poor connections or a damagedharness. Inspect the ECM harness and connector forimproper mating, broken locks, improperly formed ordamaged terminals, poor terminal-to-wire connection,and damaged harness.

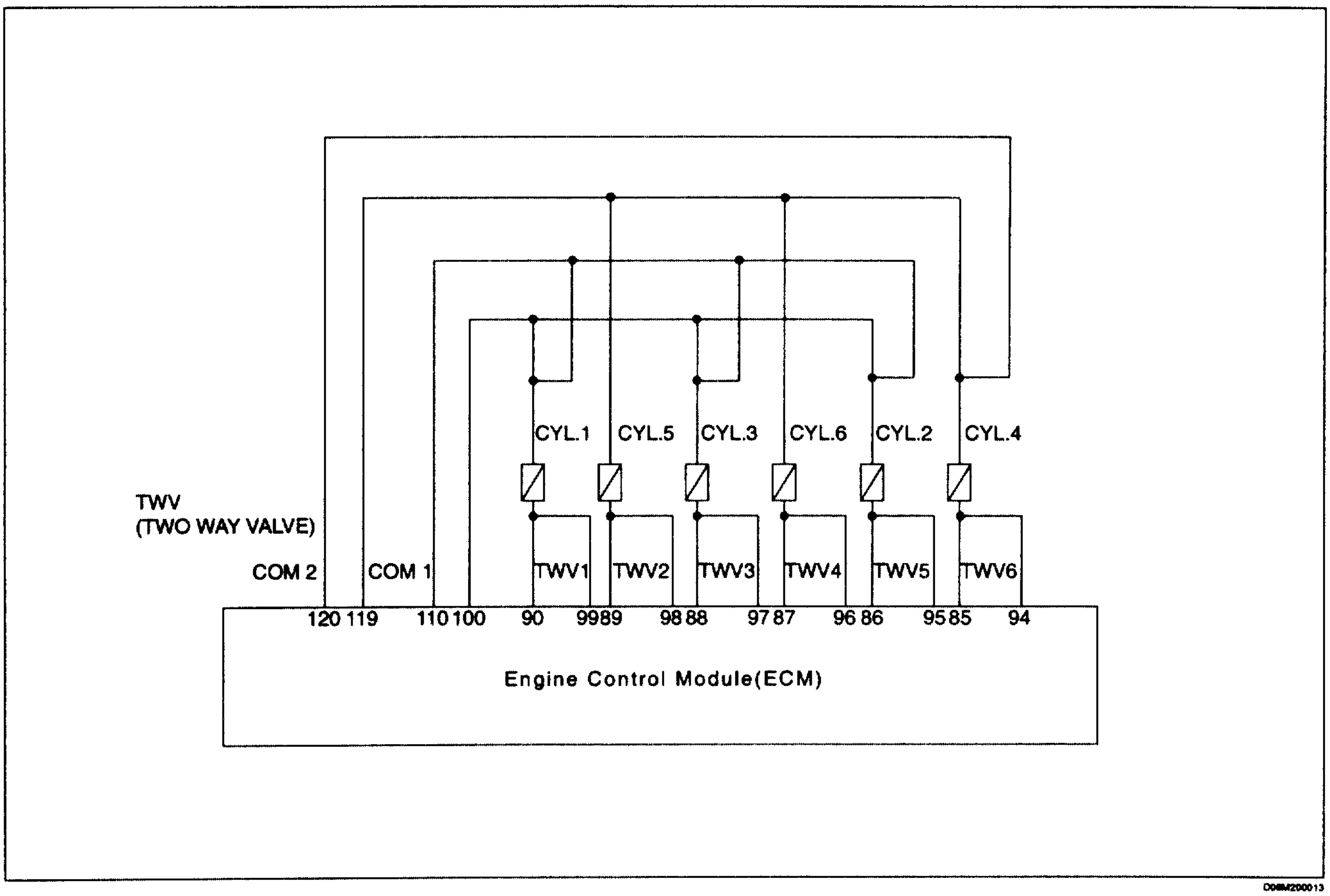
Test Description

1 It is control check. If real rail pressure is nearly purpose pressure then it is normal.

Check Fuel Pressure in Common Rail (Engine Running) Diagnosis Chart

STEP	ACTION	VALUE	YES	NO
1	1. Using a scan tool output tests (Function tests), select "common rail pressure control test". If actual rail pressure didn't follow the desired rail pressure, replace a common pressure sensor. Was a problem found ?	—	Go to step 2	Go to step 3
2	1. Test the common rail pressure control a scan tool. 2. Select "Data list". 3. Read common rail pressure on the "Data list" with the scan tool. 4. Check the value when the accelerator is opened slowly. If actual rail pressure didn't follow the desired rail pressure, replace a common pressure sensor. Was a problem found ?	—	Verify Repair Go to OBD System check	Go to step 3
3	Check idling condition. Is the engine idling normally ?	—	Verify Repair Go to OBD System check	Go to "System Operation check" Diagnosis chart

CHECK INJECTOR (ENGINE RUNNING) DIAGNOSIS CHART



Circuit Description

It comprises circuit of injector, injector, ECM and etc.

The injector of either one stops. It must be clear broken injector, it need Tech2.

Tech2 is stopped each of injector. Working noise will teach us problem of injector.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed–through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Test Description

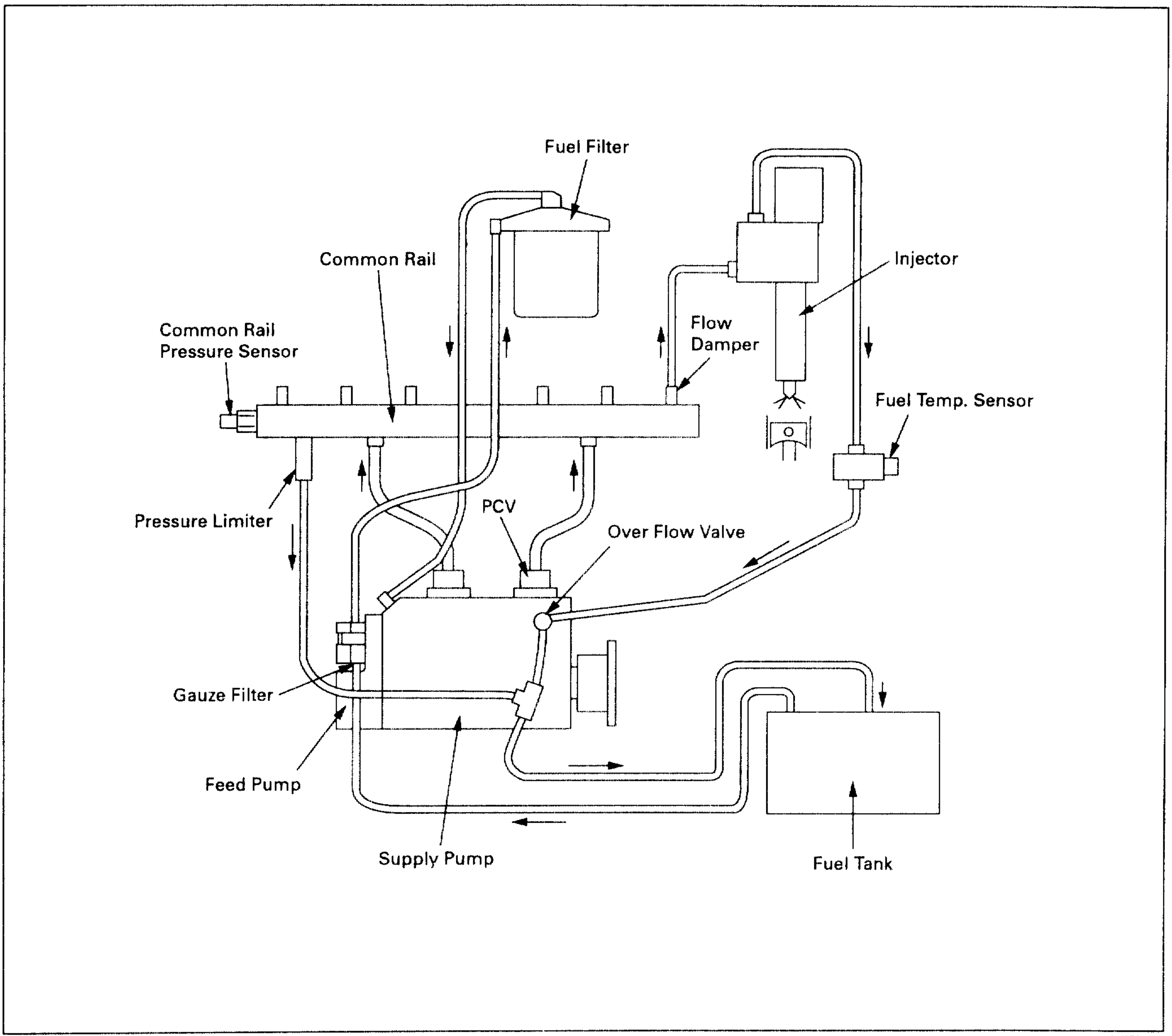
1. It conform broken injector. if one injector stopped each, the working noize and RPM drop will be change. Because all cylinder will be working. When the working noize don't change, some injectors will broke.
2. This system is adopted pilot injection. it will be improved idling stability, combustion and etc.

Check Injector (Engine Running) Diagnosis Chart

STEP	ACTION	VALUE	YES	NO
1	1. Using a scan tool output tests (Function tests), select the "Injection balance test (Injector stop test of each cylinder)" and command each "Injector stop". 2. Check working noize of the engine and RPM drop. Did working noize and RPM change at all cylinders?	—	Go to step 3	Go to step 2
2	1. Engine "OFF". 2. Replace a injector of a cylinder with no change in the working noize and RPM drop. 3. Engine "ON" Was the action completed?	—	Go to step 1	Complete action
3	1. Select "Pilot injection stop test" with the scan tool. 2. Check working noize of the engine and RPM drop. If the working noize of engine and RPM drop changed, replace Injector. Was the action completed?	—	Go to step 4	Complete action
4	Check idling condition. Was the Engine idling normally?	—	Verify repair Go to OBD system check	Go to "System operation check" Diagnosis chart

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

CHECK FUEL SYSTEM DIAGNOSIS CHART



Circuit Description

It conform leak of fuel. Accelerating of Engine raise fuel pressure and it will be leaks more. Overlook it.

It comprises following pipes and etc.

- Between injectors to common rail.
- Between common rail to supply pump.
- Between supply pump to fuel filter.
- Between fuel filter to fuel tank.
- Between pressure limiter to fuel tank.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed–through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Test Description

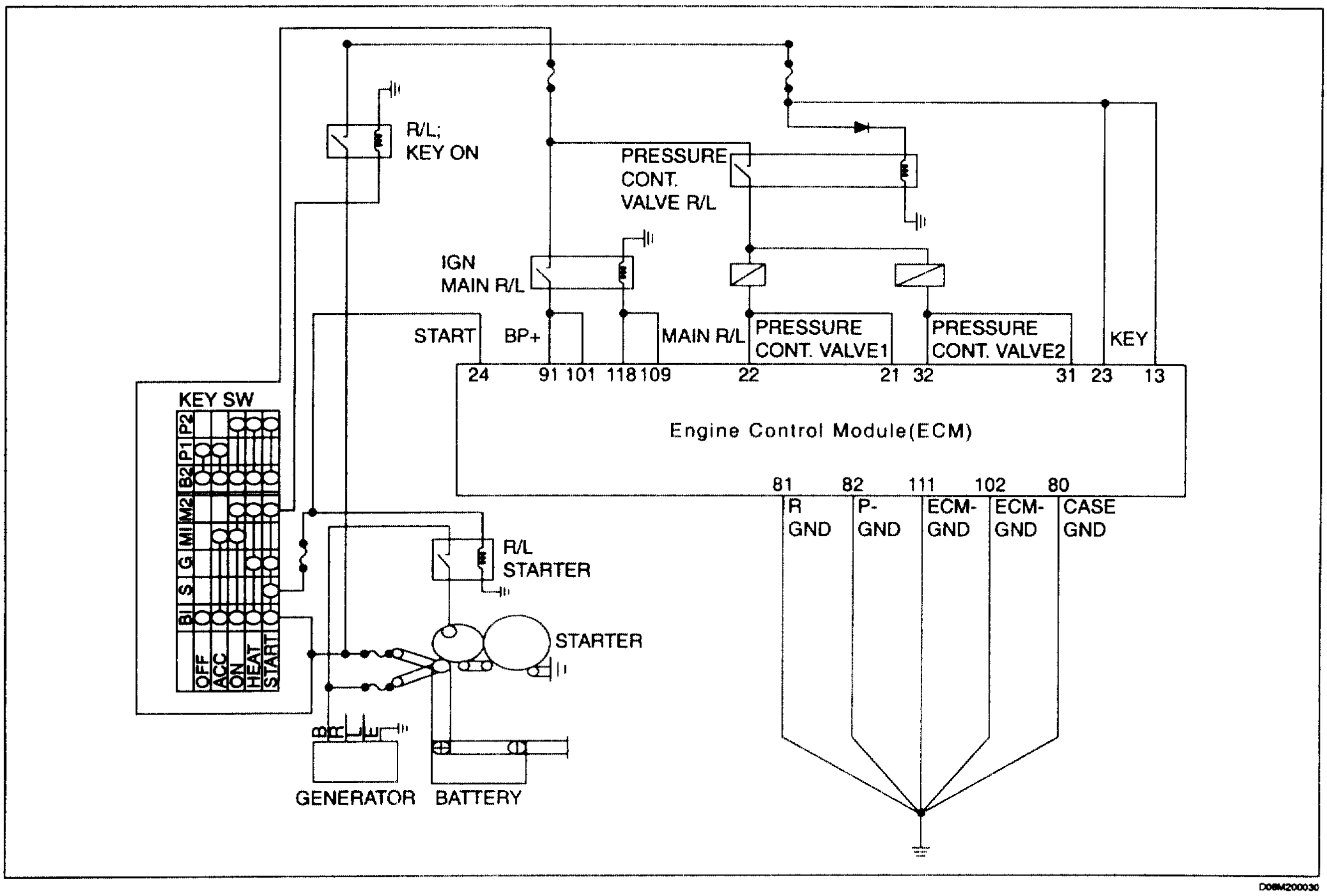
1 Accelerating of Engine raise fuel pressure and it will be leaks more. Overlook it.

Check Fuel System Diagnosis Chart

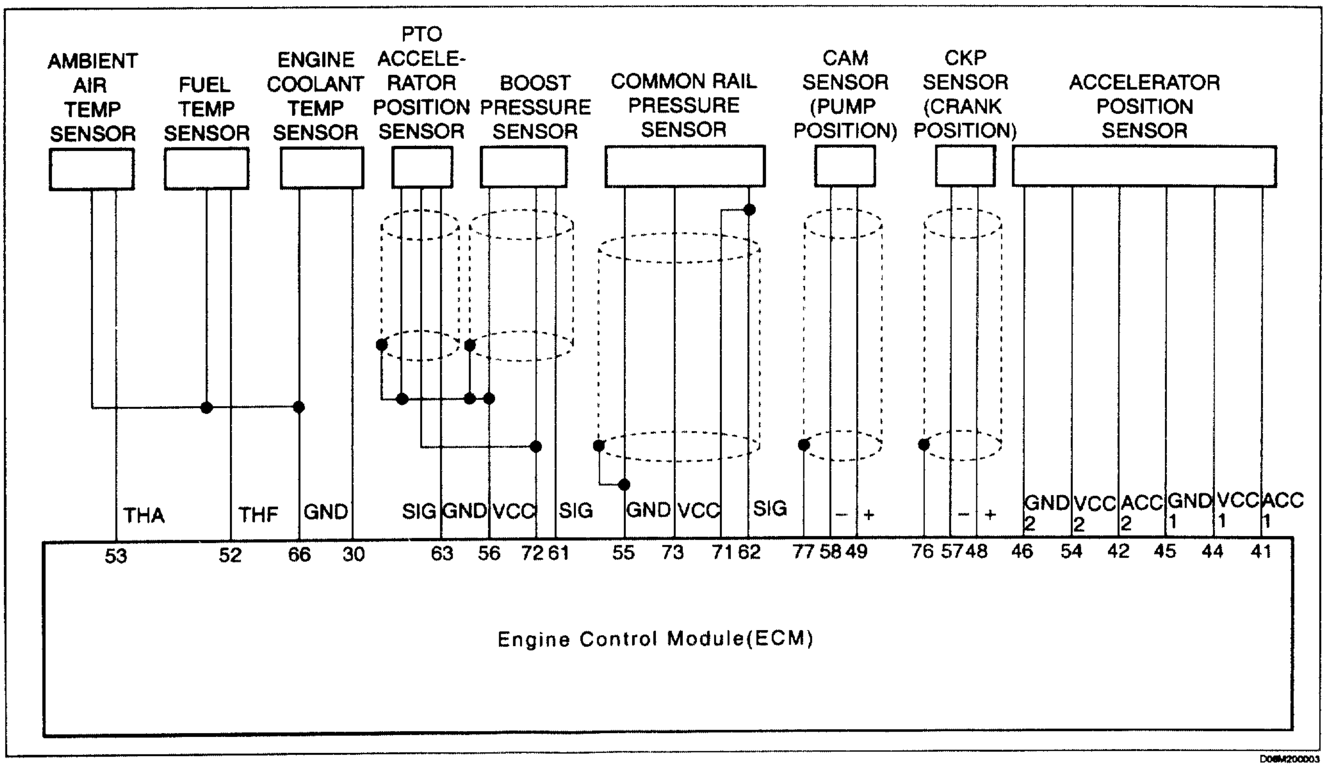
STEP	ACTION	VALUE	YES	NO
1	1. Engine "ON". 2. Acclerate the engine revolution until 3,000 rpm is reached. **NOTE: Don't over-rev. the engine.** 3. Ignition "OFF", engine "OFF" and listen for flow damper to reset ("click") sound. This may take 120 seconds. **NOTE: If this test is performed, it may operate also with a normal flow damper, and if engine is stopped, there may be flow damper working sound.** Was "click" sound heard?	—	Go to step 2	System OK
2	1. Ignition "OFF". 2. Check the fuel high pressure pipe with operated flow damper. 3. Check for leak at injector piping. If the pipe has a leak, repair as necessary. Did you the problem repair?	—	Go to step 3	Repair or Replace
3	Check the balancing fuel rate "Engine data" with the scan tool. If a problem was found, repair as necessary. Was a problem found?	–5 – 5	Verify repair Go to OBD system check	Go to step 4
4	Replace the injection parts. Was a action complete?	—	Verify repair Go to OBD system check	—

MULTIPLE DTCS STORED DIAGNOSIS CHART

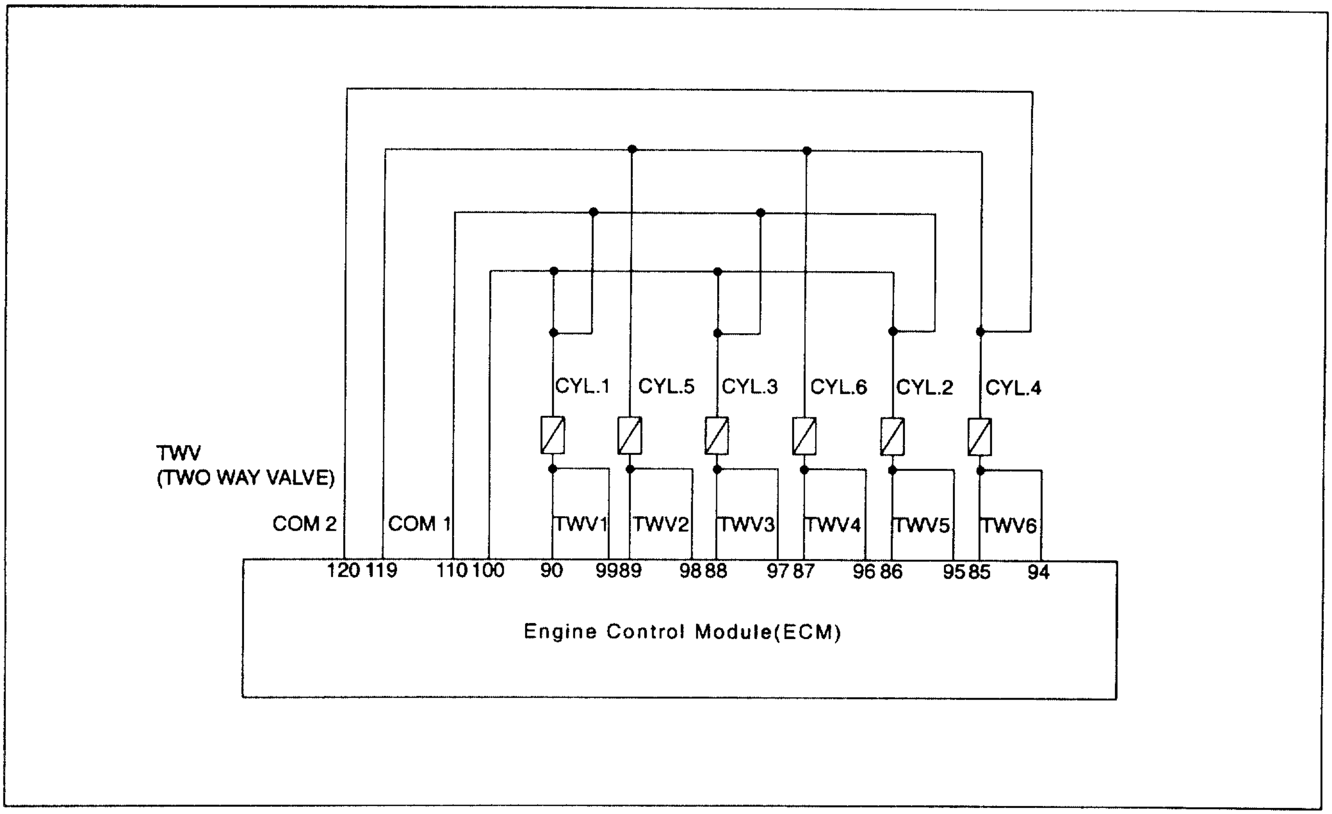
A Group



B Group



C Group



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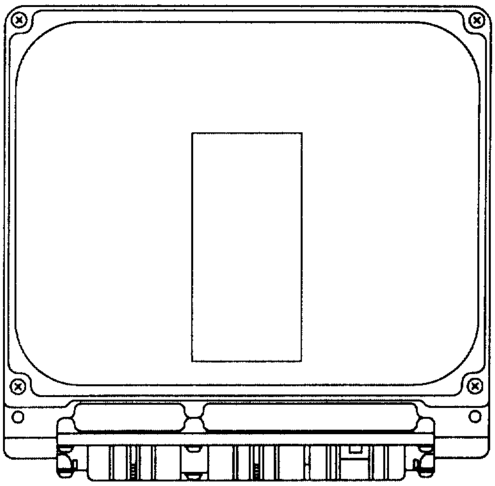
D Group



060MX113

Circuit Description

The Engine Control module(ECM) monitors varlous sensors to determines the engine operating conditions.

The ECM provides a sensor ground to all of the sensors.The ECM applies varlous sensors for a power supply.

Multiple DTCs will set when the ECM detects a problem on conmmon use for the sensors ground or power supply.

If the multiple DTCs set,check the conmmon circuit for sensors ground or power supply as necessary.

The following group to be set for circuit.

A group: Power Supply Circuit
B group: Varlous Sensors and Injectors
C group: Varlous Sensors and Injectors
D group: Internal Circuit for ECM, Signal Cicuit for ECM

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed–through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Test Description

Number below refer to the step number on the diagnosic chart.

1 If the multiple DTCs set,check the conmmon circuit for sensors ground or power supply as necessary, set ,refer to the DTC Chart.

A group: 217, 218, 247, 248, 416, 417, 421
B group: 14, 15, 22, 23, 24, 25, 28, 32,42, 65, 115, 118, 151, 211, 245
C group: 158, 159, 271, 272, 273, 274, 275, 276
D group: 34, 35, 71

STEP	ACTION	VALUE	YES	NO
1	Was the "OBD" problem ?	—	Go to step 2	Go to OBD system check
2	1. Check DTC and inspect group of each DTCs. 2. Locate circuit diagram of problem group. 3. Ignition "OFF". 4. Disconect connector from ECM. 5. Disconect sensor harness connection for DTC . 6. Probe each circuit for an open or short (Check harness side, sensor side and ECM side) 7. Probe power and ground circuit for an open or short (Check harness side, sensor side and ECM side) If a problem was found, repair as necessary Was a problem found?		Verify repair Go to OBD system check	Go to step 3
2	Probe the affected sensor If a problem was found, repair as necessary Was a problem found?	—	Verify repair Go to OBD system check	Go to step 4
3	Probe following ground circuit • ECM case • Sensor If a problem was found, repair as necessary Was a problem found?	—	Verify repair Go to OBD system check	Go to step 5
4	Replace ECM Was ECM replaced?	—	Verify repair Go to OBD system check	Replace ECM

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

ECM Diagnosis Trouble Codes

The following table lists the diagnosis trouble codes supported by this vehicle application. If any DTCs not listed here are displayed by a scan tool, the scan tool data may be faulty; notify the scan tool manufacture of any DTCs displayed that are not included in the following table.

ECM Diagnostic Trouble Codes

DTC	Description	Illuminate MIL	Refer to	Fail safe	Symptom
14	Pump Position Sensor Error (CAM sensor)	2	Check Fuel Injection Timing Relations, DTC table	• When Crank Position sensor is normal, backs up by Crank Position sensor • When both failure, injection stops.	Accuracy of fuel injection timing growing worth, Engine reverse rotation identification impossible, Pump Control Valve (PCV) control position shift, Engine hard starting No operation PTO
15	Crank Position Sensor Error (CKP sensor)	2	Check Fuel Injection Timing Relations, DTC table	• When Pump Position sensor is normal, backs up by Pump Position sensor • When both failure, injection stops.	Accuracy of fuel injection timing growing worth, Engine reverse rotation identification impossible, Pump Control Valve (PCV) control position shift, Engine hard starting, Fuel consumption cylinder balance (FCCB) impossible, Split fuel injection impossible, Taken in error of common rail pressure No operation PTO
22	Ambient Air Temperature Sensor Error	3	Multi trouble stored (Ground circuit), DTC table	At starting: THA = –20°C Other = 20°C	White smoke in cold weather
23	Engine Coolant Temperature Sensor Error	3	Multi trouble stored (Ground circuit), DTC table	Starting: Based on –20°C Other: Based on 80°C	Engine hard starting in cold weather Idle unstable in cold weather, White smoke in cold weather
24	1. Accelerator Sensor Error 1	1	DTC table	Item 1, 2, 3 and 4:When one sensor is normal, backup bynormal sensor. When both sensor are faulty accel. is fixed at 20%, however using an injection map for ASC mode. If a brake pedal is "ON", the degree of accelerator value will became 0%.	Lack of power, PTO engage impossible, Accelerator position sensor output signal error, Idle speed error.
	2. Accelerator Sensor Error 2				
	3. Accelerator Sensor 1 Intermediate Voltage Hold Trouble				
	4. Accelerator Sensor 2 Intermediate Trouble				
25	Vehcle Speed Sensor Error (VSS)	3	DTC table	The ECM records only DTC. Operation prohibition of PTO accelerator.	Lack or power. Engine hunting. No operation PTO

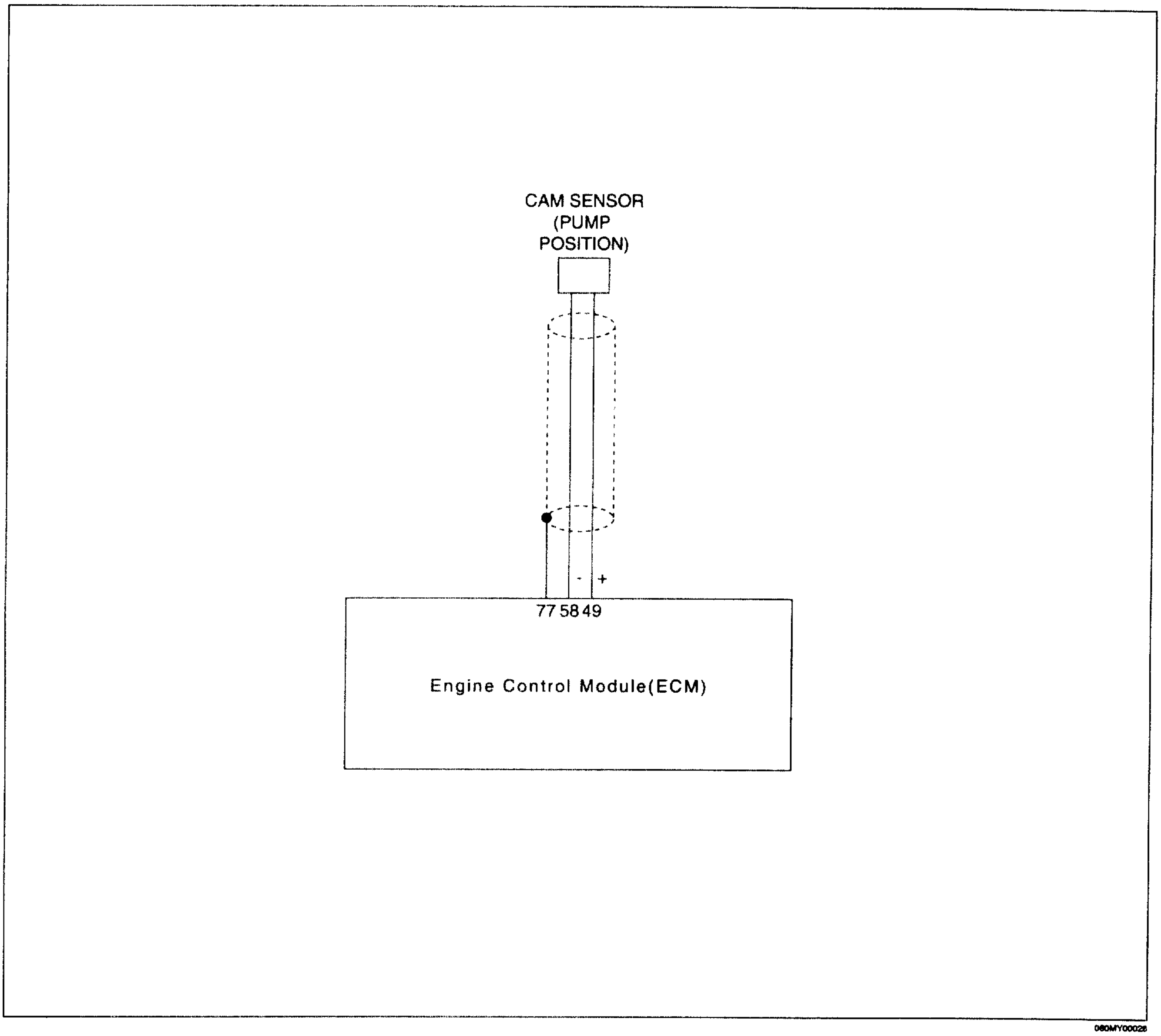
DTC	Description	Illuminate MIL	Refer to	Fail safe	Symptom
28	PTO Accelerator Position Sensor Error	3	DTC table	When the sensor is faulty, is substitute accelerator pedal of PTO accelerator.	Lack or power. Engine hunting.
32	Boost Pressure Sensor Error	3	Multi trouble stored (Ground circuit), DTC table	Based on relative pressure of 0 kPa. Injection amount map is used for a fail safe mode.	Lack of power, PTO abnormal (common used power source)
34	Fuel Rate Data Error (No History Recorded)	1	DTC table, Scan tool operation	Q (Fuel Rate Data) adjustment data No.8 selected	Lack of power, Black smoke, Poor fuel economy
35	A/D Conversion Error (ECM inside trouble)	1	System check, DTC table	Analog sensor abnormality decision stops and fail safe mode	Lack of power, Rough engine idling, Engine stall
	CPU Monitoring IC Error (ECM inside trouble)			–	
	Charging Circuit Error			Charging stops, driveable by constant current only, and injection amount limited to 80 mm^3/st.	
42	High Boost Pressure Abnormal	3	DTC table	Injection amount map is used as a fail safe mode.	Lack of power, PTO abnormal (common used power source)
65	Low Boost Pressure Abnormal	3	DTC table	–	Lack of power, PTO abnormal (common used power source)
71	BARO Sensor Error	3	DTC table	Based on the atmospheric pressure of 100 kPa.	Injection timing abnormal, White smoke, Boost compensation don't work
115	Common Rail Pressure Sensor Output Fixed	1	Check fuel pressure in a common rail, DTC table	Same as DTC P245	Lack of power, Black smoke, Both of fuel pressure and engine hunting, PTO engage impossible
118	1. Abnormal Common Rail Pressure (Control System 1st Stage)	1	Check fuel pressure in a common rail, DTC table	Same as DTC P245	Lack of power, White smoke, Both of fuel pressure and engine hunting , PTO engage impossible, Engine hard starting , Fuel leak 2nd stage: Engine stop
	2. Abnormal Common Rail Pressure (Control System 2nd Stage)				
151	Abnormal Common Rail Pressure (Pump Over Pressure Supply)	1	Check fuel pressure in a common rail, DTC table	Same as DTC P245	Lack of power, White smoke, Both of fuel pressure and engine hunting , No operation PTO
158	TWV Driving System (common 1)	1	Check Injector, DTC table	• Constant current control by common 1 or common 2 whichever normal (Abnormal system separated) • Injection amount limit 80 mm^3/st or 0 boost flat.	Rough engine idling, Lack of power, Engine hard starting No operation PTO Engine stall

DTC	Description	Illuminate MIL	Refer to	Fail safe	Symptom
159	TWV Driving System (common 2)	1	Check Injector, DTC table	• Constant current control by common 1 or common 2 whichever normal (Abnormal system separated) • Injection amount limit 80 mm^3/st or 0 boost flat.	Rough engine idling, Lack of power, Engine hard starting Engine stall
211	Fuel Temperature Sensor Error	3	Multi trouble stored (Ground circuit), DTC table	Backup control by water temperature sensor Starting: Based on −20°C Other: Based on 80°C	Common rail pressure guard impossible in high fuel temperature
217	Coil or Harness for PCV1 are Shorted	1	Check supply pump, DTC table	Abnormally high driving voltage generated PCV off, the target pressure limited to 60 MPa or less.	Lack of power, Black smoke
218	Coil or Harness for PCV2 are Shorted	1	Check supply pump, DTC table	Abnormally high driving voltage generated PCV off, the target pressure limited to 60 MPa or less.	Lack of power, Black smoke
226	Supply pump does not Supply Pressure and/or Pressure Limiter Activated	1	System check, Check supply pump, Check fuel system, DTC table	• Injection amount limit is 60 mm^3/st. • Target common rail pressure is lower than 25 MPa.	Lack of power, Black smoke
227	Supply pump does not Supply Pressure (Fuel Leakage)	1	System check, Check supply pump, Check fuel system, DTC table	• Fuel injection value lower than 60 mm^3/st. • Common rail pressure lower than 25 MPa. • Time required for running into backup is varied with the difference common rail pressure against target pressure.	Engine stall, Engine hard starting
245	Abnormal Common Rail Pressure (PC Sensor System)	1	Check fuel pressure in a common rail, DTC table	Limits are set to common rail pressure open loop control, common rail pressure and injection amount. Common rail pressure: 60 MPa Injection amount: 50 mm^3/st	Lack of power, Black smoke, Both of fuel pressure and engine hunting, PTO engage impossible
247	PCV1 Coil or Harness Disconnect or Ground Shorted	1	Check supply pump, DTC table	Common rail pressure is limited to 60 MPa or less.	Lack of power, Black smoke
248	PCV2 Coil or Harness Disconnect or Ground Shorted	1	Check supply pump, DTC table	Common rail pressure is limited to 60 MPa or less.	Lack of power, Black smoke
261	Damper is Activated for Cylinder No. 1 Flow Damper Activated	3	System check, DTC table	Cylinder injection stops	Rough engine idling, Lack of power, Fuel leakage
262	Damper is Activated for Cylinder No. 2 Flow Damper Activated	3	System check, DTC table	Cylinder injection stops	Rough engine idling, Lack of power, Fuel leakage

DTC	Description	Illuminate MIL	Refer to	Fail safe	Symptom
263	Damper is Activated for Cylinder No. 3 Flow Damper Activated	3	System check, DTC table	Cylinder injection stops	Rough engine idling, Lack of power, Fuel leakage
264	Damper is Activated for Cylinder No. 4 Flow Damper Activated	3	System check, DTC table	Cylinder injection stops	Rough engine idling, Lack of power, Fuel leakage
265	Damper is Activated for Cylinder No. 5 Flow Damper Activated	3	System check, DTC table	Cylinder injection stops	Rough engine idling, Lack of power, Fuel leakage
266	Damper is Activated for Cylinder No. 6 Flow Damper Activated	3	System check, DTC table	Cylinder injection stops	Rough engine idling, Lack of power, Fuel leakage
271	Open Circuit on Cylinder No. 1 at TWV side	1	Check Injector, DTC table	Injection amount limited to 80 mm^3/st.	Rough engine idling, Lack of power
272	Open Circuit on Cylinder No. 2 at TWV side	1	Check Injector, DTC table	Injection amount limited to 80 mm^3/st.	Rough engine idling, Lack of power
273	Open Circuit on Cylinder No. 3 at TWV side	1	Check Injector, DTC table	Injection amount limited to 80 mm^3/st.	Rough engine idling, Lack of power
274	Open Circuit on Cylinder No. 4 at TWV side	1	Check Injector, DTC table	Injection amount limited to 80 mm^3/st.	Rough engine idling, Lack of power
275	Open Circuit on Cylinder No. 5 at TWV side	1	Check Injector, DTC table	Injection amount limited to 80 mm^3/st.	Rough engine idling, Lack of power
276	Open Circuit on Cylinder No. 6 at TWV side	1	Check Injector, DTC table	Injection amount limited to 80 mm^3/st.	Rough engine idling, Lack of power
416	Main Relay System Error (No History Record)	2	Engine run steady, DTC table	Only diagnostic lamp (Flashing lamp) can be lighted by key current.	Battery consume, The system will not turn off
417	Starter Switch Abnormal	3	Engine Not Run, DTC table	—	Startup additional fuel injection don't work, Engine reverse rotation identification impossible, Air breathing impossible, Stator motor erroneous functioning
421	PCV Relay System Error	1	Check supply pump, DTC table	Only diagnostic code memory.	Bad battery consume, Pump control valve (PCV) relay burned out or failed
543	Over Speed Condition	3	DTC table	Fuel injection stop. Fuel pressure feed stop.	Stored DTC in ECM

Illuminate MIL
1 Turn on lamp is starter switch ON.
2 Turn on lamp after engine is running more than 20 second.
3 Not turn on lamp.

DTC 0014 Pump Position Sensor Error (CAM sensor)



Circuit Description

CAM sensor is installed at the side of the supply pump, serving to distinguish the cylinders of the engine and back up the detection of engine speed (in case of CKP sensor trouble).

This CAM sensor comprises the same parts as in CKP sensor, but the number of turns of its coil is different from that of CKP sensor and installed to the supply pump.

With the engine started, the pulser notches in the middle of the supply pump camshaft cut off intermittently the magnetic field made by the sensor magnet, thereby generating alternating current.

The pulser notches are made every 60° of camshaft (every 120° of crank angle) and there is a surplus tooth.

Therefore, seven pulses are outputted per one rotation of camshaft (2 rotations of the engine). The pulse outputted by the surplus tooth is recognized as engine number 1 cylinder reference pulse.

Diagnostic Trouble Code 0014 will set when the ECM detects a no signal for open circuit or sensor damage on the CAM sensor signal circuit.

Conditions for Setting the DTC

- CKP sensor pulse (Crank position, 450 times of pulse input) is normal, there is no CAM sensor pulse input.
- When CAM sensor pulse is inputted over specified cycles.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- When CKP sensor (pump position) is normal, backs up by CKP sensor.
- When both fail, injection stops.

DTC 0014 Pump Position Sensor Error (CAM sensor)

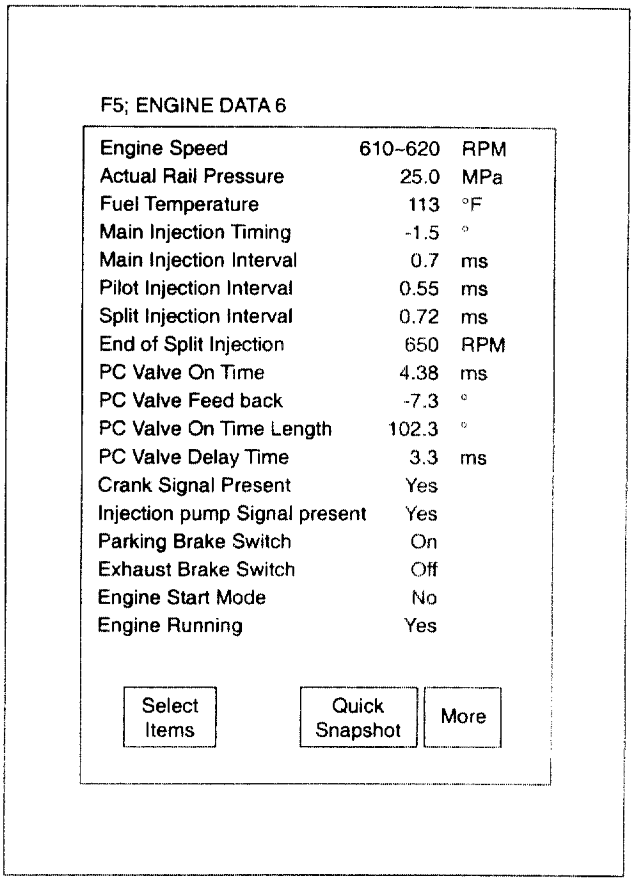
Conditions for Clearing the MIL/DTC

DTC 0014 can be cleared by using the "Clear Info" by Tech 2 or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to ground, shorts to battery and open circuits. If the harness appears to be OK, observe the injection pump signal present display on the scan tool while moving connectors and wiring harnesses related to the CAM sensor. A change in the display will indicate the location of the fault.



F5; ENGINE DATA 6

Engine Speed	610~620	RPM
Actual Rail Pressure	25.0	MPa
Fuel Temperature	113	°F
Main Injection Timing	-1.5	°
Main Injection Interval	0.7	ms
Pilot Injection Interval	0.55	ms
Split Injection Interval	0.72	ms
End of Split Injection	650	RPM
PC Valve On Time	4.38	ms
PC Valve Feed back	-7.3	°
PC Valve On Time Length	102.3	°
PC Valve Delay Time	3.3	ms
Crank Signal Present	Yes	
Injection pump Signal present	Yes	
Parking Brake Switch	On	
Exhaust Brake Switch	Off	
Engine Start Mode	No	
Engine Running	Yes	

060M200069

- White smoke in case of racing.
- Poor output of tachometer (CAM failure during drive is outputted till engine stop).

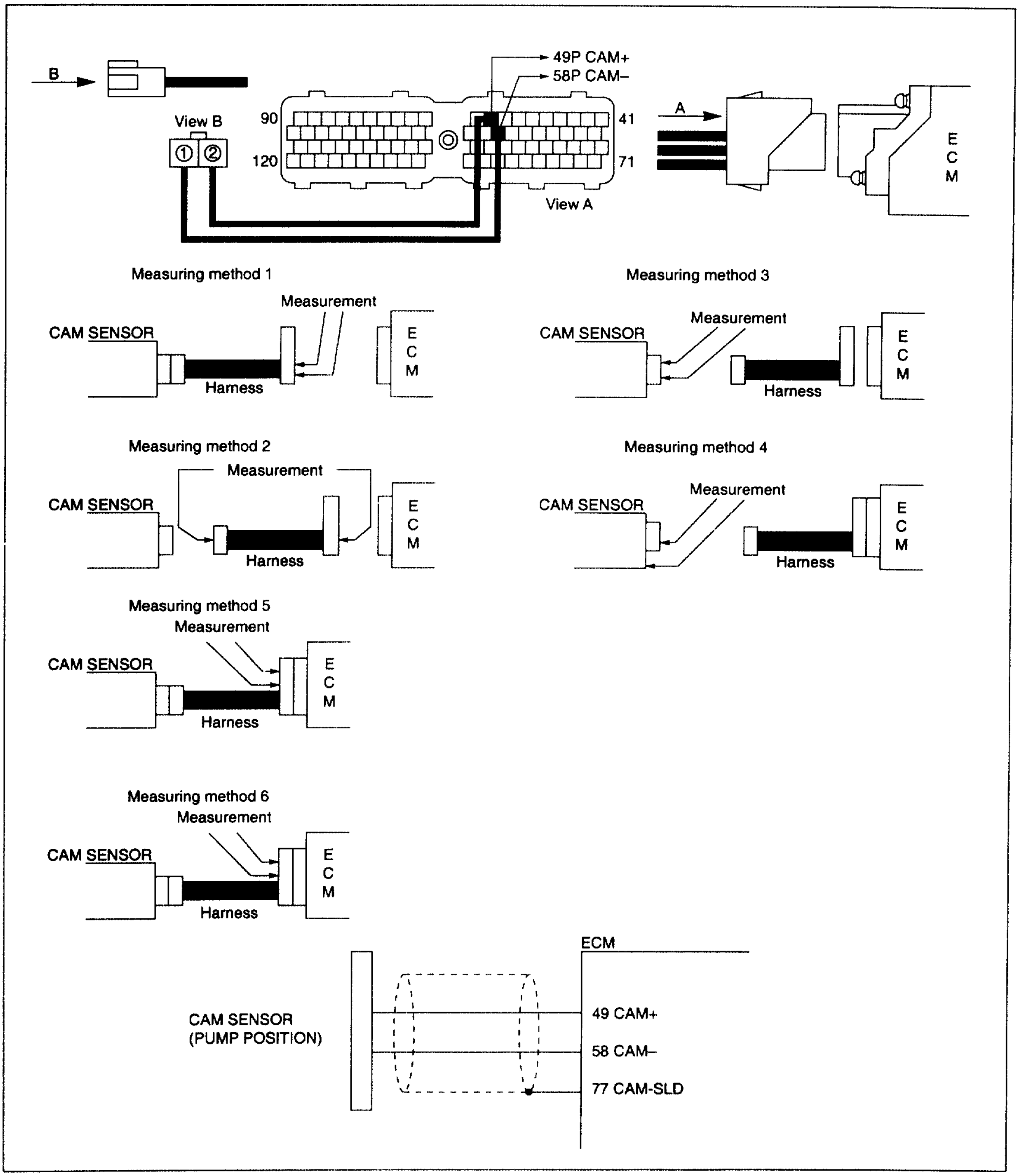
DTC 0014 Pump Position Sensor Error (CAM sensor)

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does DTC 0014 display after engine starting at 700 rpm or less.	—	Go to step 3	—
3 3	1. Key switch OFF. 2. Disconnect ECM connector. 3. Measure resistance between pin number 49 (CAM+) and pin number 58 (CAM–) on the CAM sensor harness. (Measuring method 1) Is resistance within the value?	1850Ω to 2450Ω (about 20°C)	Go to step 7	Go to step 4
4	1. Disconnect CAM sensor harness. 2. Measure resistance between pin number 49 (CAM+) and pin number 2 (CAM sensor terminal 1 side) and between pin number 58 (CAM–) and pin number 1 (CAM sensor terminal 2 side). (Measuring method 2) Is resistance within the value?	Less than 2Ω	Go to step 5	Repair harness then Go to step 9
5	Measure resistance in between terminals on the CAM sensor. (Measuring method 3) Is resistance within the value?	1850Ω to 2450Ω (about 20°C)	Go to step 6	Replace CAM sensor then Go to step 9
6	Measure shortage between CAM sensor terminal and CAM sensor body. (Measuring method 4) Is resistance within the value?	More than 10MΩ	Go to step 9	Replace CAM sensor then Go to step 9
7	1. Reconnect ECM connector and check DTC. 2. Measure CAM sensor output voltage while engine is running. 3. Observe CAM sensor output voltage waveform (Measuring method 5) by oscilloscope. Is voltage within the value?	More than 0.4V/260 rpm More than 3.4V/2600 rpm	Go to step 8	Replace supply pump assembly then Go to step 8
8	Check DTC indication. Is DTC 0014 displayed?	—	Replace ECM then Go to step 9	Double check for connector cable etc. contact incomplete. Go to step 9
9	Recheck DTC indication. Is DTC 0014 displayed?	—	Go back step 3	System OK

	Note:
	• **As compared with CAM sensor, CKP sensor is difficult to detect trouble because its influence is smaller.**
	• **An intermittent condition can be caused by the following**
	  • **Poor connections**
	  • **Rubbed through wire insulation**
	• **There are two countermeasure for CAM sensor error, one is CAM sensor replacement and the other is supply pump replacement.**			

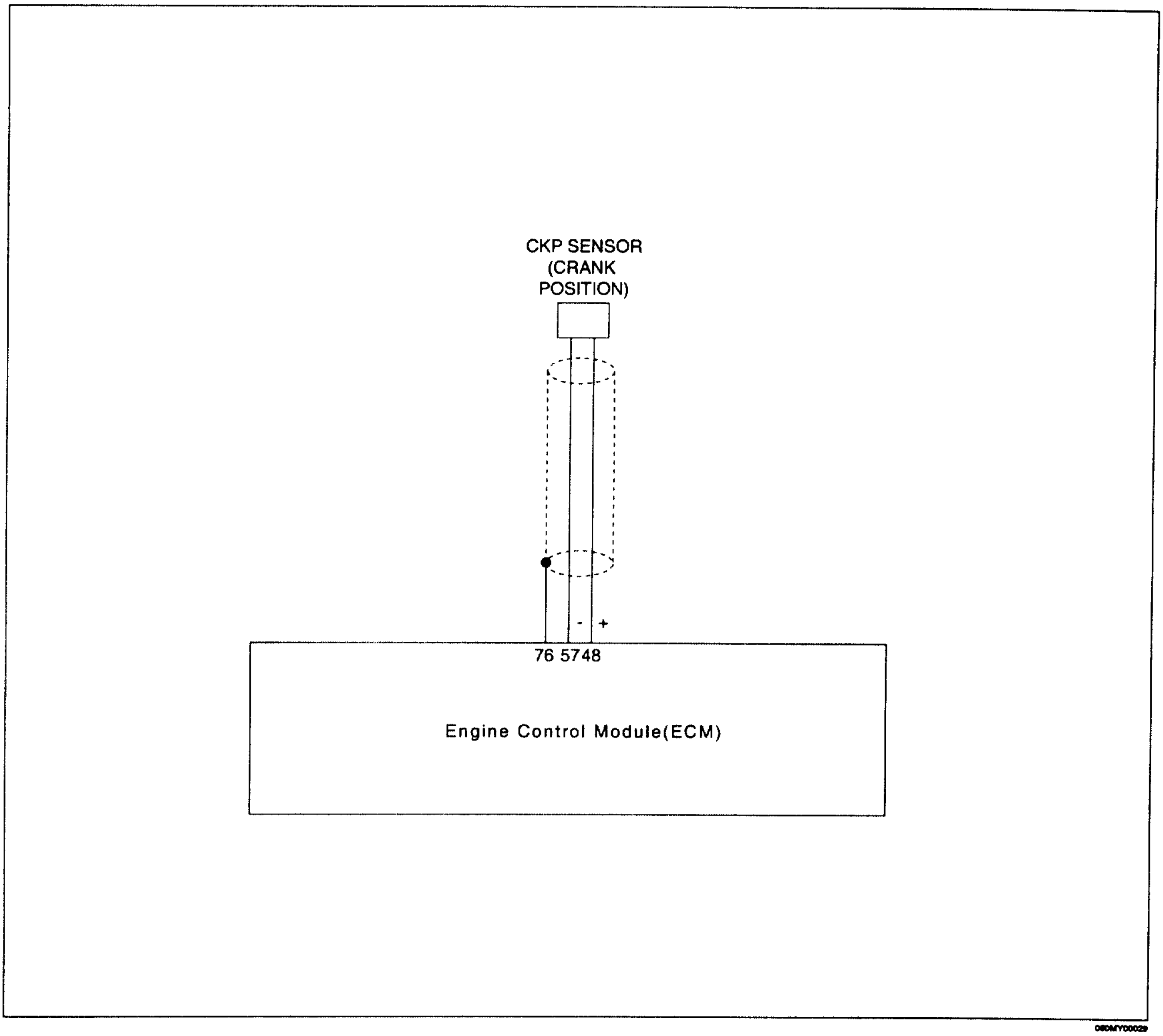
IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

DTC 0014 Pump Position Sensor Error (CAM sensor)



060MX088

DTC 0015 Crank Position Sensor Error (CKP sensor)



Circuit Description

This sensor comprises a permanent magnet, coil, and iron core and is installed to the flywheel housing. With the engine started, the signal holes made on the outer periphery of the flywheel cut off intermittently the magnetic field made by the magnet, thereby generating AC in the coil.

The signal holes on the flywheel are provided every 7.5°, but 3 point is holeless. Therefore, the signal holes total 45. 90 pulses are outputted per 2 rotations of the engine. By this signal, engine speed and 7.5°-based crank angle can be detected.

Diagnostic Trouble Code 0015 will set when the ECM detects a no signal for open circuit or sensor damage on the CKP sensor signal circuit.

Conditions for Setting the DTC

- When CAM sensor pulse (pump position, 40 times of pulse input) is normal (engine ON) there is no CKP pulse input nor 1 sec. or more.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- When the CKP sensor fails, the engine will run off of the pump position/CAM sensor.
- When both failure, injection stops.

Conditions for Clearing the MIL/DTC

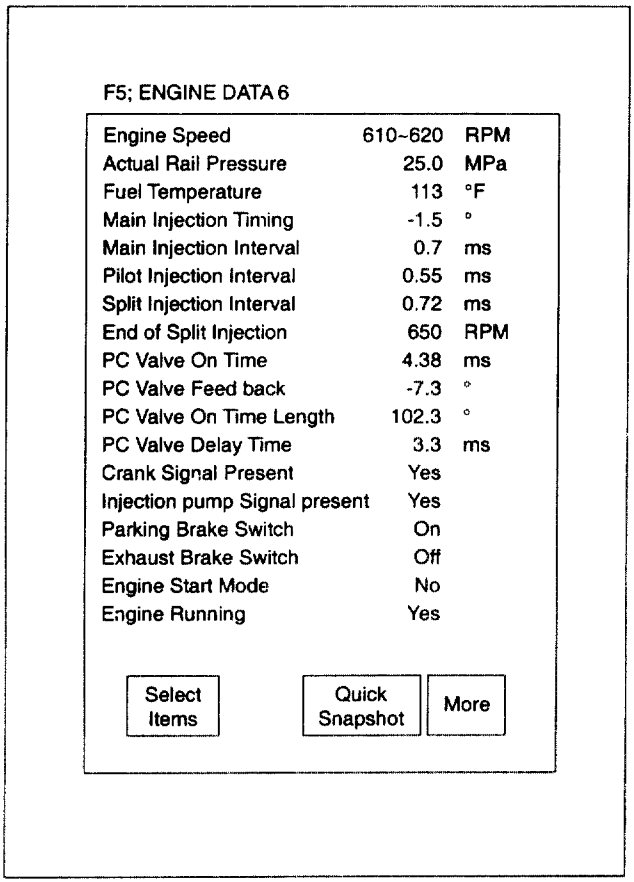
DTC 0015 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

DTC 0015 Crank Position Sensor Error (CKP sensor)

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to ground, shorts to battery and open circuits. If the harness appears to be OK, observe the crank signal present display on the scan tool while moving connectors and wiring harnesses related to the CKP sensor. A change in the display will indicate the location of the fault.



F5; ENGINE DATA 6

Engine Speed	610~620	RPM
Actual Rail Pressure	25.0	MPa
Fuel Temperature	113	°F
Main Injection Timing	-1.5	°
Main Injection Interval	0.7	ms
Pilot Injection Interval	0.55	ms
Split Injection Interval	0.72	ms
End of Split Injection	650	RPM
PC Valve On Time	4.38	ms
PC Valve Feed back	-7.3	°
PC Valve On Time Length	102.3	°
PC Valve Delay Time	3.3	ms
Crank Signal Present	Yes	
Injection pump Signal present	Yes	
Parking Brake Switch	On	
Exhaust Brake Switch	Off	
Engine Start Mode	No	
Engine Running	Yes	

060M200089

- White smoke in case of racing.
- Poor output of tachometer (CKP failure during drive is outputted till engine stop).
- Unstable idling (FCCB stops)

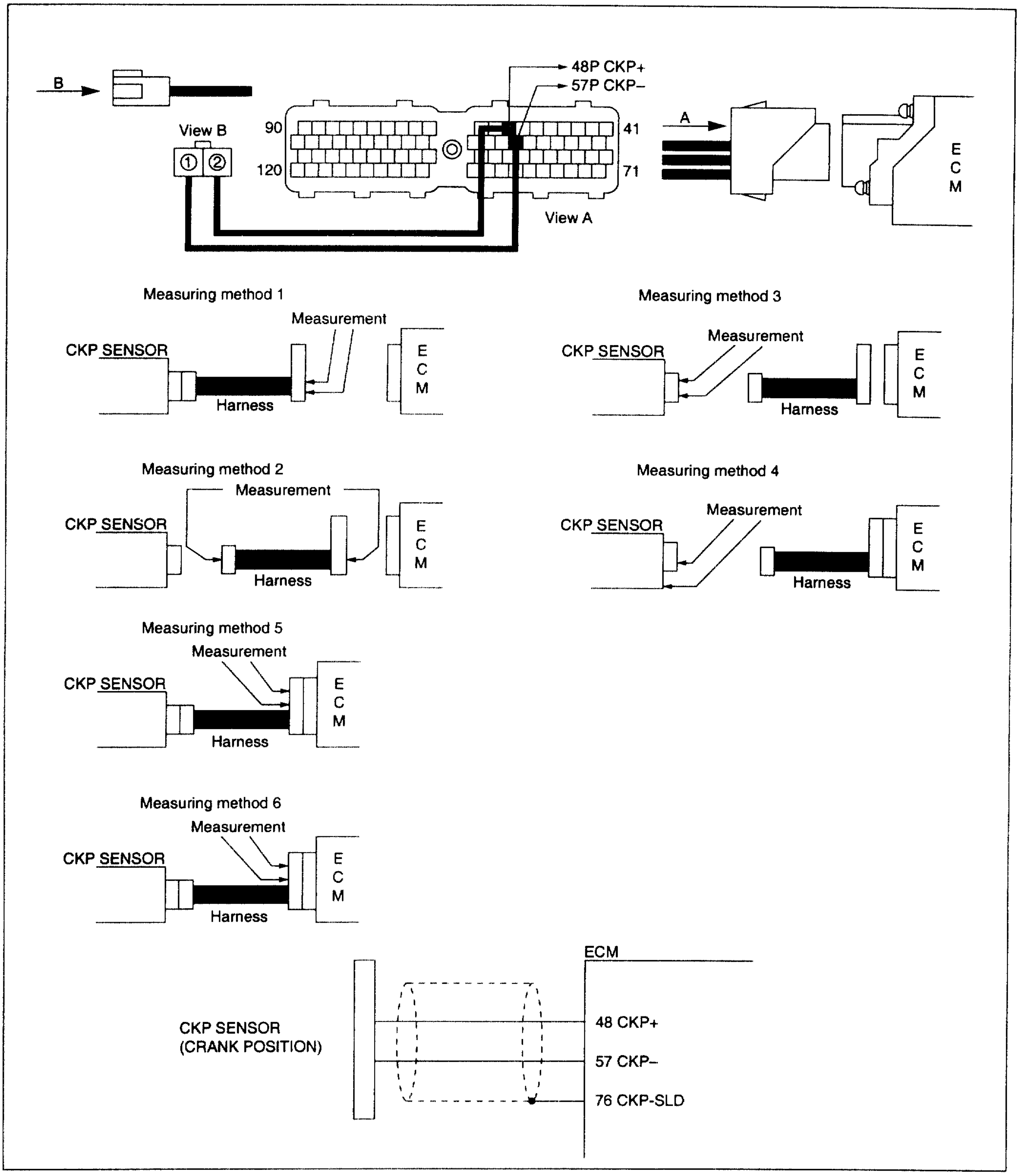
DTC 0015 Crank Position Sensor Error (CKP sensor)

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does DTC 0015 display after engine starting at 700 rpm or less.	—	Go to step 3	—
3	1. Key switch "OFF". 2. Disconnect ECM connector. 3. Measure the resistance between pin number 48 (CKP+) and pin number 57 (CKP–) on the CKP sensor harness. (Measuring method 1)	109Ω to 143Ω (about 20°C)	Go to step 7	Go to step 4
4	1. Disconnect CKP sensor connector. 2. Measure the resistance between pin number 48 (CKP+) and CKP sensor pin number 2. 3. Measure the resistance between pin number 57 (CKP–) and CKP sensor pin number 1. (Measuring method 2) Is resistance within the value?	Less than 2Ω	Go to step 5	Repair CKP sensor harness then Go to step 10
5	Measure CKP sensor unit resistance. (Measuring method 3) Is resistance within the value?	109Ω to 143Ω (about 20°C)	Go to step 6	Replace CKP sensor then Go to step 10
6	Measure resistance between CKP sensor terminal (+, –) and CKP sensor body. (Insulation shortage check) (Measuring method 4) Is resistance within the value?	10MΩ or more	Go to step 10	Replace CKP sensor then Go to step 10
7	Check CKP sensor for fitness and/or looseness. Is a problem found?	—	Go to step 8	Adjustment then Go to step 10
8	Check CKP sensor for damage. Is there damage on CKP sensor?	—	Replace CKP sensor	Go to step 9
9	1. Clear all DTCs. 2. Check DTC indication. Is DTC 0015 displayed.	—	Replace ECM Go to step 10	Double check for connector cable etc. contact incomplete Go to step 9
10	Check for DTCs. Is DTC 0015 displayed?	—	Go back step 3	System OK
	Note: **1. If scan tool is used, intermittent trouble can be detected by CKP sensor active flag(Crank signal Present).** **2. If CKP sensor signal is completely lost, tachometer output is not produced (When NG in the midway, use CAM sensor to produce output).** **3. Under CAM sensor operation, diesel knocking and/or white smoke may often occur due to racing.**			

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

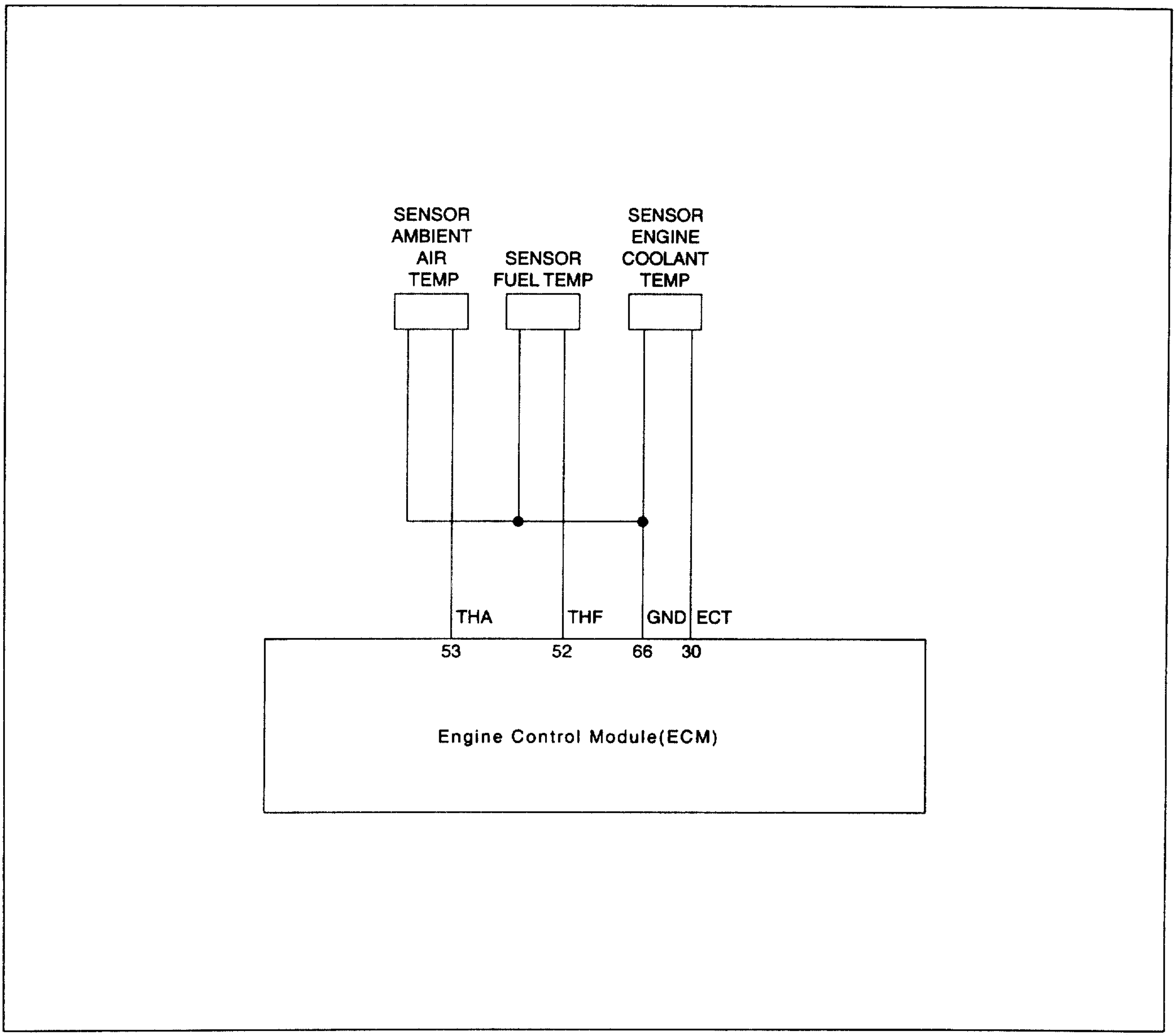
NOTE: Air gap value is 0.9 to 1.2 mm between CKP sensor and flywheel. (Not adjustable)

DTC 0015 Crank Position Sensor Error (CKP sensor)



060MX090

DTC 0022 Ambient Air Temperature Sensor Error



080MY00030

Circuit Description

The Ambient Air Temperature Sensor (THA) is located inside of cab front panel.

The THA is changed into a resistance change signal and sent to ECM for optimization of fuel injection control.

Diagnostic Trouble Code 0022 will set when the ECM detects abnormal signal for open circuit or sensor damage on the sensor signal circuit.

Conditions for Setting the DTC

- THA sensor voltage exceeding 4.95V or lower than 0.1V continues 1 sec. or more.

Action Taken When the DTC Sets

Starting:
THA = –4°F (–20°C)
Other = 68°F (20°C)

Conditions for Clearing the MIL/DTC

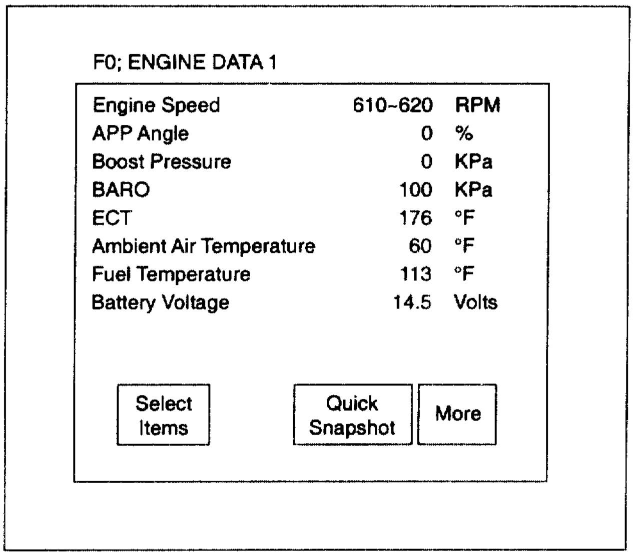
DTC 0022 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

DTC 0022 Ambient Air Temperature Sensor Error

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to ground, shorts to battery and open circuits. If the harness appears to be OK, observe the Ambient Air Temperature display on the scan tool while moving connectors and wiring harnesses related to the THA sensor. A change in the Ambient Air Temperature display will indicate the location of the fault.



F0; ENGINE DATA 1

Engine Speed	610~620	RPM
APP Angle	0	%
Boost Pressure	0	KPa
BARO	100	KPa
ECT	176	°F
Ambient Air Temperature	60	°F
Fuel Temperature	113	°F
Battery Voltage	14.5	Volts

- White smoke at the engine stgarting in cold districts.

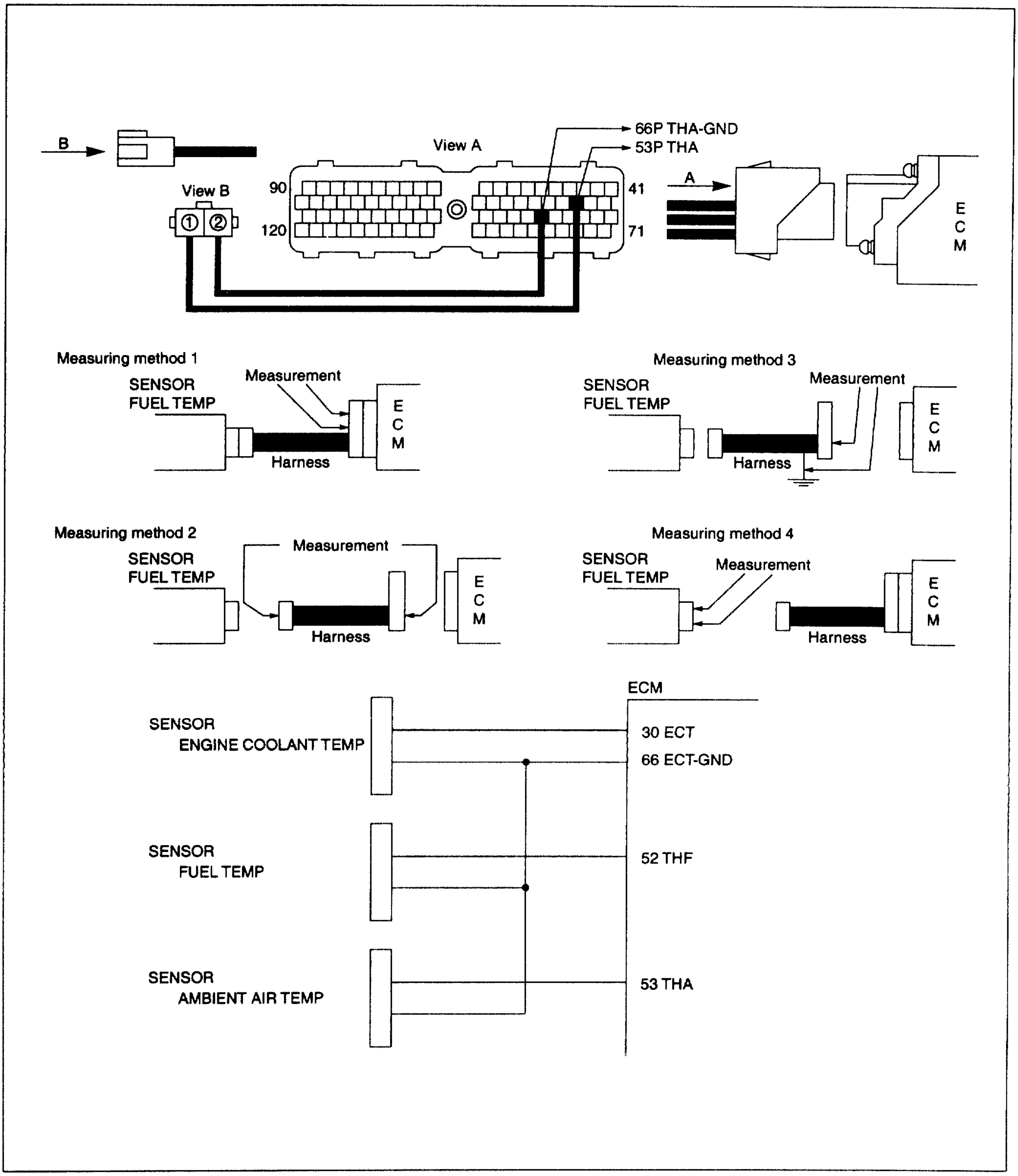
DTC 0022 Ambient Air Temperature Sensor Error

<table>
<tr><th>STEP</th><th>ACTION</th><th>VALUE</th><th>YES</th><th>NO</th></tr>
<tr><td>1</td><td>Was the “On-Board Diagnostic (OBD) System Check” performed?</td><td>—</td><td>Go to step 2</td><td>Go to OBD System Check</td></tr>
<tr><td>2</td><td>Does display DTC 0022 while key switch “ON” or engine in operating?</td><td>—</td><td>Go to step 3</td><td>—</td></tr>
<tr><td>3</td><td>Measure the voltage between pin number 53 (THA) and pin number 66 (AA–GND) at ECM side. (Measuring method 1)
Is there voltage beyond compass from value?
(2.9V when air temp. about 20°C)</td><td>0.1V
to
4.95V</td><td>Go to step 5</td><td>Go to step 4</td></tr>
<tr><td>4</td><td>Check incomplete connection connector on the THA sensor harness.
Is there incomplete connection?</td><td>—</td><td>Repair THA sensor harness</td><td>System OK</td></tr>
<tr><td>5</td><td>Is there abnormal high or low atmospheric temperature at atmospheric temperature sensor fixing area (Displayed by scan tool)?</td><td>Fixed
68°F (20°C)</td><td>Repair problem portion</td><td>Go to step 6</td></tr>
<tr><td>6</td><td>1. Key switch “OFF”.
2. Disconnect THA sensor harness.
3. Measure resistance following points. (Measuring method 2)
• Between pin number 53 (THA) at ECM side and pin number 1 at THA sensor side on the THA sensor harness.
• Between pin number 66 (AA–GND) at ECM side and pin number 2 at THA sensor side on the THA sensor harness.
Is resistance within value?</td><td>2Ω or less</td><td>Go to step 7</td><td>Repair disconnect THA sensor harness.</td></tr>
<tr><td>7</td><td>Measure resistance between pin number 53 (THA) and GND on the THA sensor harness.
Is resistance within value?</td><td>10MΩ or more</td><td>Go to step 8</td><td>Repair/replace THA sensor harness. Then go to step 10</td></tr>
<tr><td>8</td><td>Measure resistance THA sensor unit.
Is resistance within value?

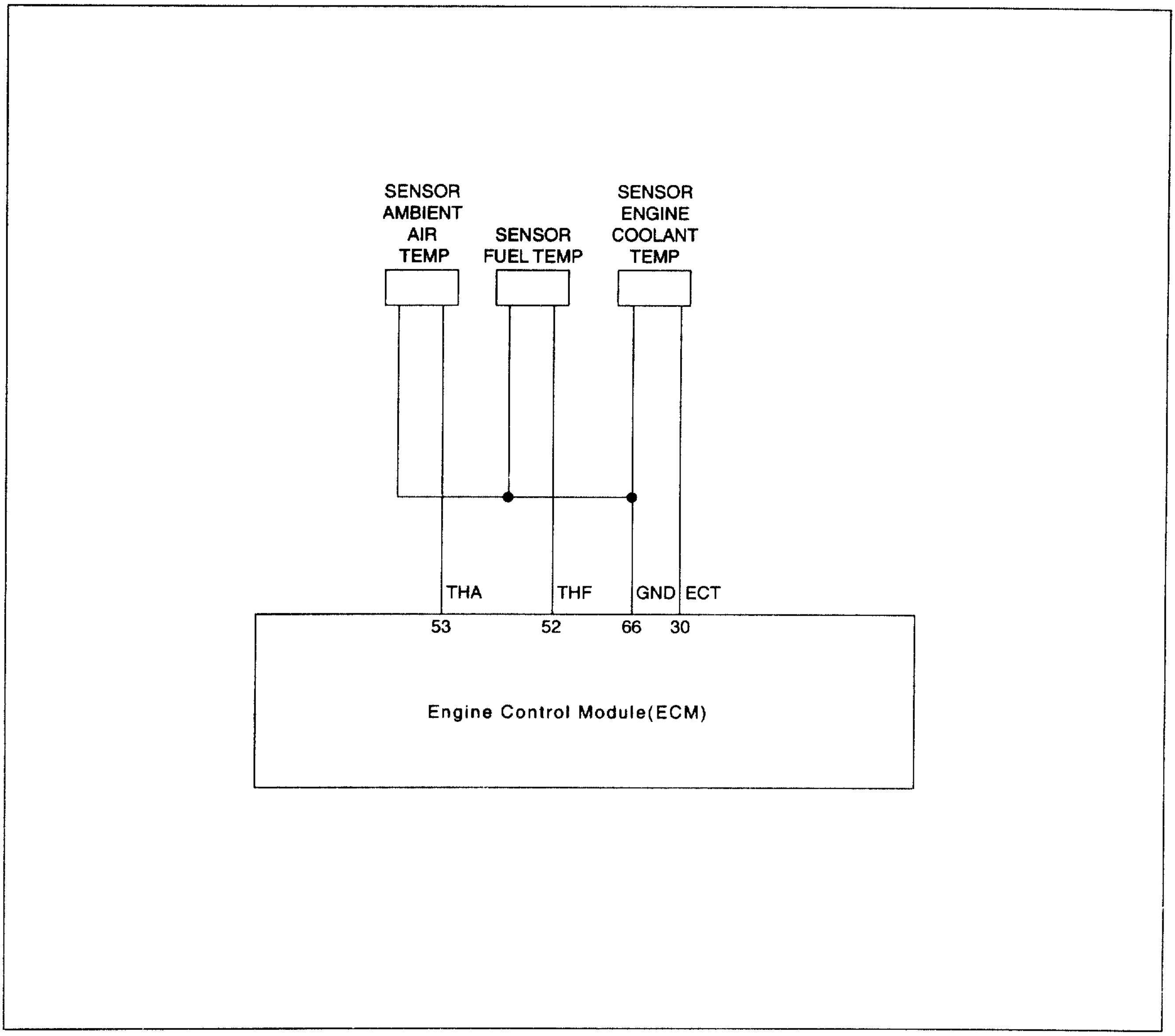
Resistance of THA sensor unit
<table>
<tr><th>Atmospheric temperature (°C)</th><th>Resistance (kΩ)</th></tr>
<tr><td>20</td><td>About 3.8 (2.9V)</td></tr>
<tr><td>40</td><td>1.6 (1.9V)</td></tr>
<tr><td>60</td><td>0.8 (1.1V)</td></tr>
<tr><td>80</td><td>0.4 (0.7V)</td></tr>
</table></td><td>See table left</td><td>Go to step 9</td><td>Replace THA sensor assembly. Then go to step 10</td></tr>
<tr><td>9</td><td>1. Reconnect THA sensor harness to ECM and THA sensor.
2. Clear DTC.
Is display DTC 0022?</td><td>—</td><td>Replace ECM assembly then Go to step 10</td><td>System OK</td></tr>
<tr><td>10</td><td>Clear DTC.
Is display DTC 0022?</td><td>—</td><td>Go back to step 3</td><td>System OK</td></tr>
<tr><td></td><td>Note: Sometimes it indicate DTC 0022 at abnormal low atmospheric temperature (Less than minus 40°C).</td><td></td><td></td><td></td></tr>
</table>

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to “Capture and Restore Fuel Rate Data” of “Tech 2 Scan Tool” in this manual.

DTC 0022 Ambient Air Temperature Sensor Error



DTC 0023 Engine Coolant Temperature Sensor Error



Circuit Description

The engine control module (ECM) applies a voltage (about 5 volts) through a pull-up resistor to the ECT signal circuit.

When the engine coolant is cold, the sensor (thermistor) resistance is high, therefore the ECM will measure a high signal voltage. As the engine coolant warms, the sensor resistance becomes less, and the ECT signal voltage measured at the ECM drops. With a fully warmed up engine, the ECT signal voltage should measure about 1.5 to 2.0 volts. If the ECM detect a continuous open in the ECT sensor or circit, then a code 0023 will set.

Conditions for Setting the DTC

- Water temperature sensor voltage exceeding 4.8V or lower than 0.1V continues for 1 sec.
  (4.8V = –50°C, 0.1V = 110°C)

Action Taken When the DTC Sets

- Starting: Based on –4°F (–20°C)
- Other: Based on 176°F (80°C)

Conditions for Clearing the MIL/DTC

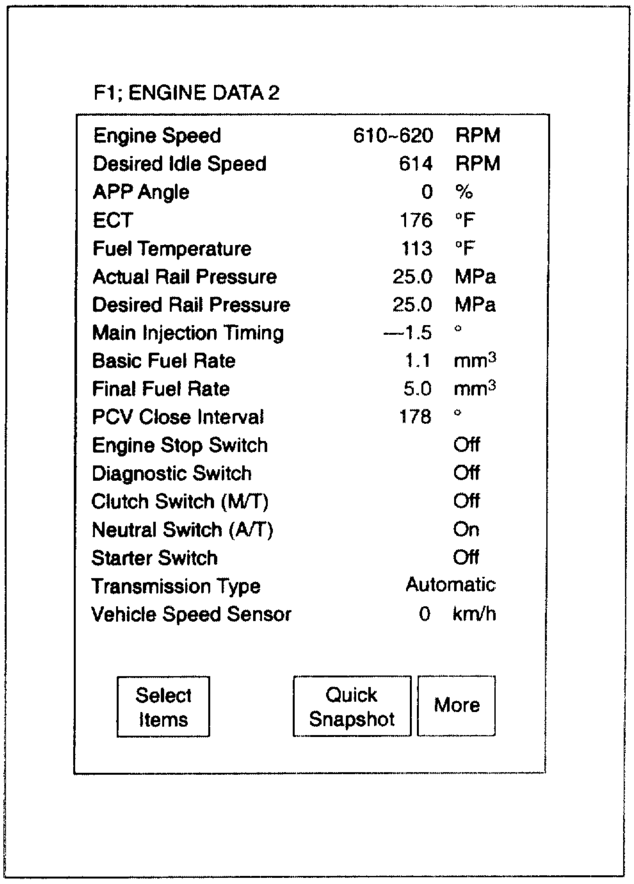
DTC 0023 can be cleared by using the “Clear Info” by scan tool or using by the Diag Clear Switch.

DTC 0023 Engine Coolant Temperature Sensor Error

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to ground, shorts to battery and open circuits. If the harness appears to be OK, observe the ECT display on the scan tool while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.



F1; ENGINE DATA 2

Engine Speed	610~620	RPM
Desired Idle Speed	614	RPM
APP Angle	0	%
ECT	176	°F
Fuel Temperature	113	°F
Actual Rail Pressure	25.0	MPa
Desired Rail Pressure	25.0	MPa
Main Injection Timing	—1.5	°
Basic Fuel Rate	1.1	mm^3
Final Fuel Rate	5.0	mm^3
PCV Close Interval	178	°
Engine Stop Switch		Off
Diagnostic Switch		Off
Clutch Switch (M/T)		Off
Neutral Switch (A/T)		On
Starter Switch		Off
Transmission Type		Automatic
Vehicle Speed Sensor	0	km/h

060M200057

- Smoke observe when started after warming up.
- Excessive white smoke when started in cold weather.

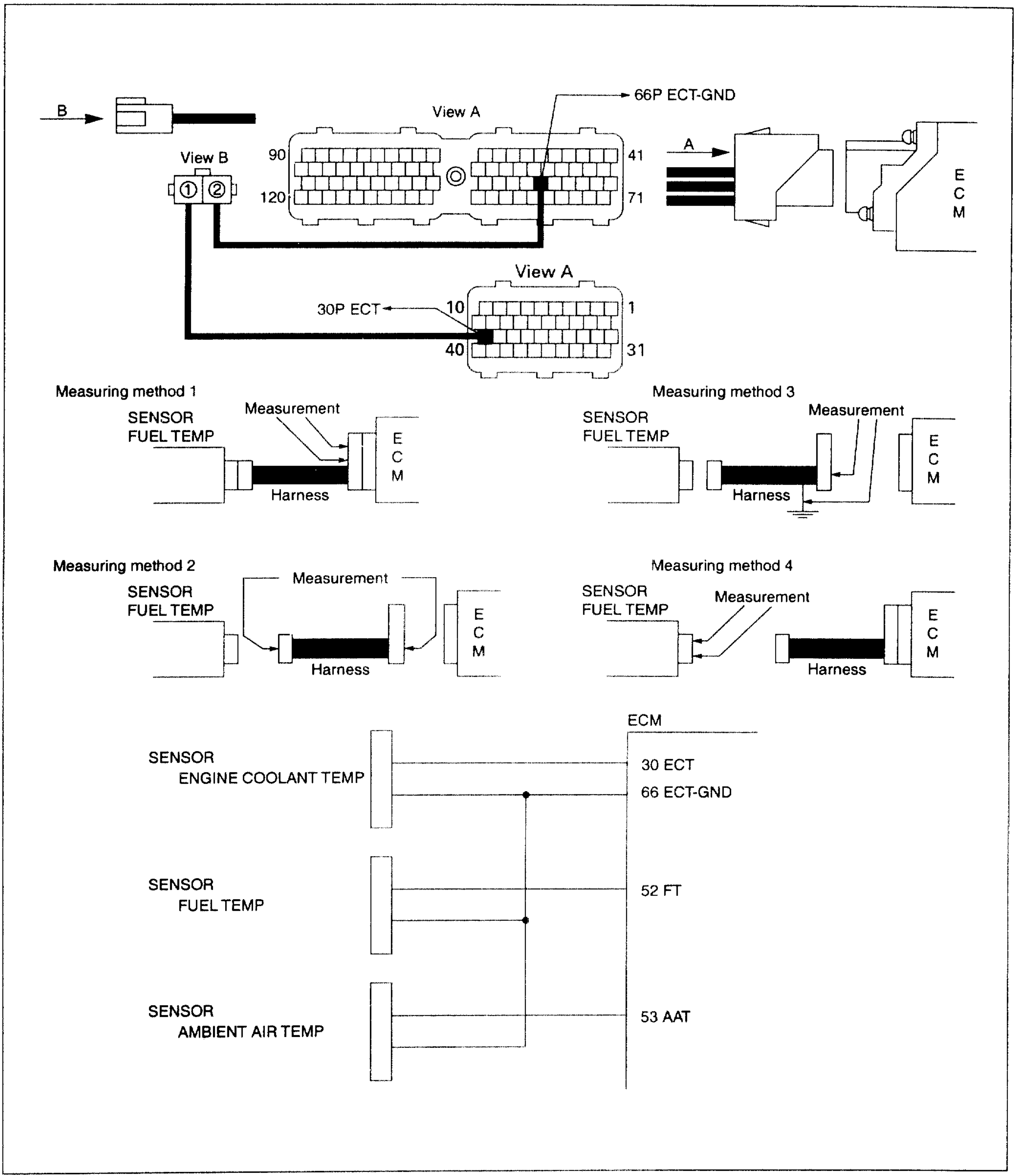
DTC 0023 Engine Coolant Temperature Sensor Error

<table>
<tr><th>STEP</th><th>ACTION</th><th>VALUE</th><th>YES</th><th>NO</th></tr>
<tr><td>1</td><td>Was the “On-Board Diagnostic (OBD) System Check” performed?</td><td>—</td><td>Go to step 2</td><td>Go to OBD System Check</td></tr>
<tr><td>2</td><td>Does display DTC 0023 when key switch “ON” or engine in operation?</td><td>—</td><td>Go to step 3</td><td>—</td></tr>
<tr><td>3</td><td>Measure the voltage between pin number 30 (ECT) and pin number 66 at ECM side while key switch “ON” and engine in operation. (Measuring method 1)
Is voltage outside specified value?
(0.65V when water temp. about 80°C)
Note: When voltage abnormally high e.g. 12V, may be short circuited with B+ line.</td><td>0.1V to 4.8V</td><td>Go to step 5</td><td>Go to step 4</td></tr>
<tr><td>4</td><td>Check intermittent incomplete connection in between connector and ECT sensor harness or temporally overheating of engine.
Is there a problem?</td><td>—</td><td>Go to step 5</td><td>Go to step 6</td></tr>
<tr><td>5</td><td>Repair/replace engine cooling system such as radiator, fan and thermostat etc.
Did you complete?</td><td>—</td><td>Go to step 3</td><td>Complete Then go to step 10</td></tr>
<tr><td>6</td><td>1. Key switch “OFF”.
2. Disconnect connector from ECM and ECT sensor.
3. Measure resistance following points. (Measuring method 2)
• Between pin number 30 (ECT) at ECM side and pin number 1 at sensor side.
• Between pin number 66 at ECM side and pin number 3 at sensor side.
Is resistance within value?</td><td>2Ω or less</td><td>Go to step 7</td><td>Repair/replace to ECT sensor harness</td></tr>
<tr><td>7</td><td>Measure the resistance between pin number 30 (ECT) and GND on the ECT sensor harness.
Is resistance within value?</td><td>10MΩ or more</td><td>Go to step 8</td><td>Repair/replace to ECT sensor harness</td></tr>
<tr><td>8</td><td>Measure the resistance ECT sensor unit.
Is resistance normal value?

Resistance for ECT sensor unit
<table>
<tr><th>Water temperature (°C)</th><th>Resistance (kΩ)</th></tr>
<tr><td>20</td><td>About 2.7 (2.5V)</td></tr>
<tr><td>40</td><td>1.3 (1.6V)</td></tr>
<tr><td>60</td><td>0.6 (0.9V)</td></tr>
<tr><td>80</td><td>0.4 (0.65V)</td></tr>
</table></td><td>See table left</td><td>Go to step 9</td><td>Replace ECT sensor</td></tr>
<tr><td>9</td><td>1. Reconnect ECT sensor harness connector to both ECM and ECT sensor.
2. Clear DTC.
Is DTC 0023 displayed?</td><td>—</td><td>Replace ECM assembly. Then go to step 10</td><td>System OK</td></tr>
<tr><td>10</td><td>Clear all DTCs.
Is DTC 0023 displayed?</td><td>—</td><td>Go back to step 3</td><td>System OK</td></tr>
<tr><td></td><td>Note: Water temperature GND is common. If disconnected or short circuited, all sensors become erroneous. (Water, atmospheric and fuel temperature)</td><td></td><td></td><td></td></tr>
</table>

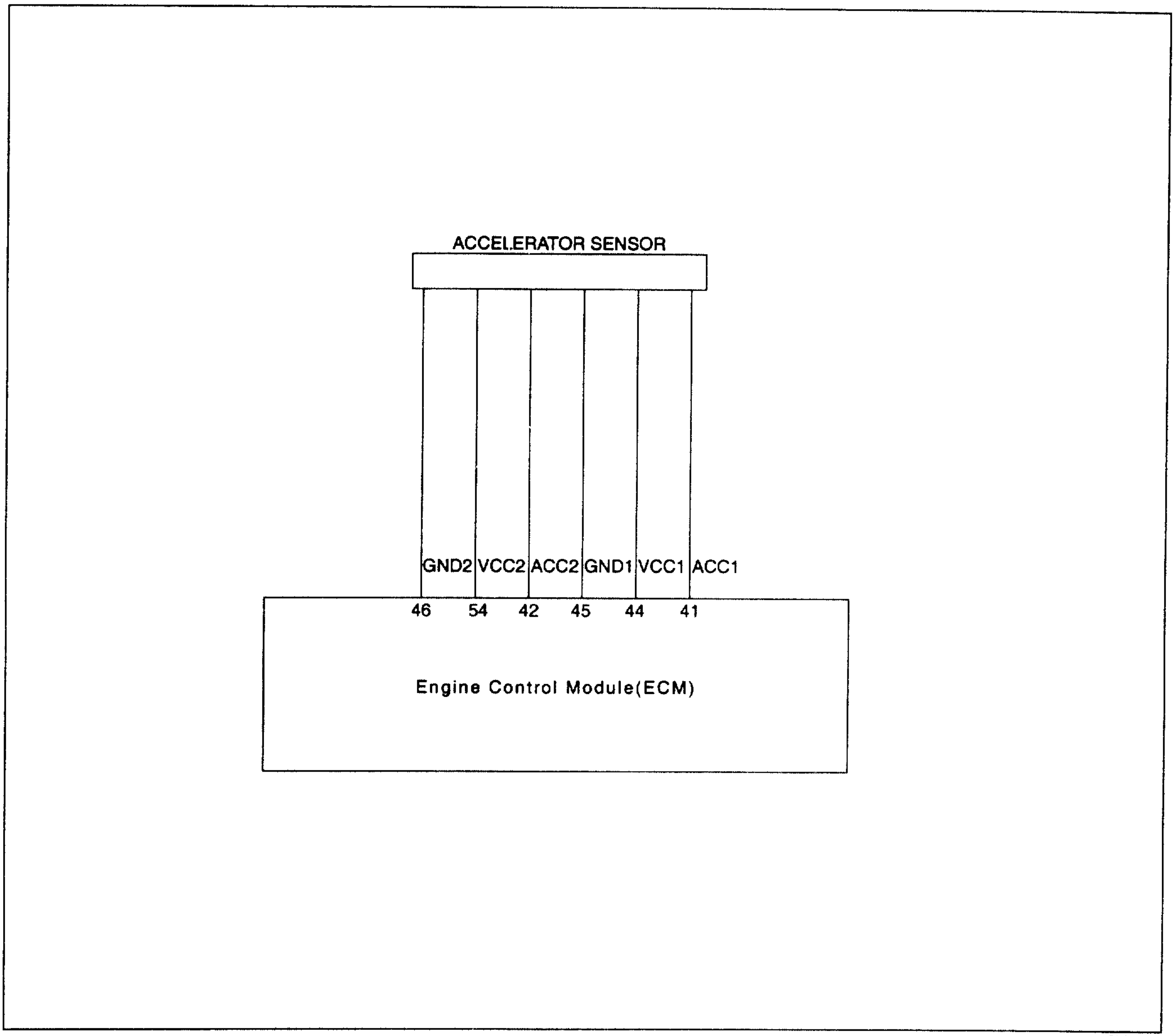
IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to “Capture and Restore Fuel Rate Data” of “Tech 2 Scan Tool” in this manual.

DTC 0023 Engine Coolant Temperature Sensor Error



060M200036

DTC 0024 Accelerator Pedal Position Sensor Error 1 and 2 (Accelerator sensor circuit/circuit performance)



Circuit Description

This sensor is an IC type substituting electric signals for accelerator pedaling amount to be sent to ECM. It is installed to accelerator pedal bracket assembly.

The Accelerator Position (AP) signal is used by the engine control module (ECM) for fuel control and most of the ECM – controlled outputs. The ECM monitors accelerator position. If the ECM detects an out-of-range condition, then a DTC code 0024 will set.

Conditions for Setting the DTC

Item 1. Accelerator
Sensor Error 1
Item 2. Accelerator
Sensor Error 2
Item 3. Accelerator
Sensor 1
Intermediate throttle position voltage hold steady.
Item 4. Accelerator
Sensor 2
Intermediate voltage hold trouble.

- Item 1 and 2: Accelerator voltage exceeding 4.8V or lower than 0.5V continues 1 sec. or more.
- Item 3 and 4: Difference between previous value and current value is lower than 0.05 V (stationary), difference from the other sensor voltage exceeding 0.2V and no individual abnormality detected by sensor 1 and 2 continues.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Item 1, 2, 3 and 4: When one sensor is normal, backup by normal sensor.
- When both sensor are faulty accelerator is fixed at 20%, however using an injection map for ASC mode.
  If a brake pedal is "ON", the degree of accelerator value will became 0%.

DTC 0024 Accelerator Pedal Position Sensor Error 1 and 2 (Accelerator sensor circuit/circuit performance)

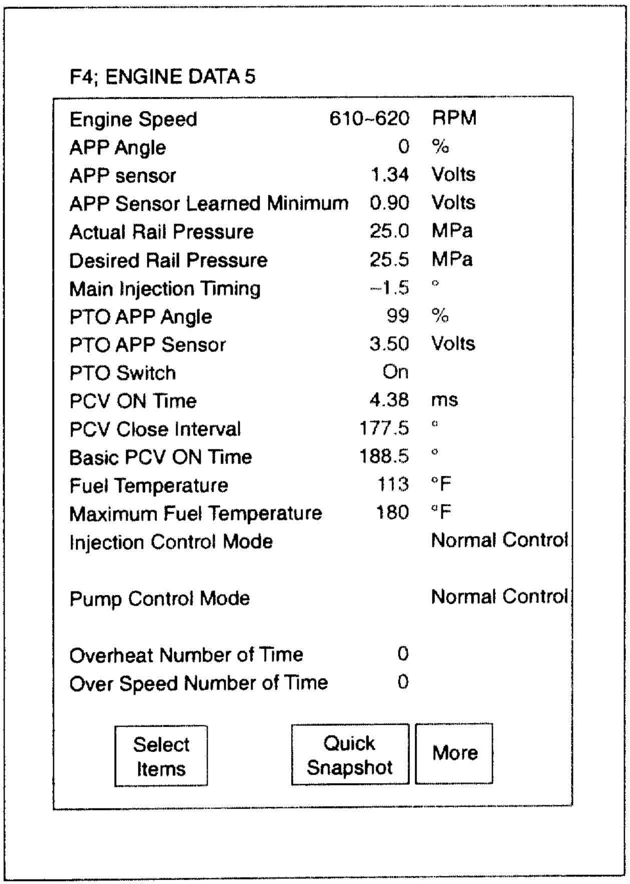
Conditions for Clearing the MIL/DTC

DTC 0024 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to ground, shorts to battery and open circuits. If the harness appears to be OK, observe the APP sensor display on the scan tool while moving connectors and wiring harnesses related to the AP sensor. A change in the APP sensor display will indicate the location of the fault.



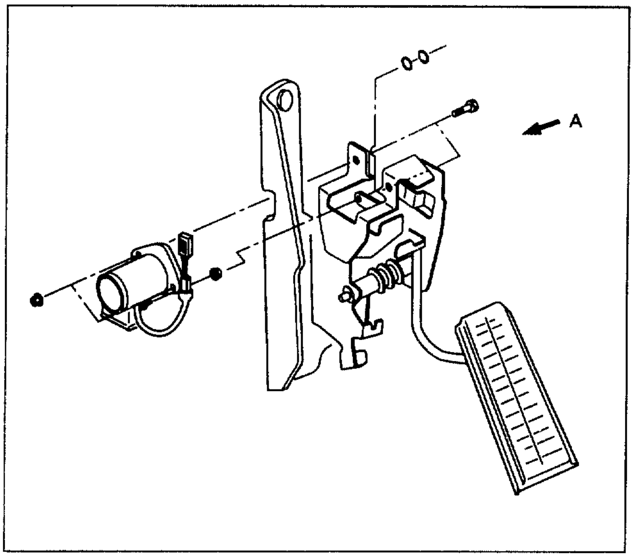
F4; ENGINE DATA 5

```
Engine Speed                  610~620  RPM
APP Angle                           0  %
APP sensor                       1.34  Volts
APP Sensor Learned Minimum       0.90  Volts
Actual Rail Pressure             25.0  MPa
Desired Rail Pressure            25.5  MPa
Main Injection Timing            -1.5  °
PTO APP Angle                      99  %
PTO APP Sensor                   3.50  Volts
PTO Switch                         On
PCV ON Time                      4.38  ms
PCV Close Interval              177.5  °
Basic PCV ON Time               188.5  °
Fuel Temperature                  113  °F
Maximum Fuel Temperature          180  °F
Injection Control Mode                 Normal Control

Pump Control Mode                      Normal Control

Overheat Number of Time             0
Over Speed Number of Time           0
```

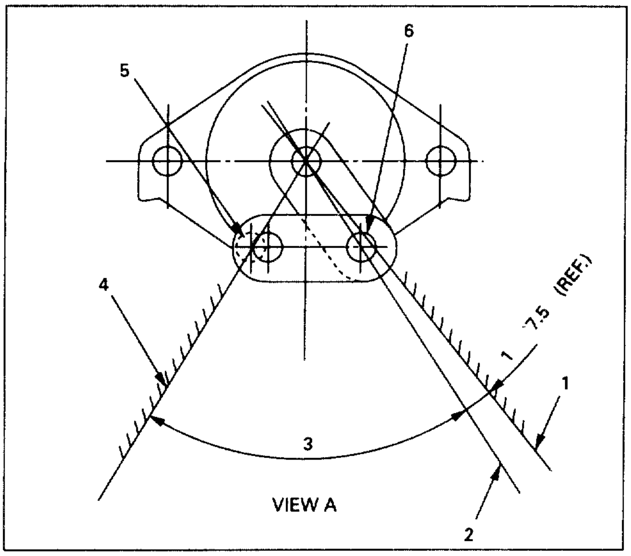
060M200080

- Poor throttle response.
- No accelerator response.
- 1200 rpm fixed.

Procedure Acceleration Sensor Adjustment



058MV040



058MV039

Legend

(1) Pedal Initial Position
(2) Sensor Set Position
(3) Sensor Travel (Deg.)
(4) Pedal Full Position
(5) Pedal Full Stroke Position
(6) Idling Side Sensor Set Position

Idling side adjustment

Set acceleration sensor output voltage between 0.85 and 1.15 volts at sensor set position (6).

Full Stroke side adjustment

Confirm sensor output voltage more than 3.49 volts (Max. 4.5V) when the pedal is AT wide open throttle (5).

DTC 0024 Accelerator Pedal Position Sensor Error 1 and 2 (Accelerator sensor circuit/circuit performance)

Note: The accelerator sensor is element type and non contact type, thus, when doing judgment to supplying voltage.

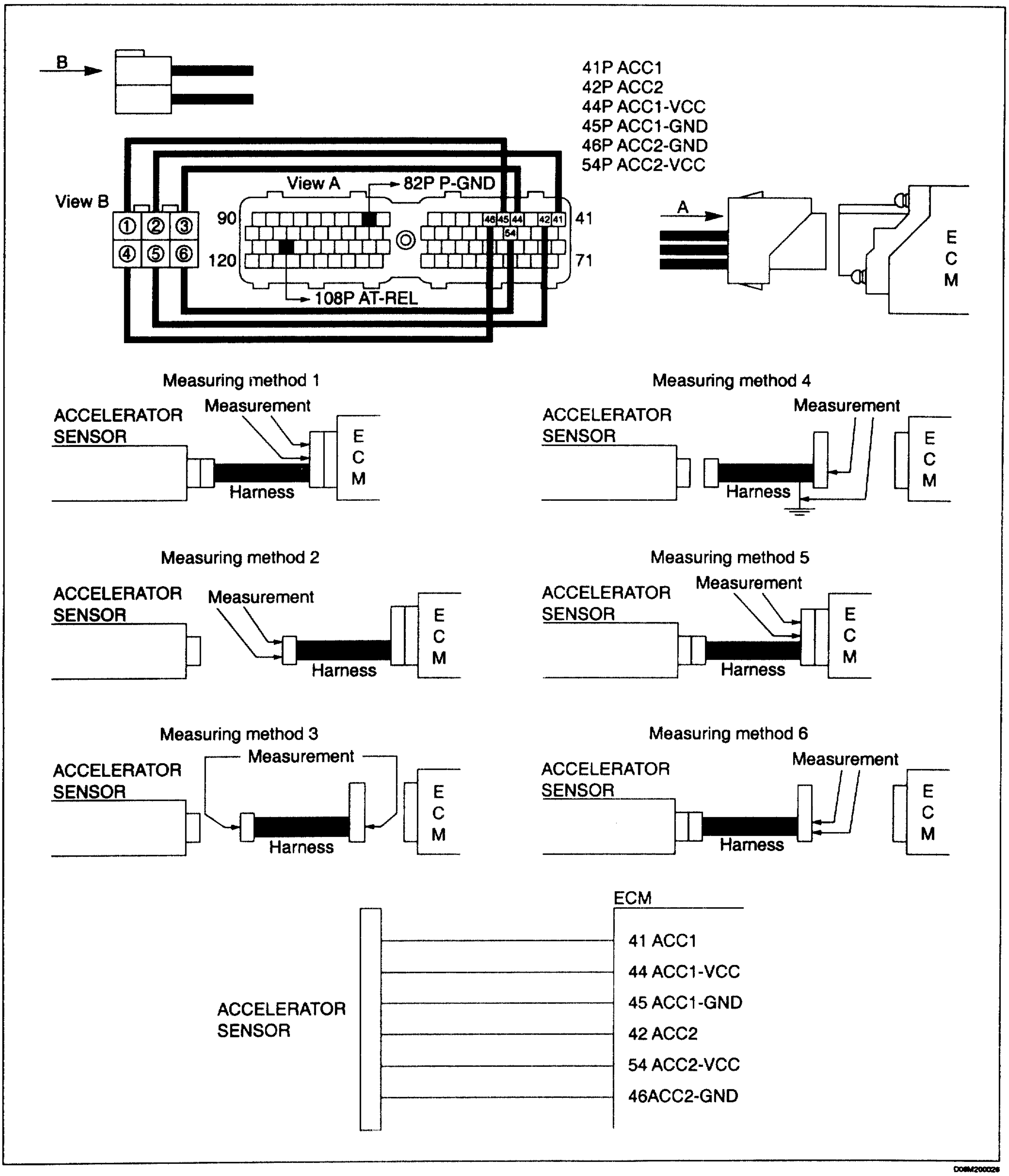
STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System check
2	Does DTC 0024 display while key switch "ON" or engine operating?	—	Go to step 3	—
3	Check the brake switch circuit. 1. Install the scan tool. 2. Starter switch "ON". 3. Depress the brake Pedal. Is "APP Angle" show normal value?	0%	Go to Step 4	Repair/ Replace circuit or brake switch
4	Check the various harness whether an open or short. (Measuring method 3) • Between ECM (pin number 44 at ECM side) and accelerator position sensor (pin number 3 at sensor side). • Between ECM (pin number 54 at ECM side) and accelerator position sensor (pin number 6 at sensor side). • Between ECM (pin number 41 at ECM side) and accelerator position sensor (pin number 2 at sensor side). • Between ECM (pin number 42 at ECM side) and accelerator position sensor (pin number 5 at sensor side). • Between ECM (pin number 45 at ECM side) and accelerator position sensor (pin number 1 at sensor side). • Between ECM (pin number 46 at ECM side) and accelerator position sensor (pin number 4 at sensor side). Was a circuit normal?	—	Go to Step 5	Repair/ Replace sensor harness
5	1. Key switch "OFF". 2. Reconnect the "ECM. 3. Key switch "ON". 4. Measure voltage following point at ECM side. (Measuring method 2) • Between pin number 44 (ACC1-VCC) and pin number 45 (ACC1-GND). • Between pin number 54 (ACC2-VCC) and pin number 46 (ACC2-GND). Is voltage within value?	4.5V to 5.5V	Go to Step 6	Replace ECM
6	1. Reconnect APP sensor. 2. Clear the DTC 3. Using the scan tool, check the value for "APP sensor Learned Minimum". 4. Check the value for "APP sensor Learned Minimum" at idle position. Is "APP sensor Learned Minimum" within value?	Idle Position 0.85 to 1.15V	Go to Step 8	Go to Step 7
7	Adjust the accelerator position sensor. (Refer to 6E-144 for procedure) Note: Sensor is replaced, when not within specified value, even if the output voltage of a sensor attaches and it adjusts an angle. Was the action complete?	—	Go to Step 8	—

DTC 0024 Accelerator Pedal Position Sensor Error 1 and 2 (Accelerator sensor circuit/circuit performance)

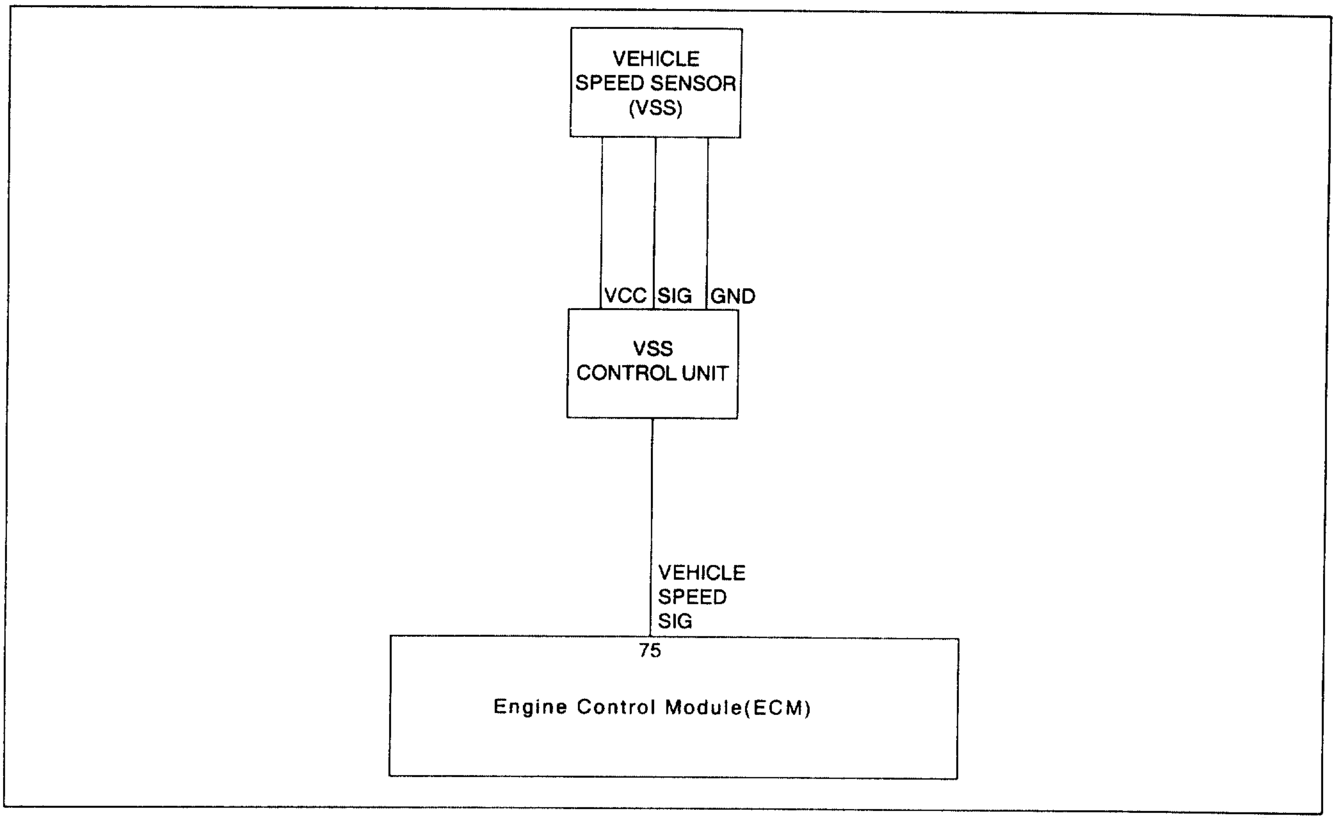
STEP	ACTION	VALUE	YES	NO
8	1. Reconnect APP sensor. 2. Clear the DTC 3. Using the scan tool, check the value for "APP sensor Learned Minimum". 4. Check the value for "APP sensor " at idle position. 5. Check the value for "APP sensor " at WOT position. Is "APP sensor" within value?	Idle Position 0.85 to 1.15V WOT Position 4.5V (MAX)	Go to Step 9	Replace accelerator position sensor Go back to step 6
9	Check the APP sensor 1 output voltage (SIG) and the APP sensor 2 output voltage (SIG) As compared with specified value, it checks whether output voltage is normal. Is voltage within value?	Idle Position 0.85 to 1.15V WOT Position 4.5V (MAX)	Go to Step 10	Replace accelerator position sensor Go back to step 6
10	1. Reconnect APP sensor. 2. Clear the DTC 3. Using the scan tool, check the value for "APP sensor Learned Minimum". 4. Check the value for "APP sensor " at idle position. 5. Check the value for "APP sensor " at WOT position. Is "APP sensor" within value?	Idle Position 0.85 to 1.15V WOT Position 4.5V (MAX)	Go to Step 11	Replace ECM
11	Clear all DTCs. Is DTC 0024 displayed?	—	Go back to step 3	System OK
	Note: After replacing the APP it is necessary to set voltage at idle position. (See page 6E-144 for procedure)			

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2.
Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

DTC 0024 Accelerator Sensor Error 1 and 2 (Accelerator sensor circuit/circuit performance)



DTC 0025 Vehicle Speed Sensor Error



Circuit Description

The VS (Vehicle Speed) Sensor monitors the vehicle speed.

The sensor is installed to the transmission output shaft.

The output signal is sent to the VS Sensor control unit where it is converted into pulses. These pulses are sent to the ECM (Engine Control Module). The ECM calculates the pulse width to determine

vehicle speed.

Conditions for Setting the DTC

- Engine revolutions 1500 rpm or more.
- Neutral switch is "OFF" (AT) or clutch switch is "ON" (MT).
- The PTO switch is "OFF" and parking switch is "OFF".
- The ECM does not detects DTC 28.
- The ECM has not received input of vehicle speed signal.
- When these states continues for 15 sec.
- Set the PTO Accelerator position sensor.

Action Taken When the DTC Sets.

- The ECM will not illuminate the malfunction indicator lamp(MIL) the first time the fault is detected.
- The ECM records only DTC.
- Operation prohibition of PTO accelerator.

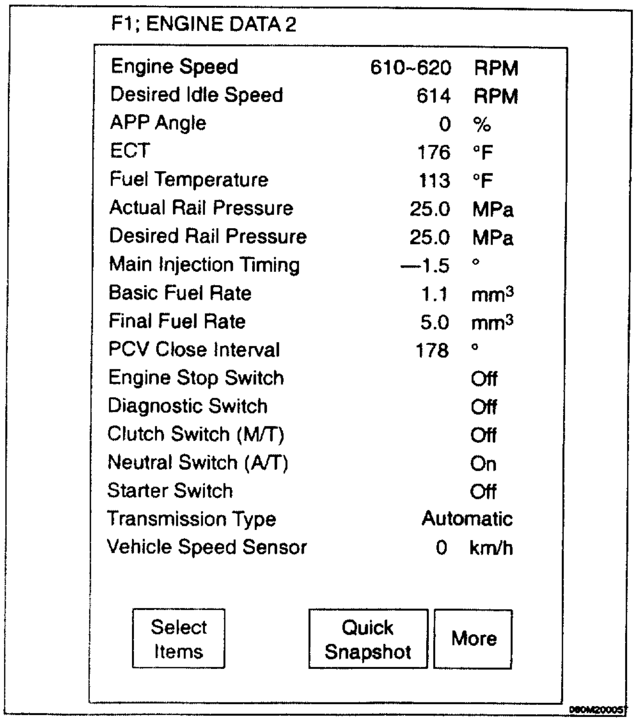
Conditions for Clearing the DTC

DTC 0025 can be cleared by using the "clear info" by Tech2 or Diag Clear Switch.

Diagnostic Aids

Check the following conditions:

- Poor connection at ECM – Inspect harness connectors for back-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to battery and open circuits. If the harness appears to be OK, observe the injection pump signal present display on the scan tool while moving connectors and wiring harness related to the VS sensor. A change in the display will indicate the location of the fault.



F1; ENGINE DATA 2

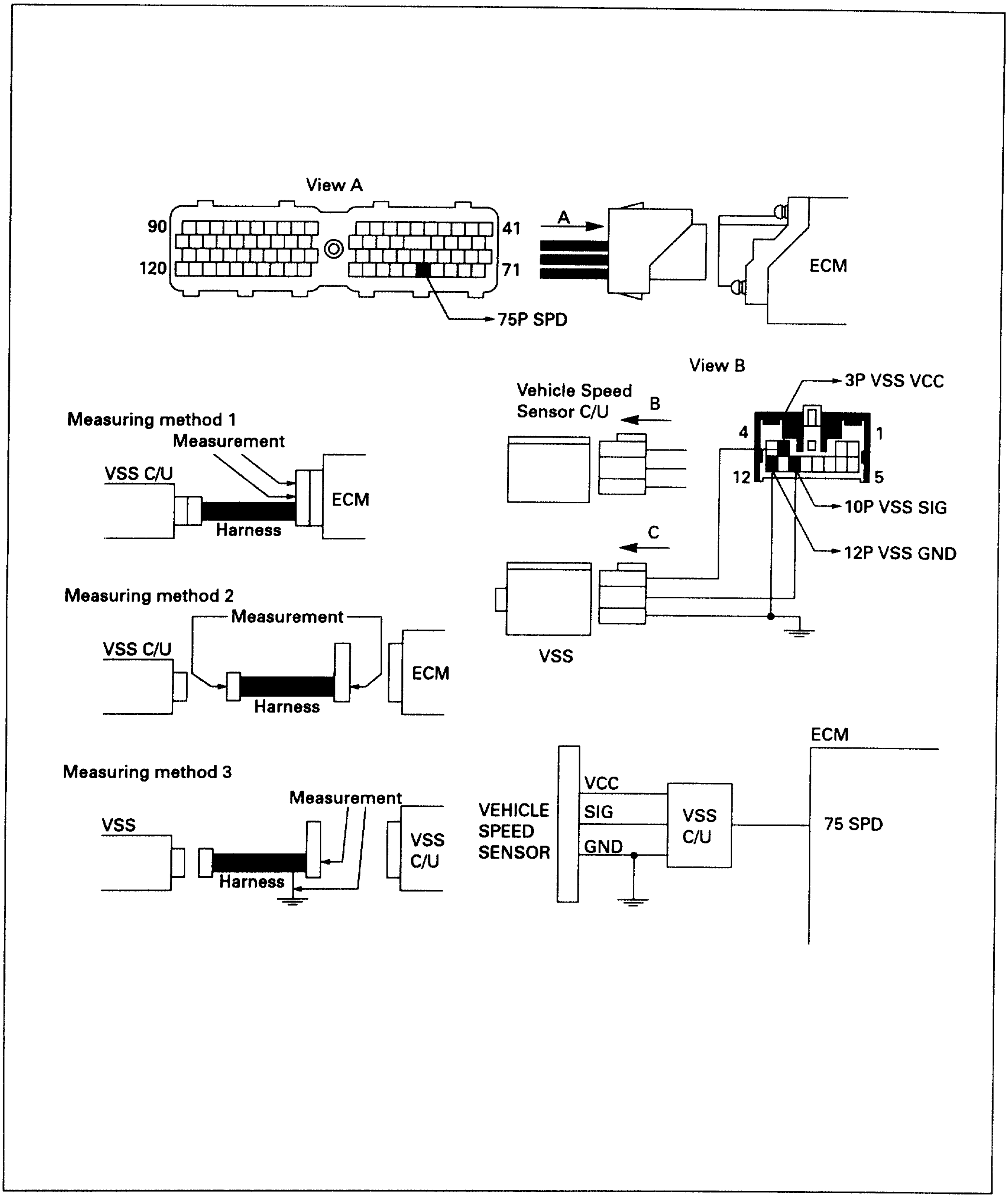
Engine Speed	610~620	RPM
Desired Idle Speed	614	RPM
APP Angle	0	%
ECT	176	°F
Fuel Temperature	113	°F
Actual Rail Pressure	25.0	MPa
Desired Rail Pressure	25.0	MPa
Main Injection Timing	—1.5	°
Basic Fuel Rate	1.1	mm^3
Final Fuel Rate	5.0	mm^3
PCV Close Interval	178	°
Engine Stop Switch		Off
Diagnostic Switch		Off
Clutch Switch (M/T)		Off
Neutral Switch (A/T)		On
Starter Switch		Off
Transmission Type		Automatic
Vehicle Speed Sensor	0	km/h

DTC 0025 Vehicle Speed (VS) Sensor Error

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Check the VS Sensor circuit. 1. Starter switch "OFF". 2. Disconnect the harness from ECM (Engine Control Module). 3. Disconnect the harness from the VS Sensor control unit. 4. Disconnect the harness from VS Sensor.	—	Go to step 3	—
3	Check the various harness whether an open or short. Between VS Sensor control unit and VS Sensor. Between ECM and VS Sensor control unit. Was a circuit normal?	—	Go to step 5	Go to step 4
4	Repair the VS Sensor circuit. Was the action complete?	—	Go to step 3	—
5	Check the VS Sensor and VS Sensor control unit with the scan tool. 1. Connect the harness. 2. Connect the scan tool. 3. Engine start. 4. Test run is performed. 5. Check the "Vehicle Speed" by the date list of scan tool. Is "Vehicle Speed" show normal value?	—	Go to step 9	Go to step 6
6	Check the circuit of VS Sensor control unit. Was a circuit normal? Was the VS Sensor control unit normal?	—	Go to step 8	Go to step 7
7	Replace the speed sensor control unit. Was the action complete?	—	Go to step 9	—
8	Replace the speed sensor. Was the action complete?	—	Go to step 6	—
9	Clear the DTC. Check the DTC is not detected. DTC is not detected.	—	Verify repair	Go to step 10
10	Replace the ECM. Was the action complete?	—	Go to step 9	—

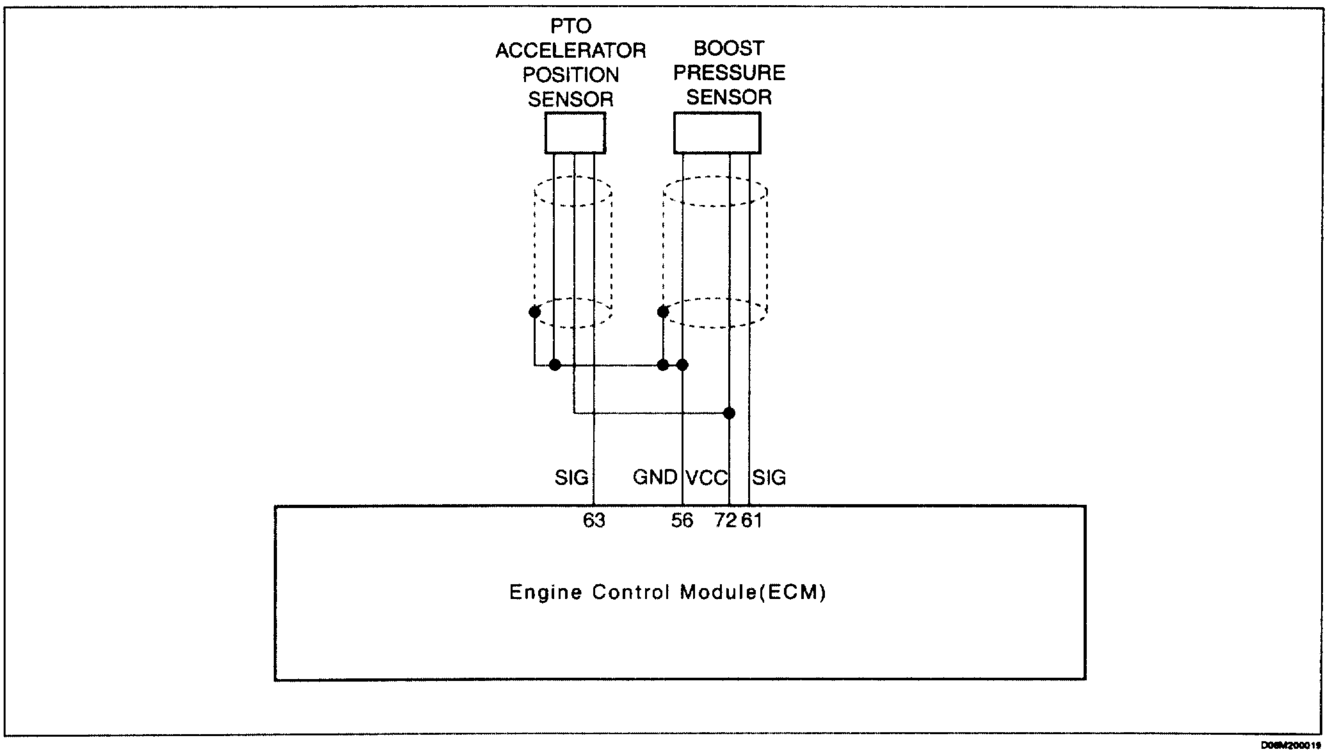
IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

DTC 0025 Vehicle Speed Sensor Error



D06M200017

DTC 0028 PTO Accelerator Position Sensor Error



Description

The PTO accelerator position sensor provides a voltage signal that changes relative to PTO accelerator angle. The signal voltage will vary from about 0.5 volts at PTO accelerator idle position to about 4.5 volts at PTO accelerator full position.

The PTO accelerator position sensor signal is used by the ECM for fuel control and many of the ECM-controlled outputs.

The ECM monitors PTO accelerator position and compares actual PTO accelerator position from the PTO accerelator position sensor to a predicted PTO accelerator position sensor value calculated from engine speed.

If the ECM detects an out-of-range condition, DTC P0028 will set.

Conditions for Setting the DTC

- The PTO switch is "ON".
- When PTO accelerator position sensor voltage more than 4.85V or lower than 0.1V.
- When these states continues more than 1 sec.

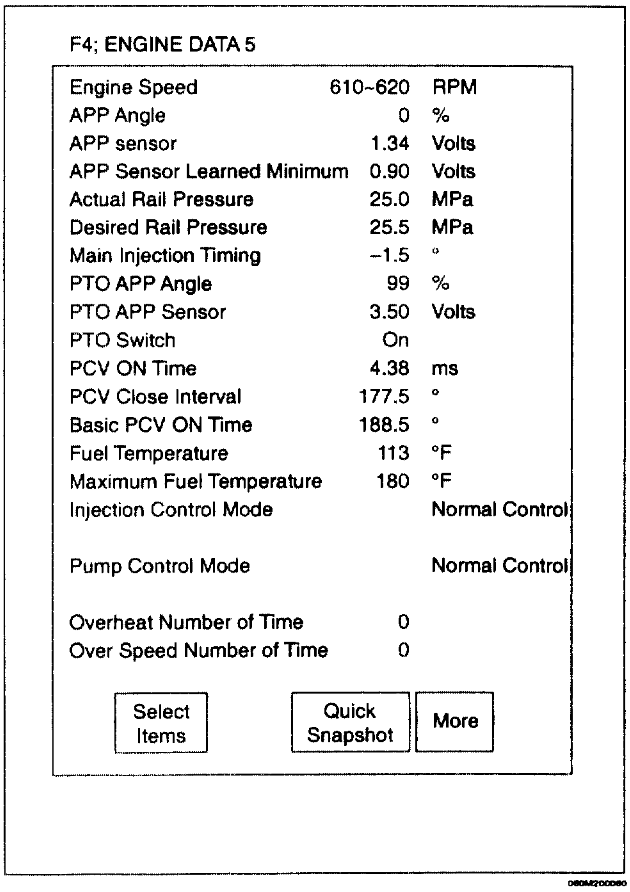
Action Taken When the DTC Sets.

- The ECM will not illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- When the sensor is faulty, is substitute accelerator pedal of PTO accelerator.

Diagnostic Aids

Check the following conditions:

- Poor connection at ECM – Inspect harness connectors for back-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to battery and open circuits. If the harness appears to be OK, observe the injection pump signal present display on the scan tool while moving connectors and wiring harness related to the PTO accelerator position sensor. A change in the display will indicate the location of the fault.


F4; ENGINE DATA 5

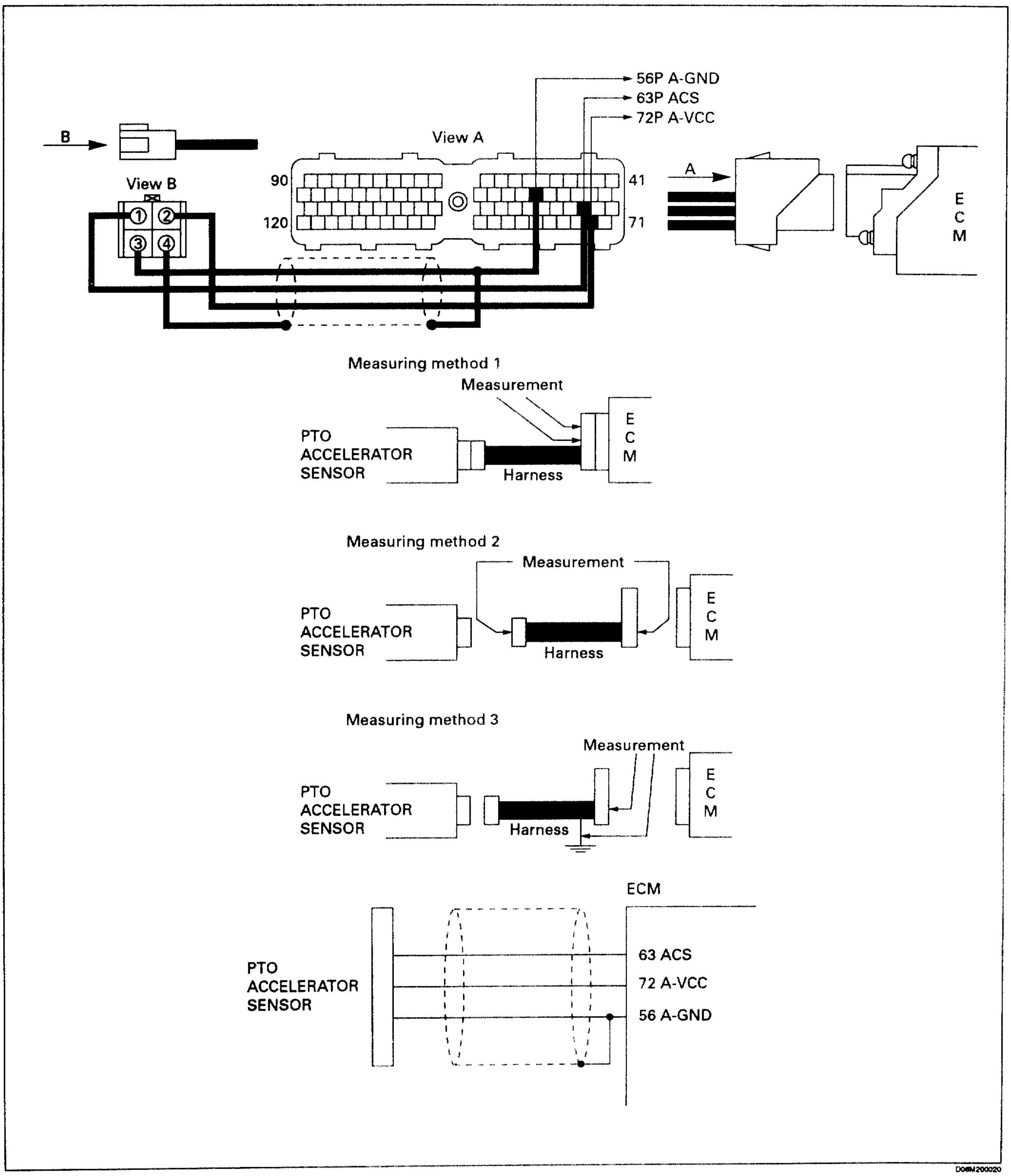
Engine Speed	610~620	RPM
APP Angle	0	%
APP sensor	1.34	Volts
APP Sensor Learned Minimum	0.90	Volts
Actual Rail Pressure	25.0	MPa
Desired Rail Pressure	25.5	MPa
Main Injection Timing	–1.5	°
PTO APP Angle	99	%
PTO APP Sensor	3.50	Volts
PTO Switch	On	
PCV ON Time	4.38	ms
PCV Close Interval	177.5	°
Basic PCV ON Time	188.5	°
Fuel Temperature	113	°F
Maximum Fuel Temperature	180	°F
Injection Control Mode		Normal Control
Pump Control Mode		Normal Control
Overheat Number of Time	0	
Over Speed Number of Time	0	

DTC 0028 PTO Accelerator Position Sensor Error

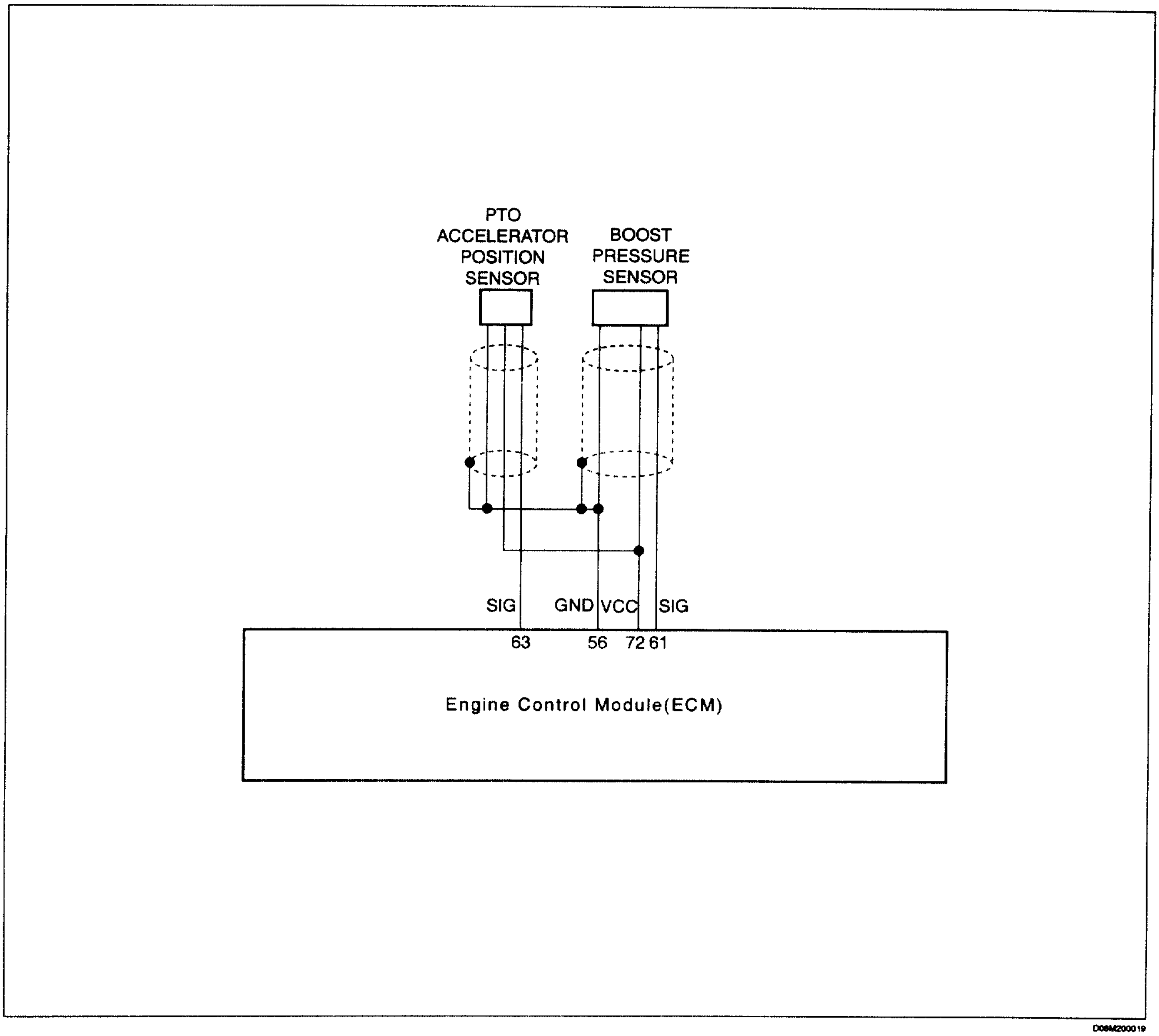
STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Measure the impression voltage of PTO accelerator position sensor. 1. Starter switch "OFF". 2. Disconnect the harness from PTO accelerator position sensor. 3. Starter switch "ON". 4. Measure voltage between VCC and ground at PTO accelerator position sensor side connector. Was voltage within value?	5V±0.25	Go to step 6	Go to step 3
3	Check the PTO accelerator position sensor circuit whether an open or short. 1. Starter switch "OFF". 2. Disconnect the harness from ECM. 3. Inspect the PTO accelerator position sensor circuit. Was a problem found?	—	Go to step 5	Go to step 4
4	Replace the ECM. Was the action complete?	—	Go to step 3	—
5	Repair the PTO accelerator position sensor circuit. Was the action complete?	—	Go to step 3	—
6	Check the signal voltage of PTO accelerator position sensor. 1. Starter switch "OFF". 2. Reconnect the harness to PTO accelerator position sensor. Starter switch "ON". 3. Measure voltage between the signal wire and ground wire at PTO accelerator position sensor side connector. Was voltage within value?	Sensor signal position: 0.3 to 0.5V (Idle position) position: 4.2 to 4.5V (WOT)	Go to step 7	Go to step 8
7	Clear the DTC. Was the action complete?	—	Go to step 11	—
8	Sensor lever changed from idle position up to full position. Does PTO accelerator position sensor signal change?	—	Go to step 10	Go to step 9
9	Replace the PTO accelerator position sensor. Was the action complete?		Go to step 10	—
10	Reconnect the PTO accelerator position sensor adjustment. Reconnect the PTO accelerator position sensor while measure voltage between the signal wire and ground wire at PTO accelerator position sensor side connector. Full Voltage : Stopper bolt adjustment. Was voltage within value?	Sensor signal position: 0.3 to 0.5V position: 4.2 to 4.5V	Go to step 7	—
11	DTC is not detected		Verify repair	Go to Step 12
12	Replace the ECM. Was the action complete?	—	Go to step 11	—

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

DTC 0028 PTO Accelerator Position Sensor Error



DTC 0032 Boost Pressure Sensor Error



Circuit Description

The boost sensor is fixed on the cab back frame and is connected to rear portion of intake manifold by vacuum hose.

The boost sensor generates voltage according to air aspiration pressure and generation voltage is input to ECM for boost sensor signal.

The ECM monitors the boost pressure sensor signals for voltage outside the normal range of the boost pressure sensor. If the ECM detects a boost pressure sensor signal voltage that is excessively low, Diagnostic Trouble Code 0032 will be set.

Conditions for Setting the DTC

(1)
- When engine stalls and relative boost pressure is higher than 20 kPa continues for 1 sec. or more.

(2)
- Relative boost pressure lower than the –28 kPa continues for 1 sec. or more.

(3)
- If the ECM detects a higher boost sensor signal that continues for 10 sec. or more, a DTC 0042 will be set.

Action Taken When the DTC Sets

- (1), (2) left: Based on relative pressure of 0 kPa.
- (3) left: Injection amount map is used for a fail safe mode.

Conditions for Clearing the MIL/DTC

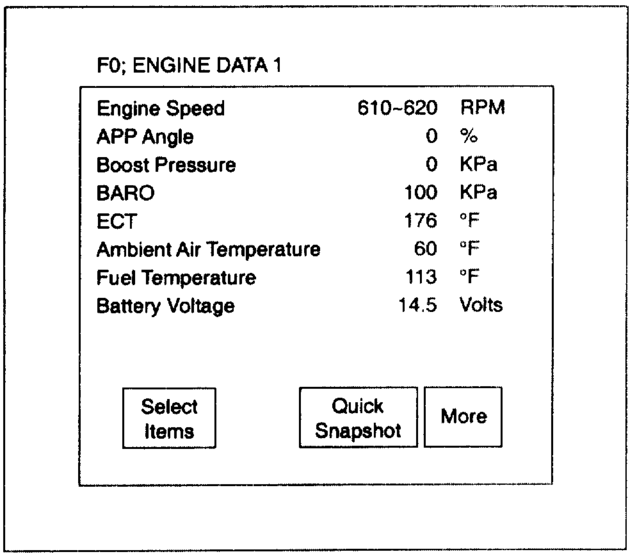
DTC 0032 can be cleared by using the “Clear Info” by scan tool or using by the Diag Clear Switch.

DTC 0032 Boost Pressure Sensor Error

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to ground, shorts to battery and open circuits. If the harness appears to be OK, observe the Boost Pressure display on the scan tool while moving connectors and wiring harnesses related to the Boost Pressure sensor. A change in the Boost Pressure display will indicate the location of the fault.



```
F0; ENGINE DATA 1

Engine Speed                 610~620  RPM
APP Angle                          0  %
Boost Pressure                     0  KPa
BARO                             100  KPa
ECT                              176  °F
Ambient Air Temperature           60  °F
Fuel Temperature                 113  °F
Battery Voltage                 14.5  Volts
```

060M200058

- Lack of power due to injection limitation.
- High boost error (DTC 0042).
- Low boost error (DTC 0065).
- Harness open / short (DTC 0032).

DTC 0032 Boost Pressure Sensor Error

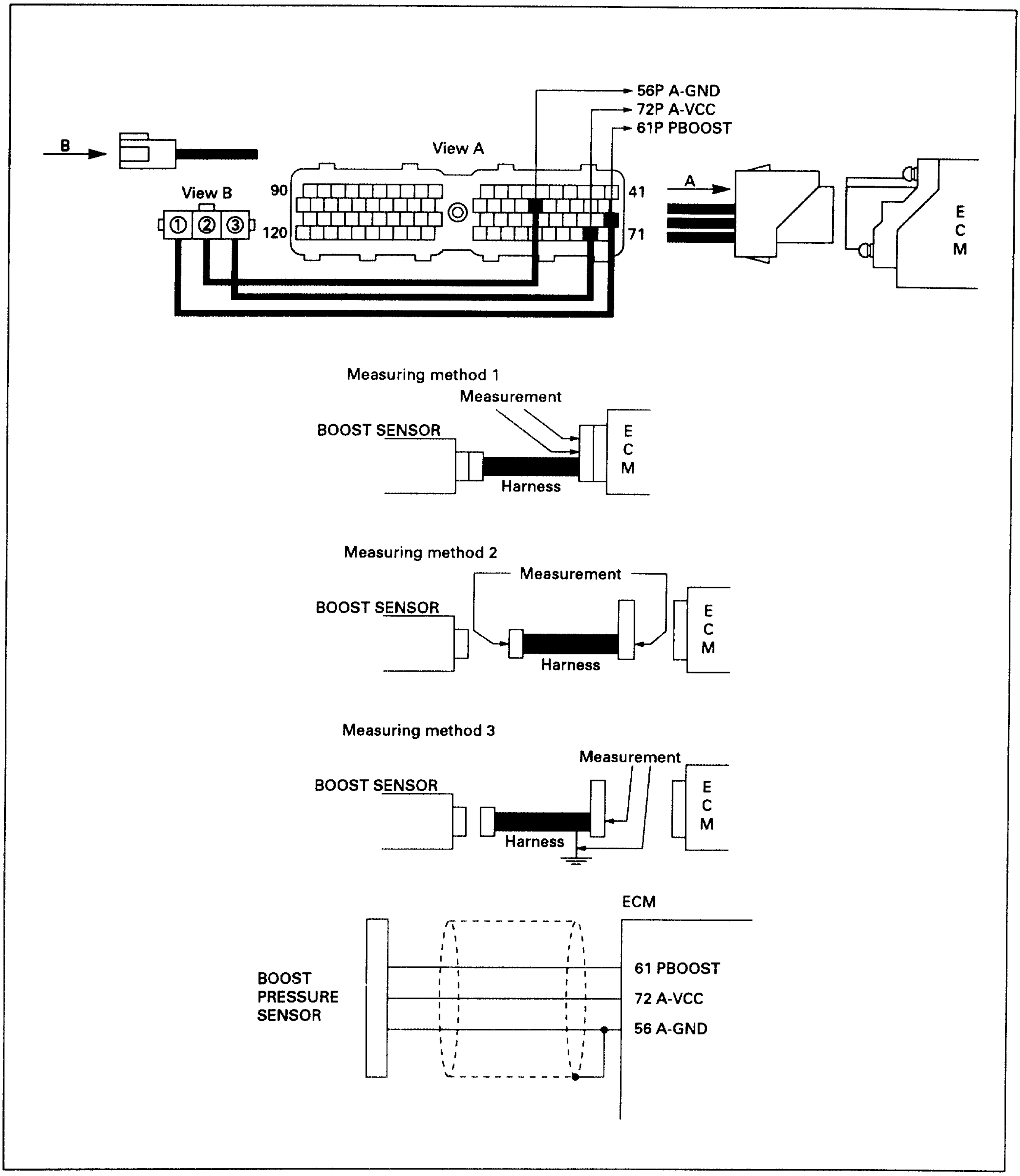
<table>
<tr><th>STEP</th><th>ACTION</th><th>VALUE</th><th>YES</th><th>NO</th></tr>
<tr><td>1</td><td>Was the "On-Board Diagnostic (OBD) System Check" performed?</td><td>—</td><td>Go to step 2</td><td>Go to OBD System Check</td></tr>
<tr><td>2</td><td>Does DTC 0032 display, while key switch "ON" or engine in operation?</td><td>—</td><td>Go to step 3</td><td>—</td></tr>
<tr><td>3</td><td>1. Key switch "ON".
2. Measure voltage between pin number 61 for boost sensor and pin number 56 for A–GND at ECM side connector. (Measuring method 1)
Is voltage within value?</td><td>About 1.3V</td><td>Go to step 7</td><td>Go to step 4</td></tr>
<tr><td>4</td><td>Measure voltage between pin number 72 for A–VCC and pin number 56 for A–GND at ECM side connector. (Measuring method 1)
Is voltage within value?</td><td>4.75V
to
5.25V</td><td>Go to step 6</td><td>Go to step 5</td></tr>
<tr><td rowspan="2">5</td><td>1. Key switch "OFF".
2. Disconnect boost sensor harness connector from sensor and ECM.
3. Measure resistance of the following points on the boost sensor harness. (Measuring method 2)
• Between pin number 72 (A–VCC) at ECM side connector and pin number 1 at sensor side.
• Between pin number 56 (A–GND) at ECM side connector and pin number 3 at sensor side.</td><td>2Ω or less</td><td rowspan="2">Replace boost sensor. Then go to step 10</td><td rowspan="2">Repair boost pressure sensor harness.</td></tr>
<tr><td>• Between pin number 72 (A–VCC) and GND.
• Between pin number 56 (A–GND) and GND.</td><td>10MΩ or more</td></tr>
<tr><td rowspan="2">6</td><td>1. Key switch "OFF"
2. Disconnect boost sensor harness connector from sensor and ECM.
3. Measure resistance of the following points on the boost sensor harness. (Measuring method 2)
• Between pin number 61 (P BOOST) of ECM and pin number 3 (SENSOR).
• Between pin number 56 (A–GND) and pin number 2 (SENSOR).</td><td>2Ω or less</td><td rowspan="2">Replace boost sensor or ECM assembly. Then go to step 10</td><td rowspan="2">Repair boost pressure sensor harness.</td></tr>
<tr><td>• Between pin number 61 (P BOOST) of ECM and GND.
• Between pin number 56 (A–GND) and GND.</td><td>10MΩ or more</td></tr>
<tr><td>7</td><td>1. Connect pressure gauge to boost pressure sensor.
2. Supply pressure.
Is voltage created to meet boost pressure?</td><td><table><tr><th>Pressure (kPa)</th><th>Voltage (V)</th></tr><tr><td>0</td><td>1.029</td></tr><tr><td>50</td><td>1.75</td></tr><tr><td>162</td><td>3.43</td></tr></table></td><td>Go to step 8</td><td>Replace boost sensor</td></tr>
<tr><td>8</td><td>1. Connect all connectors.
2. Start engine.
3. Operate the vehicle several times.
Are there any boost pressure abnormally and/or any leakage?</td><td>—</td><td>Go to step 9</td><td>Go to step 10</td></tr>
<tr><td>9</td><td>Check turbocharger condition, waste gate opening pressure and/or piping.
Is turbocharger and/or piping OK?</td><td></td><td>System OK</td><td>Repair piping and/or Replace turbocharger</td></tr>
</table>

DTC 0032 Boost Pressure Sensor Error

STEP	ACTION	VALUE	YES	NO
10	Clear all DTCs. Is DTC 0032?	—	Replace ECM assembly. Then go to step 11	System OK
11	Clear the DTCs. Is DTC 0032 still displayed? **Note: High boost also abnormal.**	—	Replace ECM. Go to step 11	System OK
	Caution: The actual measuring output voltage of boost sensor will be drifted due to if power source voltage of boost sensor comes down.			

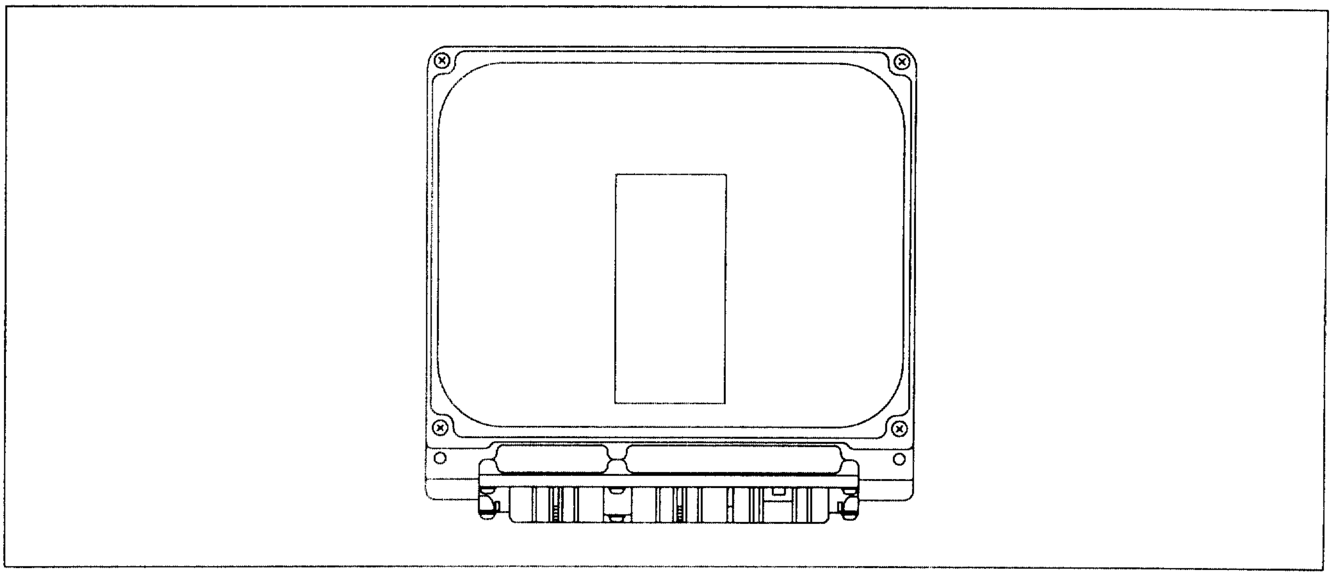
IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2.
Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

DTC 0032 Boost Pressure Sensor Error



D06M200031

DTC 0034 Fuel Rate Data Error (No history recorded)



060MX113

Compare to Fuel rate data (Q-data) chart on the cylinder head to the Fuel rate data (Q-data) on scan tool.

Conditions for Setting the DTC

- EEPROM is not written to continues 0.2 sec.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Fuel rate data No. 8 selected (correction "0").

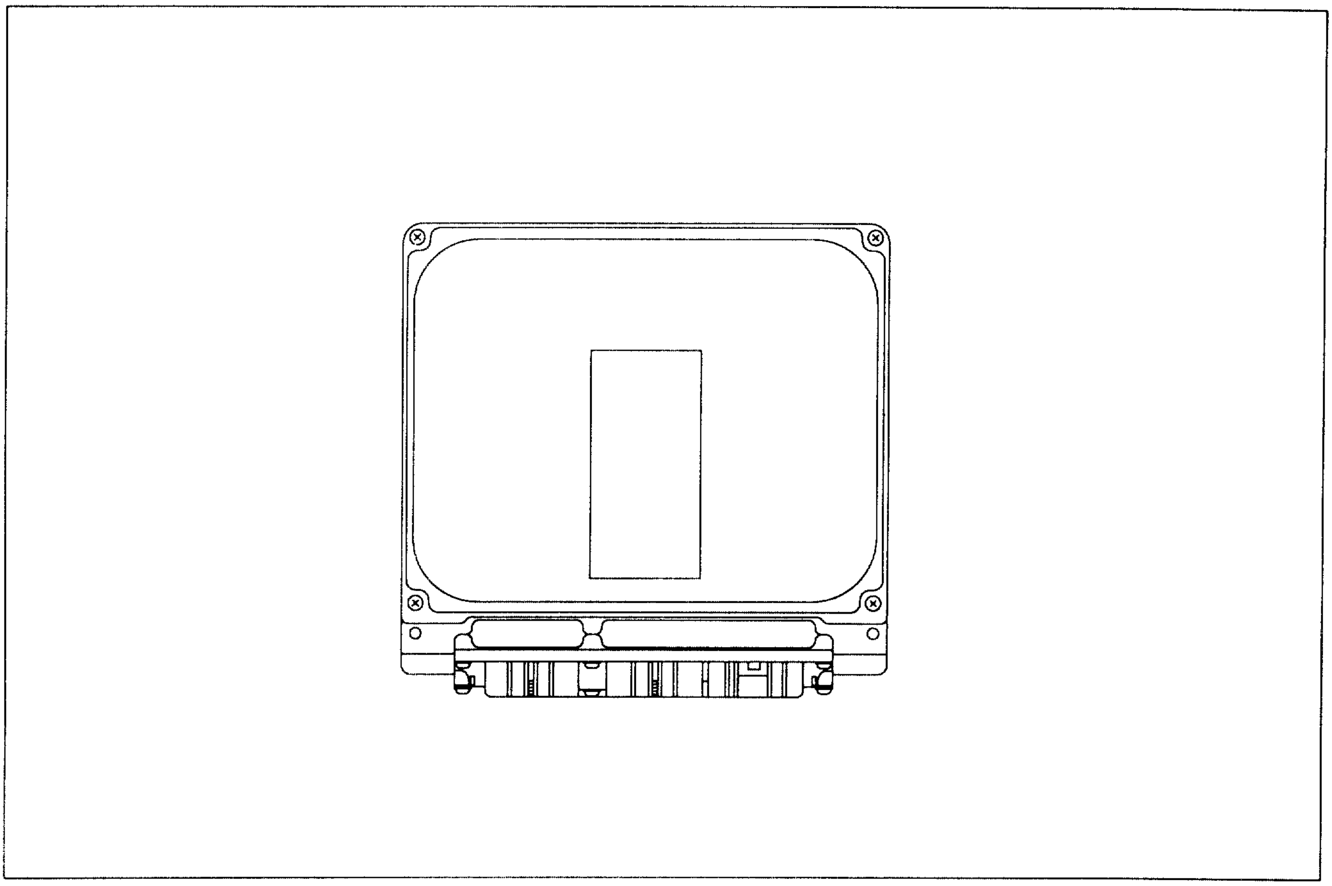
Conditions for Clearing the MIL/DTC

DTC 0034 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Refer to "Capture and Restore Fuel Rate Data" of "Scan Tool Scan Tool" in this manual.

STEP	ACTION	VALUE	YES	NO
1	Does DTC 0034 display when key switch "ON"	—	Go to step 2	—
2	Assume that fuel rate data may not be written to ECM after replaced ECM assembly. Is the Fuel Rate data listed on the scan tool?	—	Check scan tool connection and/or ECM connection. Then go to step 4	Go to step 3
3	Write fuel rate data to ECM using scan tool. Does DTC 0034 display after writing the fuel rate data?	—	Same as step 2	System OK
4	Does DTC 0034 display when ignition switch "ON"?	—	Go back to step 2	System OK
	Note: • **When ECM assembly replaced, scan tool is required.** • **Make sure that lamp is lighted when DTC 0034 code is set.** • **When ECM replaced, down load fuel rate number from the old ECM, and then input it into new ECM by scan tool.** • **If step 2 and/or 4 are intermittents, call ISUZU Tech Line staff.**			

DTC 0035 Analog Digital Conversion Error, CPU Monitoring IC Error and Charging Circuit Error



Circuit Description

The ECM supplies either 5 or 12 volts to power various sensors or switches. The power is supplied through resistances in the ECM which are so high in value that a test light will not light when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. The ECM controls output circuits such as the injectors, ISC, etc.

The input/output devices in the ECM include analog-to-digital converters, signal buffers, counters, and special drivers. The ECM controls most components with electronic switches which complete a ground circuit when turned "ON".

Conditions for Setting the DTC

A/D Conversion Error

- CPU A/D conversion is not completed and CPU is normal.

CPU Monitoring IC Error (ECM inside trouble)

- B+ voltage higher than 10V after 2 sec. from resetting, starter switch off continues for 300 ms, timer pulse time abnormal continues over 50 times.

Charging Circuit Error

- Charging voltage abnormal and battery voltage higher than 10V.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.

A/D Conversion Error (ECM inside trouble)

- Analog sensor abnormal and runs in backup mode.

Charging Circuit Error (ECM inside trouble)

- Charging stops, driveable by constant current only, and injection amount limited to 80 mm^3/st.

DTC 0035 Analog Digital Conversion Error, CPU Monitoring IC Error and Charging Circuit Error

Conditions for Clearing the MIL/DTC

DTC 0035 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

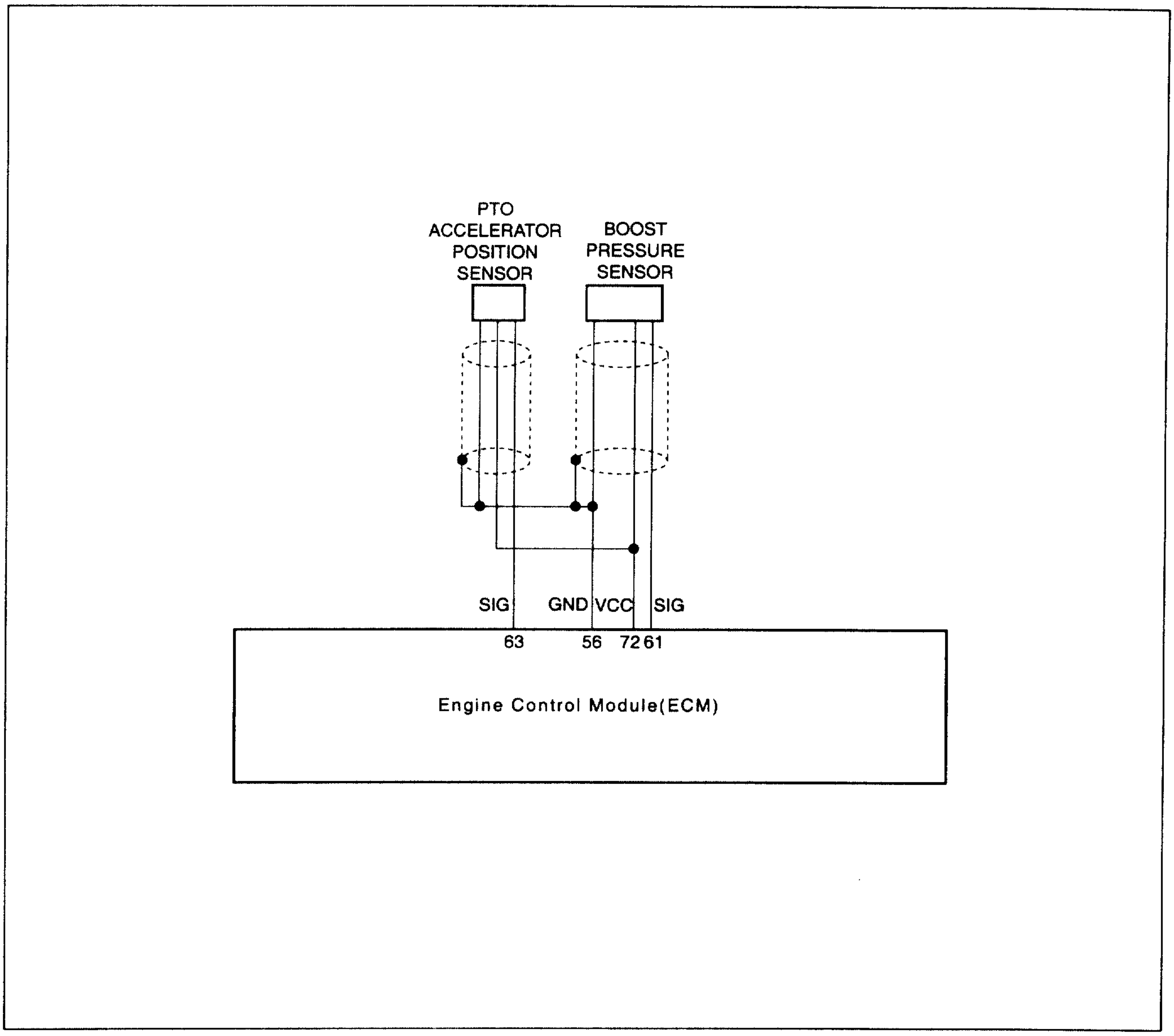
- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

A/D Conversion Error (ECM inside trouble)	Runs poorly ECM in backup mode.
CPU Monitoring IC Error (ECM inside trouble)	Turn on MIL.
Charging Circuit Error (ECM inside trouble)	Lack of power. and increasing smoke. (white smoke)

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does DTC 0035 display when key switch "ON" or engine is running?	—	Go to step 3	—
3	Clear to the DTCs. Is DTC 0035 displayed?	—	Go to step 5	Go to step 4
4	Check radio wave interference (Is there wireless transmitter near the vehicle?), temporary incomplete contact at harness connector, noise due to harness GND floating or ECM connector GND incomplete connection. Is there any problem?	—	Repair problem. Then go to step 6	System OK
5	Check the GND for a incomplete connection at ECM connector (ECM pin number 81, 82, 102, 111, 80). Is DTC 0035 displayed again?	—	Replace ECM assembly. Then go to step 6	System OK
6	Clear to the DTCs. Is DTC 0035 displayed. **Note: This trouble is circuit problem within ECM. If no problem in power supply or GND, but DTC will not clear, replace ECM.**	—	System OK	Go back to step 3

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

DTC 0042, 0032 High Boost Pressure Abnormal



Circuit Description

The boost sensor is fixed on the cab back frame and is connected to rear portion of inlet manifold by vacuum hose.

The boost sensor generates voltage according to air aspiration pressure and the generated voltage is input to ECM for boost sensor signal.

If the ECM detects a boost sensor signal voltage that is excessively high, Diagnostic Trouble Codes 0042, 0032 will be set.

Conditions for Setting the DTC

- No engine stall, abnormal boost pressure (boost pressure sensor normal condition) and high boost pressure abnormal area continues for 3 sec. or more.

Action Taken When the DTC Sets

- Injection amount map is used as a fail safe mode.

Conditions for Clearing the MIL/DTC

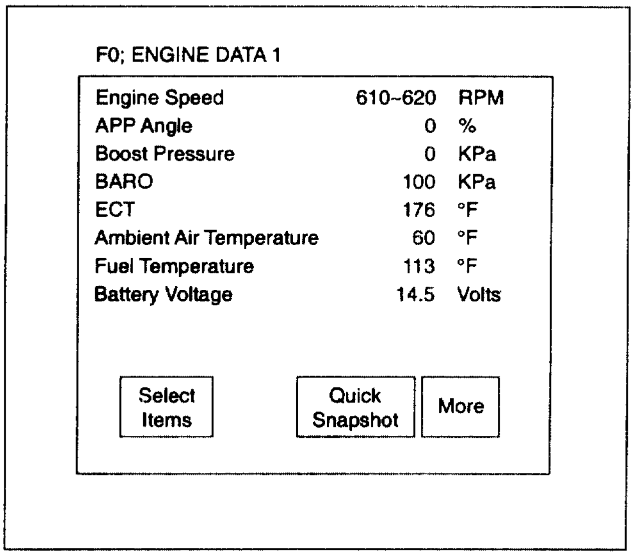
DTC 0042 or 0032 can be cleared by using the “Clear Info” by scan tool or using by the Diag Clear Switch.

DTC 0042, 0032 High Boost Pressure Abnormal

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to ground, shorts to battery and open circuits (sensor harnnes, ECM GND circuit). If the harness appears to be OK, observe the Boost Pressure display on the scan tool while moving connectors and wiring harnesses related to the Boost Pressure sensor. A change in the display will indicate the location of the fault.



```
F0; ENGINE DATA 1

Engine Speed               610~620  RPM
APP Angle                        0  %
Boost Pressure                   0  KPa
BARO                           100  KPa
ECT                            176  °F
Ambient Air Temperature         60  °F
Fuel Temperature               113  °F
Battery Voltage               14.5  Volts
```

- Lack of engine power etc.

DTC 0042, 0032 High Boost Pressure Abnormal

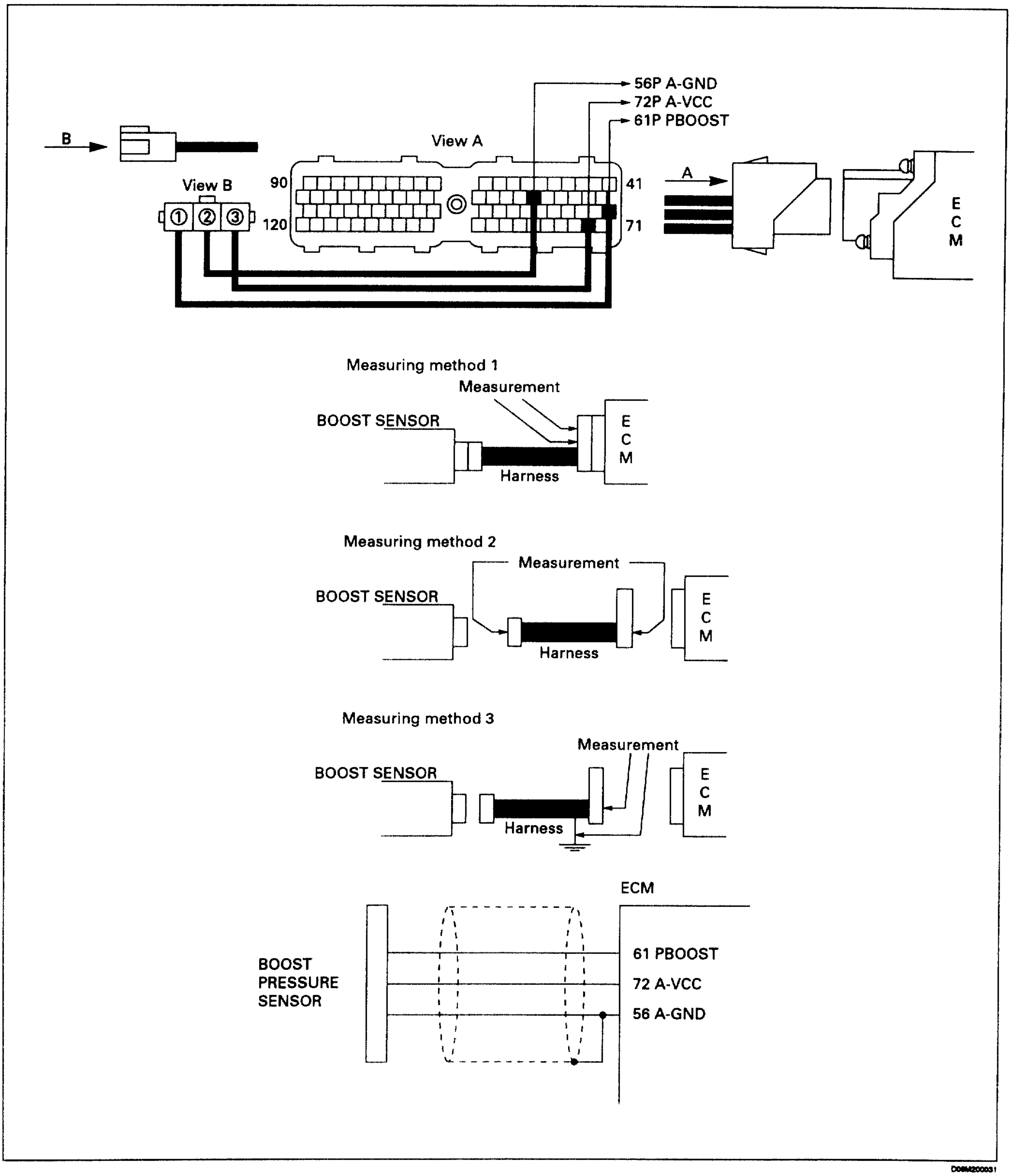
<table>
<tr><th>STEP</th><th>ACTION</th><th>VALUE</th><th>YES</th><th>NO</th></tr>
<tr><td>1</td><td>Was the “On-Board Diagnostic (OBD) System Check” performed?</td><td>—</td><td>Go to step 2</td><td>Go to OBD System Check</td></tr>
<tr><td>2</td><td>Does DTC 0042 or DTC 0032 display while key switch “ON” or engine in operation?
Note: When atmospheric pressure sensor abnormal, PATM is calculated at 100 kPa.</td><td>—</td><td>Go to step 3</td><td>—</td></tr>
<tr><td>3</td><td>1. Connect pressure gauge and pressure supply to boost sensor.
2. Measure voltage between pin number 61 (P BOOST) and pin number 56 (A–GND) at ECM side. (Show Measuring method 1)
Does voltage indicate a normal value according to boost pressure?

Normal value (When VCC = 5V)
<table>
<tr><th>Boost pressure</th><th>Sensor voltage</th></tr>
<tr><td>80 kPa</td><td>About 0.7V
(Negative pressure)</td></tr>
<tr><td>Atmospheric release</td><td>1.0V</td></tr>
<tr><td>169 kPa</td><td>2.0V</td></tr>
</table></td><td>Normal value see table left</td><td>Go to step 4</td><td>Replace boost sensor and/or repair piping</td></tr>
<tr><td>4</td><td>Do you find any problem (leakage, etc.) on turbocharger?</td><td>—</td><td>Repair or replace abnormal portion.</td><td>Go to step 5</td></tr>
<tr><td>5</td><td>Drive vehicle to check the following.
Does actual boost pressure and voltage with in specifications?

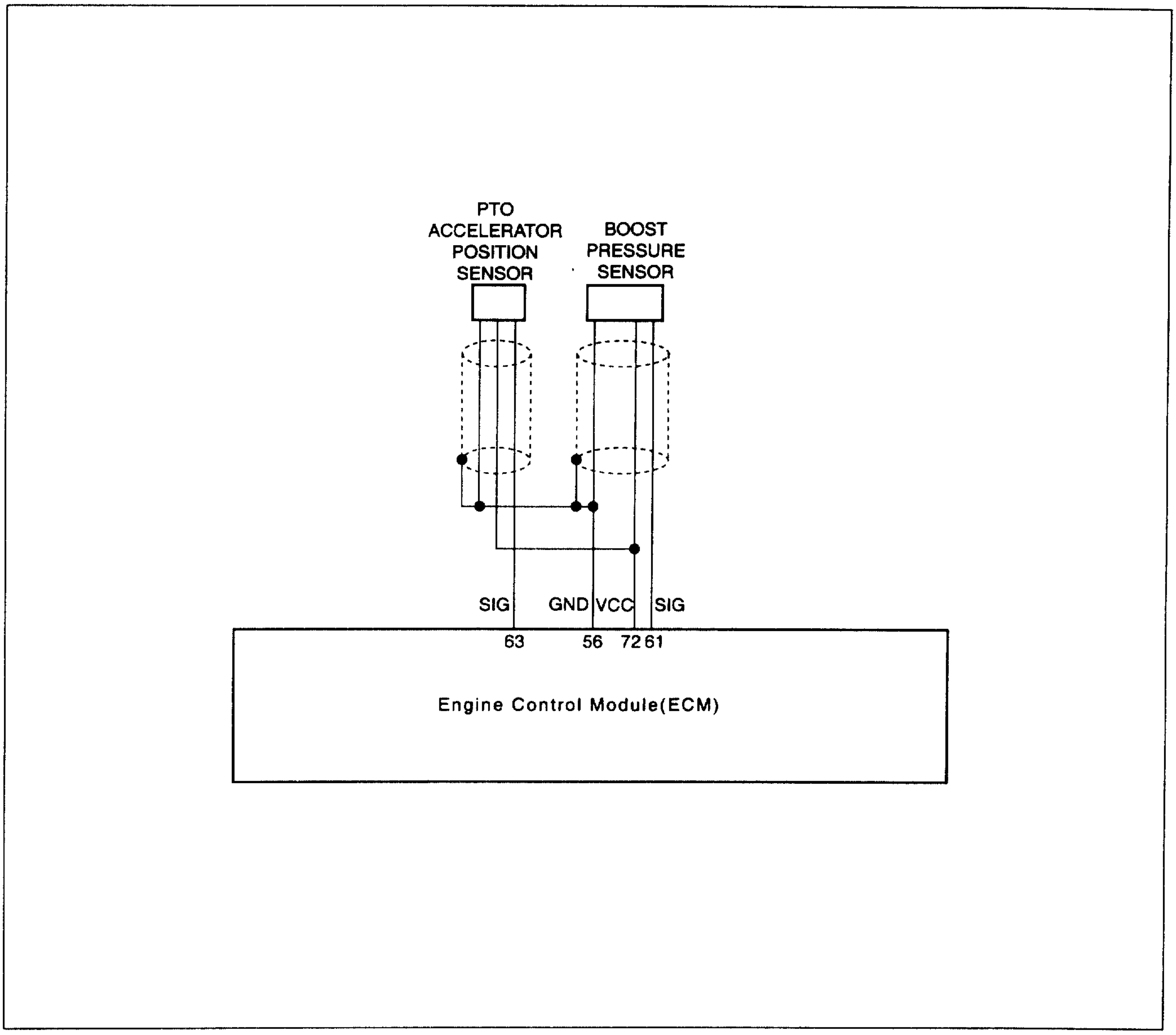
Specifications (When PATM = 100 kPa)
<table>
<tr><td>Voltage</td><td>3.4 V or more</td></tr>
<tr><td>Boost pressure</td><td>162 kPa or more</td></tr>
<tr><td>CKP</td><td>About 2,000 rpm</td></tr>
<tr><td>Acceleration</td><td>100%</td></tr>
</table></td><td>Guide line value see table at left</td><td>Go to step 6</td><td>Repair/replace turbocharger and/or wastegate piping. Refer to Section 6J in this manual. Then go to step 6</td></tr>
<tr><td>6</td><td>Clear the DTCs.
Does DTC 0042 or DTC 0032 display?</td><td>—</td><td>Replace ECM. Then go to step 7</td><td>System OK</td></tr>
<tr><td>7</td><td>Clear the DTCs.
Does DTC 0042 or DTC 0032 still display?</td><td>—</td><td>Go back to step 3</td><td>System OK</td></tr>
<tr><td></td><td colspan="4">Caution: The actual measuring output voltage of boost sensor will be drifted due to if power source voltage of boost sensor comes down.</td></tr>
</table>

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2.
Refer to “Capture and Restore Fuel Rate Data” of “Tech 2 Scan Tool” in this manual.

DTC 0042, 0032 High Boost Pressure Abnormal



DTC 0065 Low Boost Pressure Abnormal



Circuit Description

The boost pressure sensor is located on the cab back frame and is connected to rear portion of inlet manifold by vacuum hose.

The boost pressure sensor generates a voltage according to air aspiration pressure and the generated voltage is input to ECM for boost sensor signal.

If the ECM detects a boost pressure sensor signal voltage that is excessively low, Diagnostic Trouble Codes 0065 will be set.

Conditions for Setting the DTC

- No engine stall, abnormal boost pressure not in the boost pressure sensor, accelerator open more than 80% and low boost pressure continues for 25 sec. or more.

Conditions for Clearing the MIL/DTC

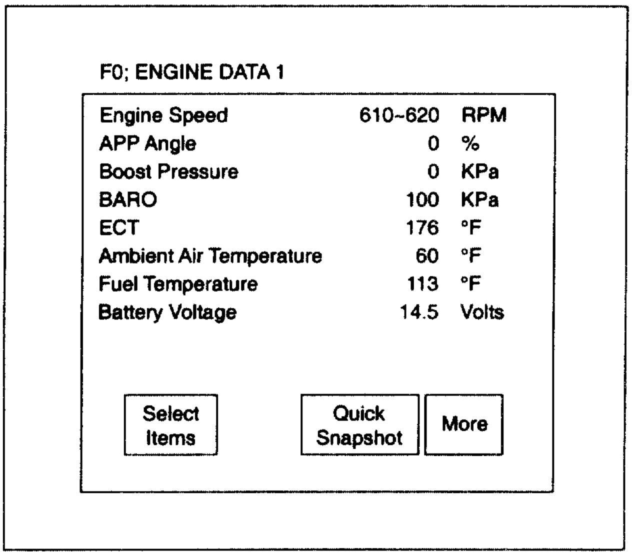
DTC 0065 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

DTC 0065 Low Boost Pressure Abnormal

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to ground, shorts to battery and open circuits. If the harness appears to be OK, observe the Boost Pressure display on the scan tool while moving connectors and wiring harnesses related to the Boost Pressure sensor. A change in the display will indicate the location of the fault.



```
F0; ENGINE DATA 1

Engine Speed               610~620  RPM
APP Angle                        0  %
Boost Pressure                   0  KPa
BARO                           100  KPa
ECT                            176  °F
Ambient Air Temperature         60  °F
Fuel Temperature               113  °F
Battery Voltage               14.5  Volts
```

060M200086

- Lack of engine power etc.

DTC 0065 Low Boost Pressure Abnormal

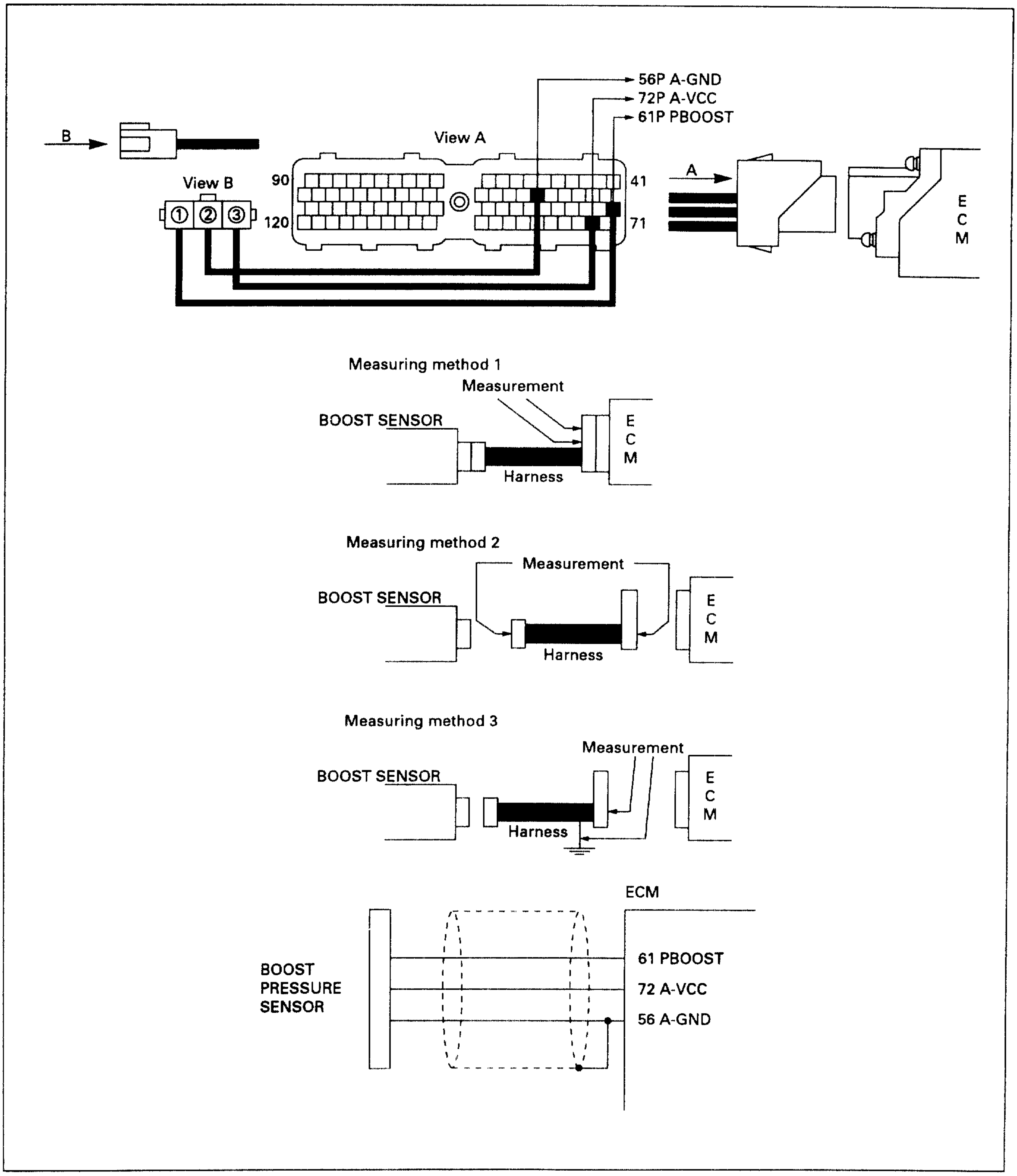
<table>
<tr><th>STEP</th><th>ACTION</th><th>VALUE</th><th>YES</th><th>NO</th></tr>
<tr><td>1</td><td>Was the "On-Board Diagnostic (OBD) System Check" performed?</td><td>—</td><td>Go to step 2</td><td>Go to OBD System Check</td></tr>
<tr><td>2</td><td>Does DTC 0065 display, while key switch "ON" or engine in operation?</td><td>—</td><td>Go to step 3</td><td>—</td></tr>
<tr><td>3</td><td>1. Connect pressure gauge and pressure supply to hose of boost sensor side.
2. Key switch "ON".
3. Measure voltage between pin number 61 (P BOOST) and pin number 56 (A–GND) at ECM side. (Measuring method 1)
Does voltage indicate normal value according to boost pressure?

Normal value (When VCC = 5V)
<table>
<tr><th>Boost pressure</th><th>Sensor voltage</th></tr>
<tr><td>80 kPa</td><td>About 0.7V
(Negative pressure)</td></tr>
<tr><td>Atmospheric release</td><td>1.0V</td></tr>
<tr><td>169 kPa</td><td>2.0V</td></tr>
</table></td><td>Normal value see table left</td><td>Go to step 4</td><td>Replace boost sensor or repair/replace boost sensor harness.</td></tr>
<tr><td>4</td><td>Is there leakage from piping and/or any problem on turbocharger?</td><td>—</td><td>Repair or replace abnormal portion.</td><td>Go to step 5</td></tr>
<tr><td>5</td><td>Make vehicle actually drive to check as following.
Does actual boost pressure and voltage indicate guide line value? (at acceleration 80% or more opened)

Guide line value (When PATM = 100 kPa)
<table>
<tr><td>Voltage</td><td>2.0 V or less</td></tr>
<tr><td>Boost pressure</td><td>70 kPa or less</td></tr>
<tr><td>CKP</td><td>2,000 rpm</td></tr>
<tr><td>Acceleration</td><td>100%</td></tr>
</table></td><td>Guide line value see table left</td><td>Go to step 6</td><td>Replace boost sensor and/or repair turbocharger. Refer to section 6J in this manual then go to step 6</td></tr>
<tr><td>6</td><td>Clear the DTCs.
Does DTC 0065 still display?</td><td>—</td><td>Replace ECM assembly. Then go to step 7</td><td>System OK</td></tr>
<tr><td>8</td><td>Clear the DTCs.
Does DTC 0065 still display?</td><td>—</td><td>Go back to step 3</td><td>System OK</td></tr>
<tr><td></td><td colspan="4">**Caution: The actual measuring output voltage of boost sensor will be drifted due to if power source voltage of boost sensor comes down.**</td></tr>
</table>

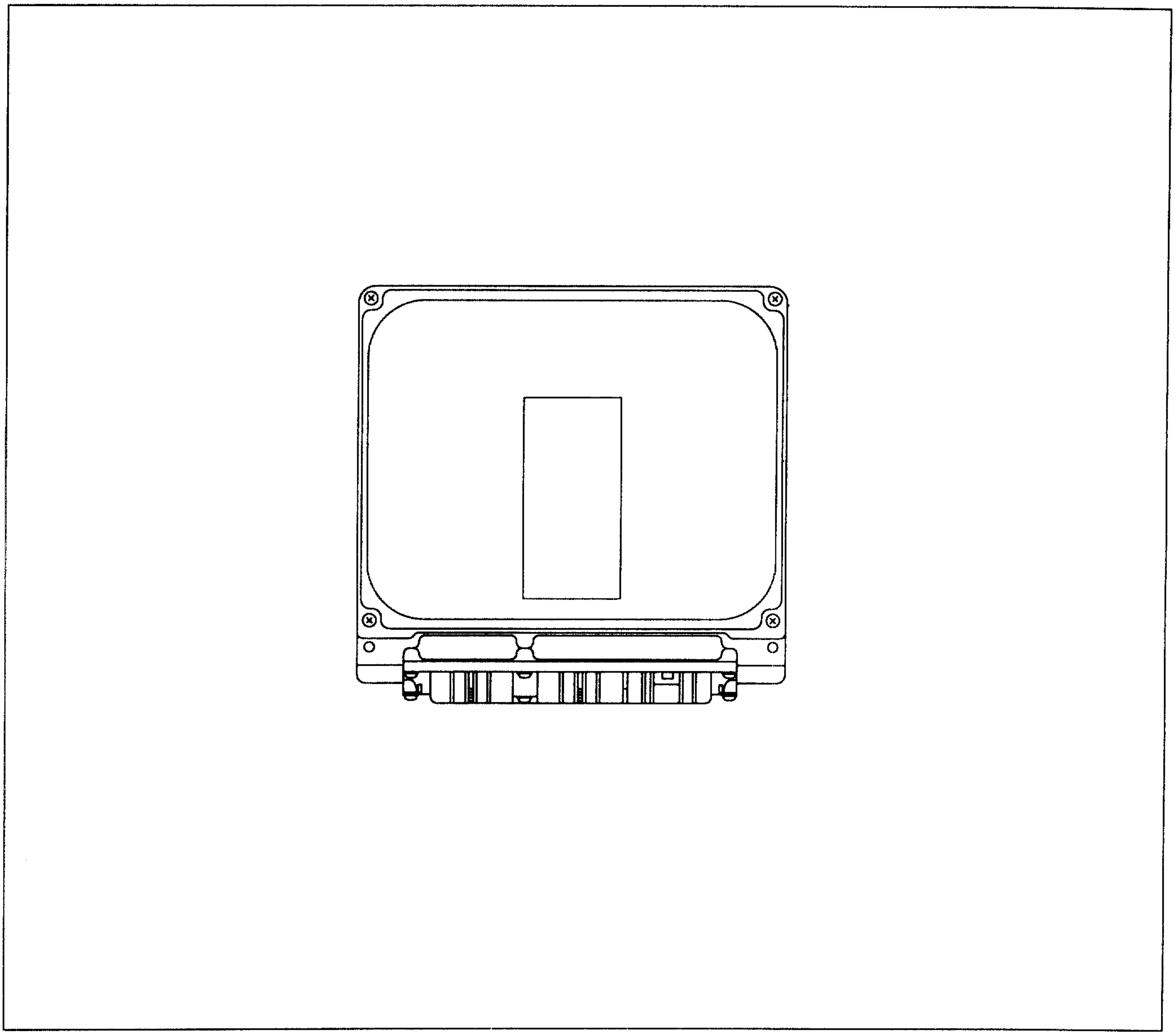
IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2.
Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

DTC 0065 Low Boost Pressure Abnormal



D06M200031

DTC 0071 BARO Sensor Error



Circuit Description

The Atmospheric pressure sensor is installed in the ECM.

If the ECM detects a signal voltage that is excessively low or high, Diagnostic Trouble Code 0071 will be set.

Conditions for Setting the DTC

- Atmospheric pressure sensor voltage exceeding 4.7V and lower than 1.9V and continues 1 sec. or more.

Action Taken When the DTC Sets

- Based on the atmospheric pressure of 100 kPa.

Conditions for Clearing the MIL/DTC

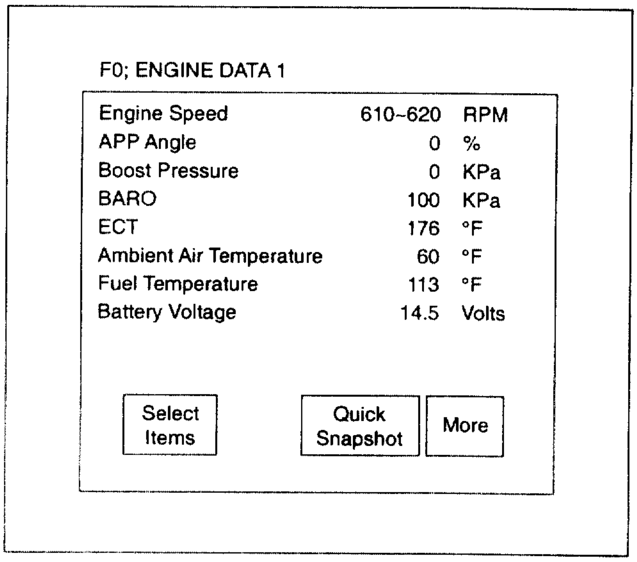
DTC 0071 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

DTC 0071 BARO Sensor Error

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to ground, shorts to battery and open circuits. If the harness appears to be OK, observe the display on the scan tool while moving connectors and wiring harnesses related to the BARO sensor. A change in the BARO display will indicate the location of the fault.



F0; ENGINE DATA 1

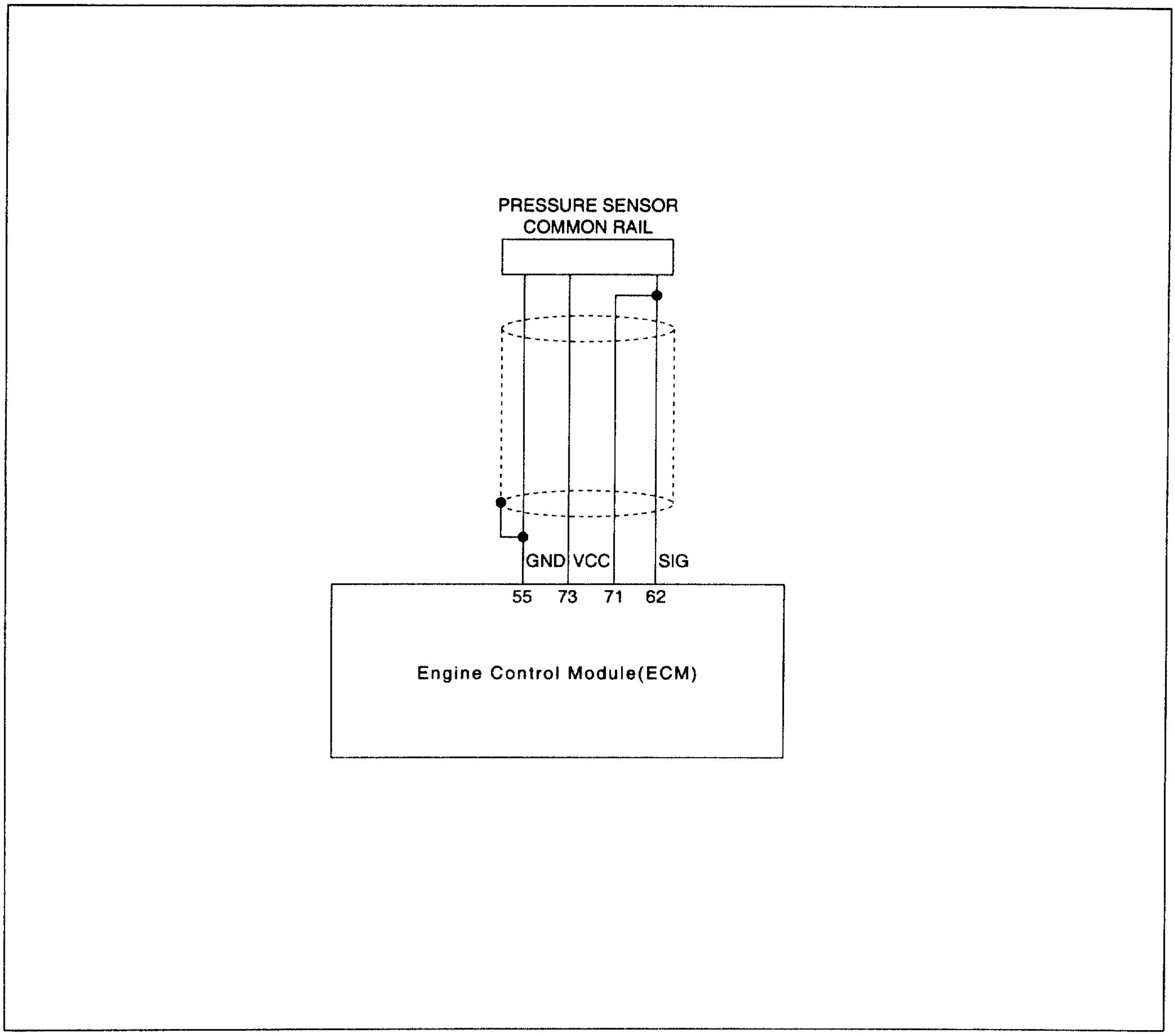
Engine Speed	610~620	RPM
APP Angle	0	%
Boost Pressure	0	KPa
BARO	100	KPa
ECT	176	°F
Ambient Air Temperature	60	°F
Fuel Temperature	113	°F
Battery Voltage	14.5	Volts

060M200056

STEP	ACTION	VALUE	YES	NO
1	Does DTC 0071 display while key switch "ON" and engine running?	—	Go to step 2	—
2	Does display DTC 0071 again after memory is cleared?	—	Replace ECM assembly. Then go to step 3.	Erroneous diagnosis due to electrical noise or intermittent problem.
3	Clear the DTCs. Does DTC 0071 display?	—	Go back to step 2	System OK
	Note: BARO sensor is inside ECM.			

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

DTC 0115 Common Rail Pressure Sensor Output Fixed



Circuit Description

The common rail is installed to intake manifold, equipped with flow damper, pressure limiter, and common rail pressure sensor.

The common rail unit has a common fuel passage, fuel passage holes, and installing threaded holes. The common fuel passage is a through hole made in the common rail unit. The common rail pressure sensor is installed at the left end of the hole.

The ECM monitors the Rail Pressure signals for voltage outside the normal range of the Rail Pressure sensor. If the ECM detects a Rail Pressure signal voltage that is excessively abnormal, Diagnostic Trouble Code 0115 will be set.

Conditions for Setting the DTC

- Excessive difference between the current and previous valves of common rail pressure, difference from the target value being greater than 10 MPa, common rail pressure being greater than 10 MPa does not set DTC 0245.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Limits are set to common rail pressure open loop control, common rail pressure and injection amount.
- Common rail pressure: 60 MPa maximum Injection amount is limited for 50 mm^3/st.

DTC 0115 Common Rail Pressure Sensor Output Fixed

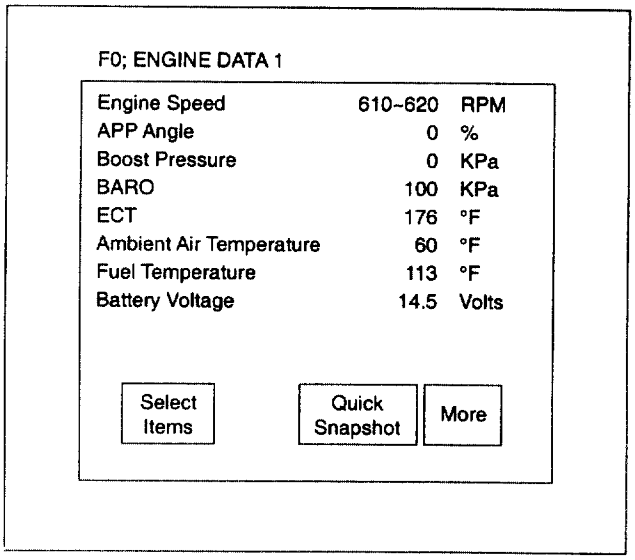
Conditions for Clearing the MIL/DTC

DTC 0115 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to ground, shorts to battery and open circuits. If the harness appears to be OK, observe the Rail pressure display on the scan tool while moving connectors and wiring harnesses related to the Rail pressure sensor. A change in the Rail pressure display will indicate the location of the fault.



F0; ENGINE DATA 1

Engine Speed	610~620	RPM
APP Angle	0	%
Boost Pressure	0	KPa
BARO	100	KPa
ECT	176	°F
Ambient Air Temperature	60	°F
Fuel Temperature	113	°F
Battery Voltage	14.5	Volts

DTC 0115 Common Rail Pressure Sensor Output Fixed

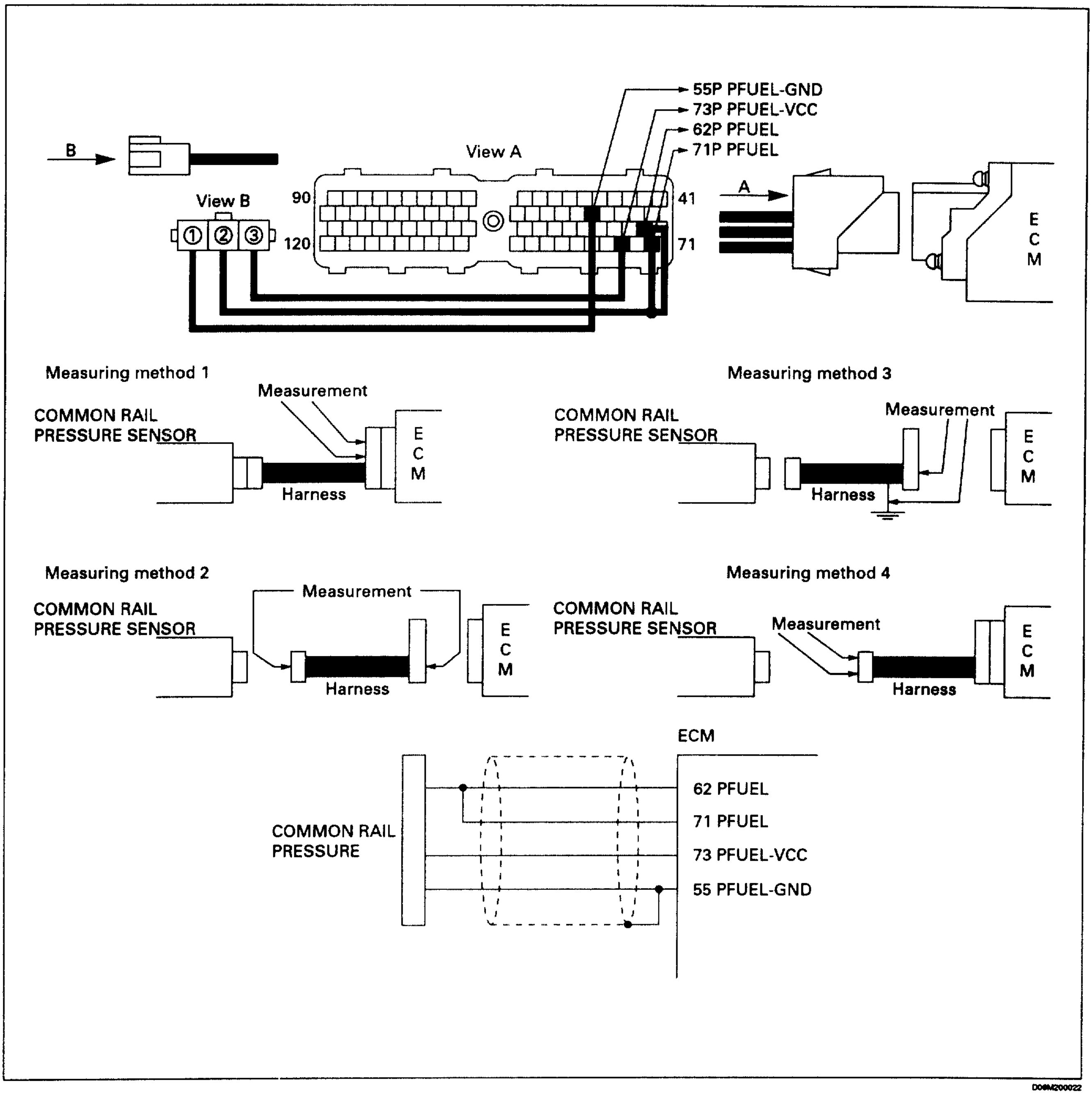
STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does DTC 0115 display while engine running on when key switch "ON"?	—	Go to step 3	—
3	1. Key switch "ON". 2. Measure the voltage between pin number 62 and 71 (PFUEL) on ECM side connector and pin number 55 (PFUEL – GND) (Measuring method 1) Is voltage within value? (At idling and fuel pressure 25 MPa, the voltage about 1.4V)	0.9V to 1.1V	Go to step 5	Go to step 4
4	1. Key switch "OFF". 2. Disconnect common rail pressure sensor harness from both common rail pressure sensor side and ECM side. 3. Measure resistance as below. (List measurement method number) • Between pin number 71 (PFUEL) at ECM side and pin number 2 at common rail pressure sensor side. • Between pin number 62 (PFUEL) at ECM side and pin number 2 at common rail pressure sensor side. • Between pin number 55 (PFUEL – GND) at ECM side and pin number 3 at common rail pressure sensor side. (Measuring method 2) • Between pin number 73 (PFUEL – VCC) at ECM side and pin number 3 at common rail pressure sensor side.	2Ω or less	Replace common rail pressure sensor or ECM assembly then Go to step 11	Repair or replace common rail pressure sensor harness then Go to step 11
5	1. Reconnect common rail pressure sensor harness. 2. Start the engine. 3. Measure the voltage between pin number 62 and 71 (PFUEL) at ECM side and pin number 55 (PFUEL – GND) at ECM side. (Measuring method 1) Measure voltage while the engine is idling and at varying engine RPMs using the accelerator pedal. Does voltage change?	No change	Go to step 7	Go to step 6
6	Clear to DTC code. Does DTC 0115 display?	—	Replace ECM assembly then Go to step 11	Correct to incomplete contact of connector then Go to step 11
7	1. KEY switch "OFF". 2. Disconnect connector from both ECM and common rail pressure sensor. 3. Measure the resistance as below. (List measurement method number) • Between pin number 71 (PFUEL) at ECM side connector and pin number 2 at sensor side. • Between pin number 62 (PFUEL) at ECM side connector and pin number 2 sensor side. • Between pin number 55 (PFUEL – GND) at ECM side connector and pin number 3 sensor side. Is resistance within the value?	2Ω or less	Go to step 8	Repair the common rail pressure sensor harness then Go to step 11

DTC 0115 Common Rail Pressure Sensor Output Fixed

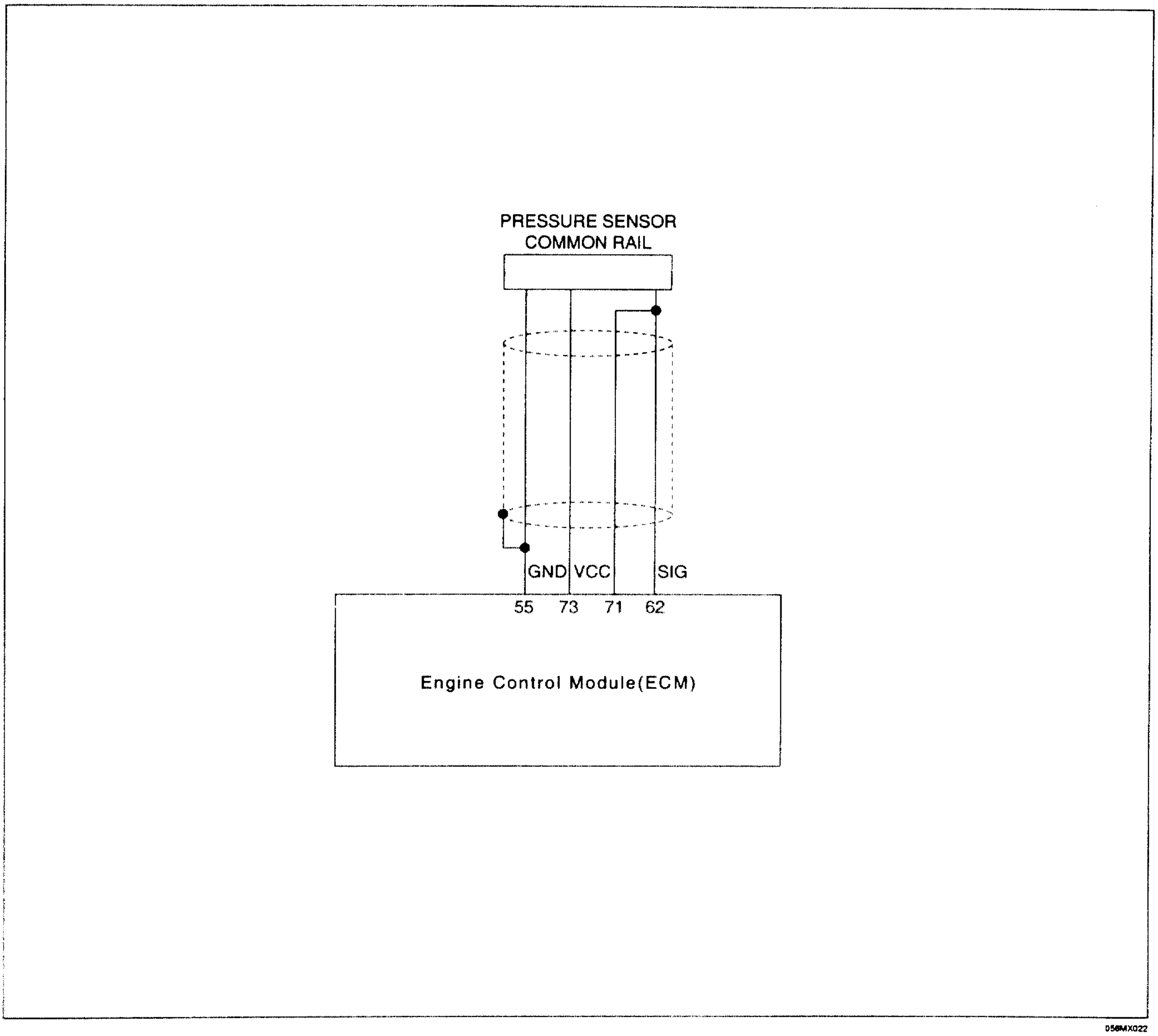
STEP	ACTION	VALUE	YES	NO
8	Measure the resistance between pin number 71 and 62 (PFUEL) at ECM side connector and GND on common rail pressure sensor harness. (List measurement method number) Is resistance within value?	10MΩ or more	Go to step 9	Repair the common rail pressure sensor harness then Go to step 11
9	1. Reconnect all connectors such as common rail pressure sensor harness, etc. 2. Clear DTC code. Does DTC 0115 display?	—	Go to step 10	Correct to incomplete contact of connector, then Go to step 11
10	Start engine and race accelerator several times. Does DTC 0115 display?	—	Replace common rail pressure sensor or ECM assembly then Go to step 11	System OK
11	Clear DTC. Does DTC 0115 display?	—	Go back to step 3	System OK
	Note: Sometimes it display DTC 0261 to DTC 0266 are set due to common rail pressure sensor failure.			

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

DTC 0115 Common Rail Pressure Sensor Output Fixed



DTC 0118 Common Rail Pressure Abnormal (Control system) 1st and 2nd Stage



Circuit Description

The Common rail is installed to intake manifold, equipped with flow damper, pressure limiter, and common rail pressure sensor.

The common rail pressure sensor, installed at left end of the common rail, serving the detect fuel pressure. It is a semiconductor type pressure sensor utilizing silicon's property that the electric resistance of pressurized silicone is varied.

The ECM monitors the Rail Pressure signals for voltage outside the normal range of the Rail Pressure sensor. If the ECM detects a Rail Pressure signal voltage that is excessively low, Diagnostic Trouble Code 0118 will be set.

Conditions for Setting the DTC

Common Rail Pressure 1st Stage

- No DTC 0245 and common rail pressure over 127 MPa continues for 0.2 sec.

Common Rail Pressure 2nd Stage

- No DTC 0245 and common rail pressure over 132 MPa continues for 0.2 sec.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.

Common Rail Pressure 1st Stage

- Limits are set to common rail pressure open loop control, common rail pressure and injection amount.
- Common rail pressure: 60 MPa maximum Injection amount is limited for 50 mm^3/st.

Common Rail Pressure 2nd Stage

Injection stop and pressure feed stop.

DTC 0118 Common Rail Pressure Abnormal (Control system) 1st and 2nd Stage

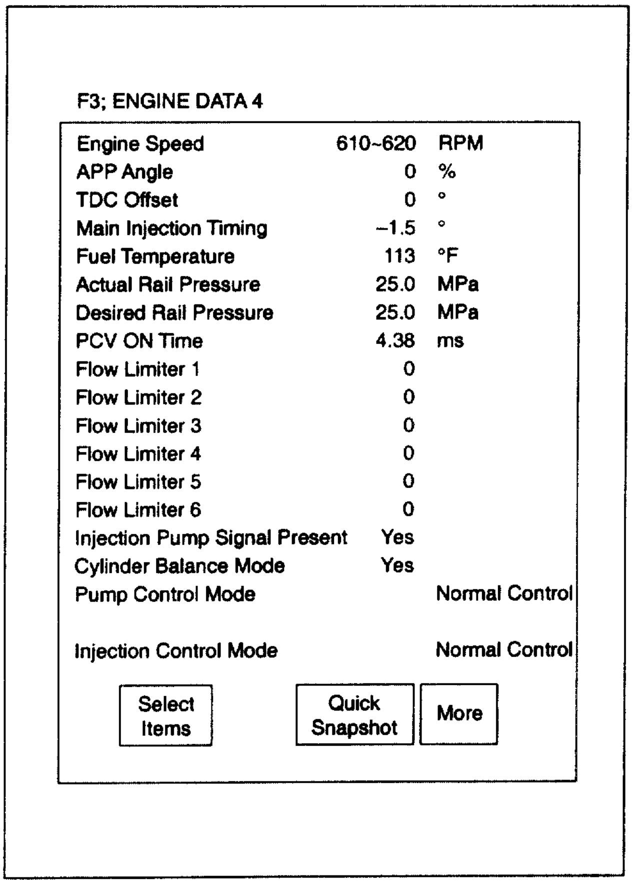
Conditions for Clearing the MIL/DTC

DTC 0118 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to ground, shorts to battery and open circuits. If the harness appears to be OK, observe the display on the scan tool while moving connectors and wiring harnesses related to the sensor. A change in the display will indicate the location of the fault.



```
F3; ENGINE DATA 4

Engine Speed                    610~620  RPM
APP Angle                             0  %
TDC Offset                            0  °
Main Injection Timing              –1.5  °
Fuel Temperature                    113  °F
Actual Rail Pressure               25.0  MPa
Desired Rail Pressure              25.0  MPa
PCV ON Time                        4.38  ms
Flow Limiter 1                        0
Flow Limiter 2                        0
Flow Limiter 3                        0
Flow Limiter 4                        0
Flow Limiter 5                        0
Flow Limiter 6                        0
Injection Pump Signal Present       Yes
Cylinder Balance Mode               Yes
Pump Control Mode                        Normal Control

Injection Control Mode                   Normal Control
```

DTC 0118 Common Rail Pressure Abnormal (Control system) 1st and 2nd Stage

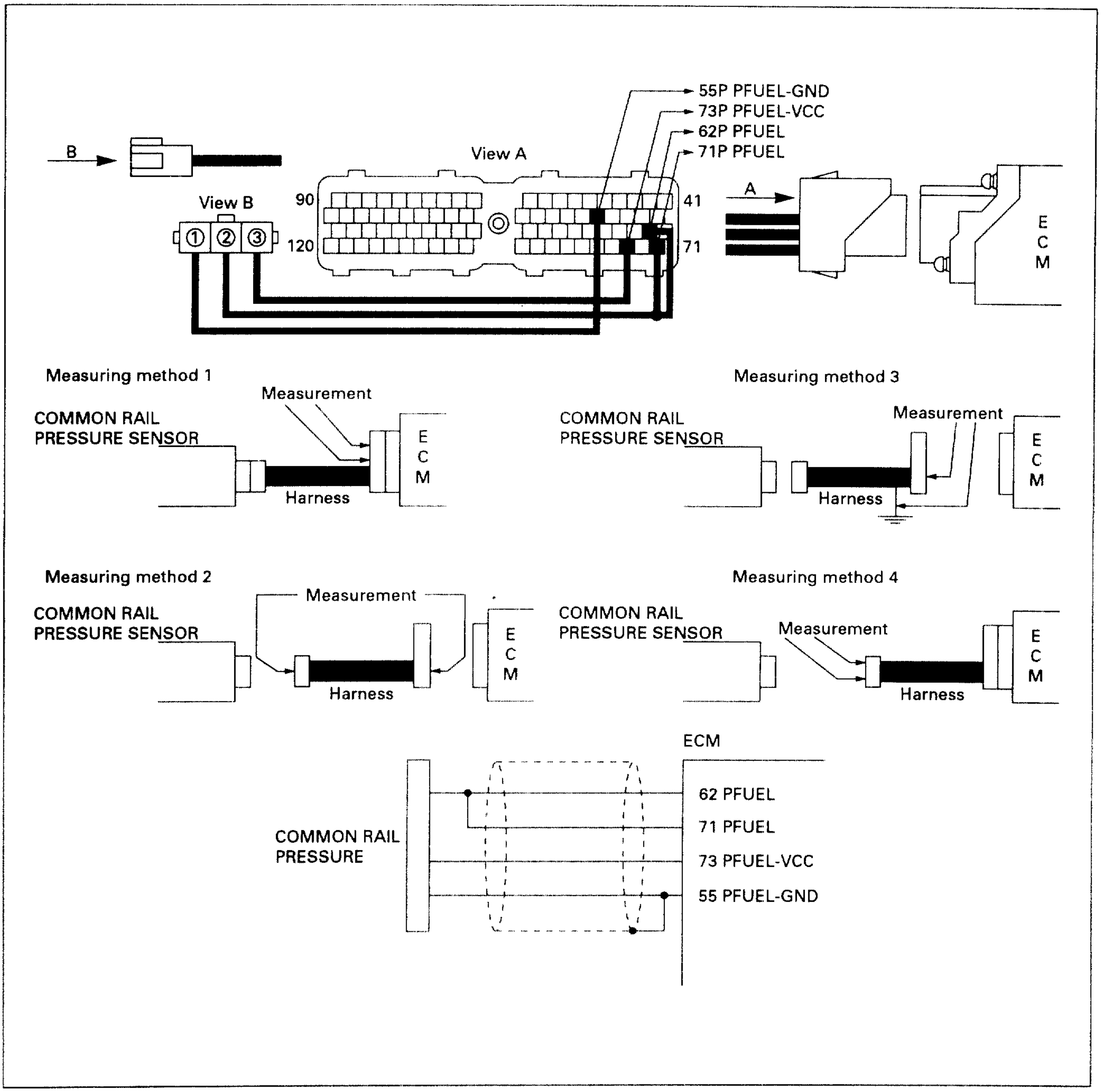
STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does DTC 0118 display?	—	Go to step 3	—
3	Measure the voltage following points. (Measuring method 2) 1. Disconnect common rail pressure sensor harness from both common rail pressure sensor and ECM. 2. Check the harness for shorts to battery between pin number 55 (GND – Battery voltage line) at ECM side. Is voltage within value?	Less than 0.1V	Go to step 5	Repair/replace common rail pressure sensor harness. Then go to step 4
4	Does DTC 0118 with other DTCs display? Other DTCS: 0022, 0023, 0024, 0028, 0032, 0071, 0115, 0211.	—	Replace ECM assembly. Then go to step 5	—
5	Measure the voltage while key switch "ON" as follow. (Measuring method 1) Between pin number 62 and 71 (PFUEL) and pin number 55 (PFUEL – GND) at ECM side.	3.4V or more (at 125 MPa)	Go to step 9	Go to step 6
6	1. Clear the memory. 2. Engine start. Does DTC 0151 or 0118 display? **Note: If you want to start engine, disconnect common rail pressure sensor connector (Make open loop circuit).**	—	Go to step 7	Repair incomplete connection on the connector Go to step 12
7	Is common rail pressure sensor voltage more than 3.4V when key "ON"?	3.4V or more	Replace common rail pressure sensor. Then go to step 8	Go back to step 6
8	Does DTC 0118 display?	—	Go to step 7	System OK
9	1. Disconnect common rail pressure sensor harness from both common rail pressure sensor and ECM. 2. Measure the resistance following points. (Measuring method 2) • Between pin number 71 and 62 (PFUEL) at ECM side and pin number 2 at common rail pressure sensor side on the common rail pressure sensor harness. • Between pin number 55 (PFUEL – GND) at ECM side and pin number 3 at common rail pressure sensor side on the common rail pressure sensor harness. Is resistance within value?	2Ω or less	Go to step 10	Repair/replace common rail pressure sensor harness. Then go to step 12
10	Measure resistance between pin number 62 and 72 (PFUEL) at ECM side and GND on the common rail pressure sensor harness. (Measuring method 3) Is resistance within value?	10MΩ or more	Replace common rail pressure sensor. Then go to step 11	Replace common rail pressure sensor harness then go to step 11

DTC 0118 Common Rail Pressure Abnormal (Control system)
1st and 2nd Stage

STEP	ACTION	VALUE	YES	NO
11	Reconnect all connectors. Does DTC 0118 display?	—	Replace ECM assembly. Then go to step 12	System OK
12	Does DTC 0118 display?	—	Go back to step 3	System OK

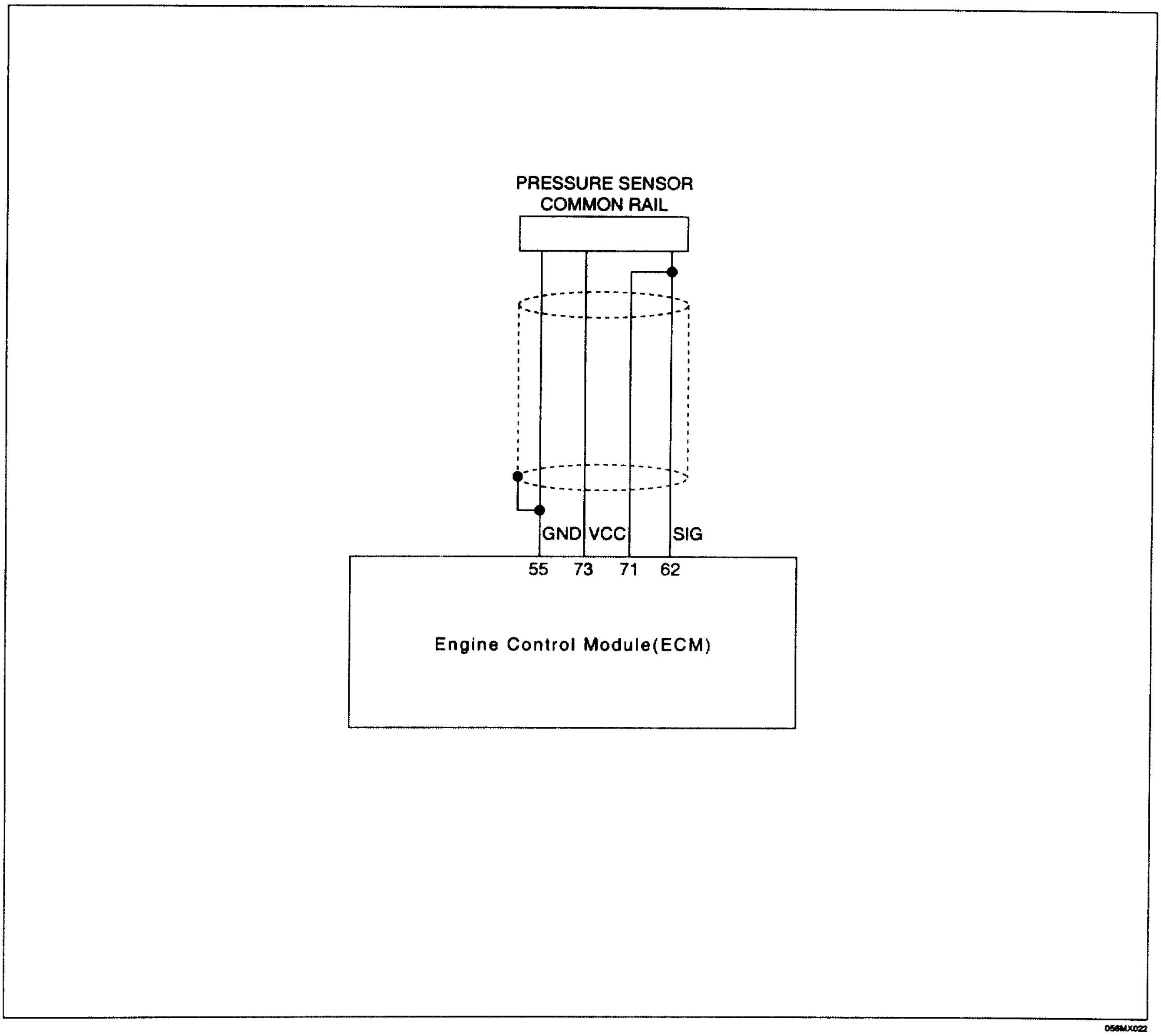
IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

DTC 0118 Common Rail Pressure Abnormal (Control system) 1st and 2nd Stage



D08M200022

DTC 0151 Common Rail Pressure Abnormal (Pump over pressure supply)



Circuit Description

The Common rail is installed on the intake manifold, equipped with flow damper, pressure limiter, and common rail pressure sensor.

The common rail unit has a common fuel passage and fuel passage holes. The common fuel passage is a through hole made in the common rail unit. The common rail pressure sensor is installed at the left end of the unit.

The ECM monitors the Rail Pressure signals for voltage outside the normal range of the Rail Pressure sensor. If the ECM detects a Rail Pressure signal voltage that is excessively high, Diagnostic Trouble Code 0151 will be set.

Conditions for Setting the DTC

- CKP sensor normal, pump normal mode, battery voltage ≥ 8V, pump revolution is 450 rpm or more.
- Water temperature 60°C or more.
  PCV open timing constant, no DTC 0245 and 0115, and common rail pressure continues to be greater than target plus 10 MPa.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Limits are set to common rail pressure open loop control, common rail pressure and injection amount.
- Common rail pressure: 60 MPa maximum Injection amount is limited for 50 mm^3/st.

Conditions for Clearing the MIL/DTC

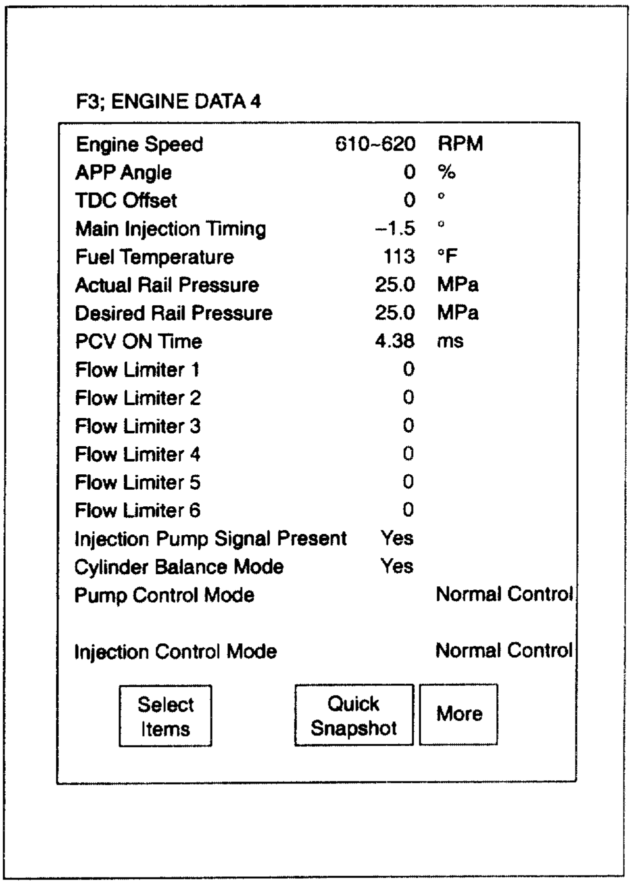
DTC 0151 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

DTC 0151 Common Rail Pressure Abnormal (Pump over pressure supply)

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to ground, shorts to battery and open circuits. If the harness appears to be OK, observe the Rail pressure display on the scan tool while moving connectors and wiring harnesses related to the Rail pressure sensor. A change in the Rail pressure display will indicate the location of the fault.
- Poor condition - mechanical timing, Supply pump, Fuel leak pipe, Fuel injection (High pressure) pipe



F3; ENGINE DATA 4

```
Engine Speed                    610~620  RPM
APP Angle                             0  %
TDC Offset                            0  °
Main Injection Timing              -1.5  °
Fuel Temperature                    113  °F
Actual Rail Pressure               25.0  MPa
Desired Rail Pressure              25.0  MPa
PCV ON Time                        4.38  ms
Flow Limiter 1                        0
Flow Limiter 2                        0
Flow Limiter 3                        0
Flow Limiter 4                        0
Flow Limiter 5                        0
Flow Limiter 6                        0
Injection Pump Signal Present       Yes
Cylinder Balance Mode               Yes
Pump Control Mode                        Normal Control

Injection Control Mode                   Normal Control
```

060M200059

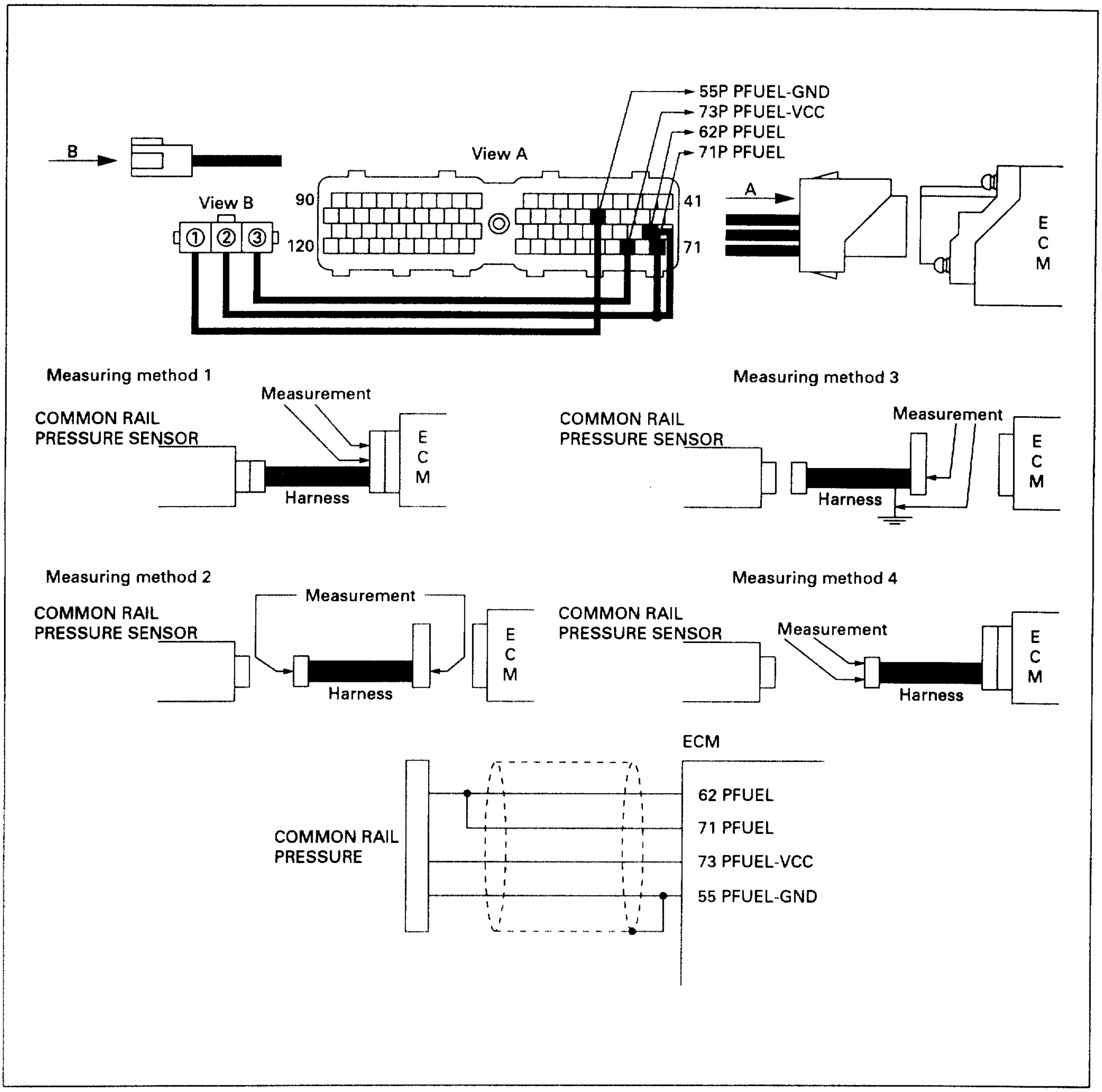
DTC 0151 Common Rail Pressure Abnormal (Pump over pressure supply)

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does the scan tool display DTC 0151 while engine is running or when key switch "ON"?	—	Go to step 3	—
3	1. Key switch "OFF". 2. Disconnect common rail pressure sensor harness connector from common rail pressure sensor. 3. Start and idle the engine. 4. Measure the voltage between pin number 2 (PFUEL) and pin number 3 (PFUEL – GND) with ECT more than 60°C. (Measuring method 4) Is voltage within value?	More than 1.4V	Go to step 4	Go to step 7
4	Clear all DTCs. Is DTC 0151 display?	—	Go to step 6	Go to step 5
5	Check for an open circuit on the common rail pressure sensor harness connector. Is there a complete connection?	—	System OK	Reconnect or repair common rail pressure sensor harness, then Go to step 11
6	1. Check for any DTCs for CKP/CAM sensor. 2. Check complete installation of the supply pump. Was a problem found?	—	First,repair or replace for these problems.	Go to step 8
7	1. Key switch "OFF". 2. Disconnect common rail pressure sensor harness from the sensor and the ECM. 3. Measure the resistance at the following points. (Measuring method 2) • Between pin number 71 (PFUEL) at ECM side and pin number 2 at common rail pressure sensor side on the common rail pressure sensor harness. • Between pin number 62 (PFUEL) at ECM side and pin number 2 at common rail pressure sensor side on the common rail pressure sensor harness. • Between pin number 55 (PFUEL – GND) at ECM side and pin number 3 at common rail pressure sensor side on the common rail pressure sensor harness. Is resistance within value?	2Ω or less	Go to step 8	Repair/replace or correct connector contact for common rail pressure sensor harness. Then go to step 11
8	Measure the resistance at the following points. (Measuring method 3) • Between pin number 71 (PFUEL) at ECM side and GND on the common rail pressure sensor harness. • Between pin number 62 (PFUEL) at ECM side and GND on the common rail pressure sensor harness. • Between pin number 55 (PFUEL – GND) and GND on the common rail pressure sensor harness. Is resistance within value?	10MΩ or more	Go to step 9	Repair harness shortage or replace common rail pressure sensor harness. Then go to step 11
9	1. Reconnect common rail pressure sensor harness to both common rail pressure sensor and ECM. 2. Clear all DTCs, then start the engine. 3. Press and release the accelerator pedal several times. Is DTC 0151 display?	—	Replace common rail pressure sensor. Then go to step 11	Repair harness shortage or replace common rail pressure sensor harness. Then go to step 11

DTC 0151 Common Rail Pressure Abnormal (Pump over pressure supply)

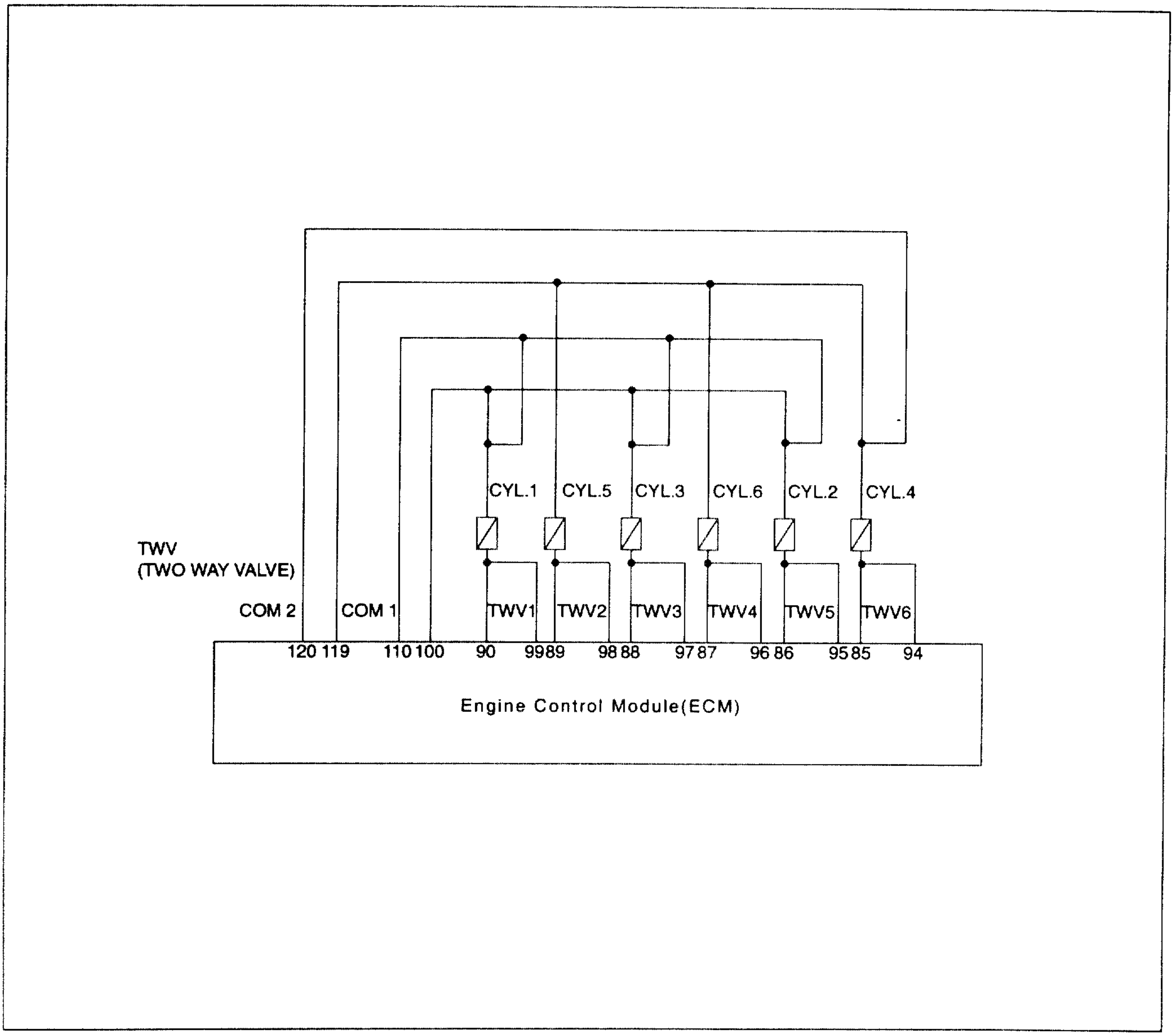
STEP	ACTION	VALUE	YES	NO
10	Clear all DTCs then engine start. Is DTC 0151 display?	—	Replace ECM assembly. Then go to step 11	System OK
11	Is DTC 0151 display?		Go back to step 3	System OK

DTC 0151 Common Rail Pressure Abnormal (Pump over pressure supply)



D06M200022

DTC 0158 TWV Driving System Error (Common 1)



Circuit Description

A hydraulic piston and TWV (solenoid valve) have been added to the conventional nozzle. Receiving signals from the ECM, the TWV opens and closes to change the pressure in the pressure adjustment chamber on top of the hydraulic piston so that the hydraulic piston operates, thereby to inject the fuel from the nozzle.

Conditions for Setting the DTC

Common 1

TWV Driving System B+ shorted.

- TWV harness B+ shorted and/or common harness B+ shorted and battery voltage is higher than 10V except when an overspeed condition occurs.

TWV Driving System Ground shorted.

- TWV harness ground shorted and/or common harness ground shorted and battery voltage is higher than 10V except when an overspeed condition occurs.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Constant current control by common 1 or common 2 circuit whichever normal (Abnormal system separated)
- Injection amount limited maximum 80 mm^3/st and boost becomes 0.
- Engine running

Conditions for Clearing the MIL/DTC

DTC 0158 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

DTC 0158 TWV Driving System Error (Common 1)

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Poor condition of fuse, relay.
- No smooth rotation.
- Hard starting.
- Excessive smoke, etc.
- Lack of engine power.
- If Common 1 line and common 2 lines short-circuit, ECM will set both of DTCs 158, 159.
- If harness (Injector to ECM) short-circuits between Injectors circuit belonging to Common 1, DTC is not set but engine may carry out hunching..
- If the harness between ECMs short-circuits from Injector to GND, Engine may stop. DTC is set at this time.
- DTC is not set when the harness between ECMs short-circuits on a battery line from Injector.

DTC 0158 TWV Driving System Error (Common 1)

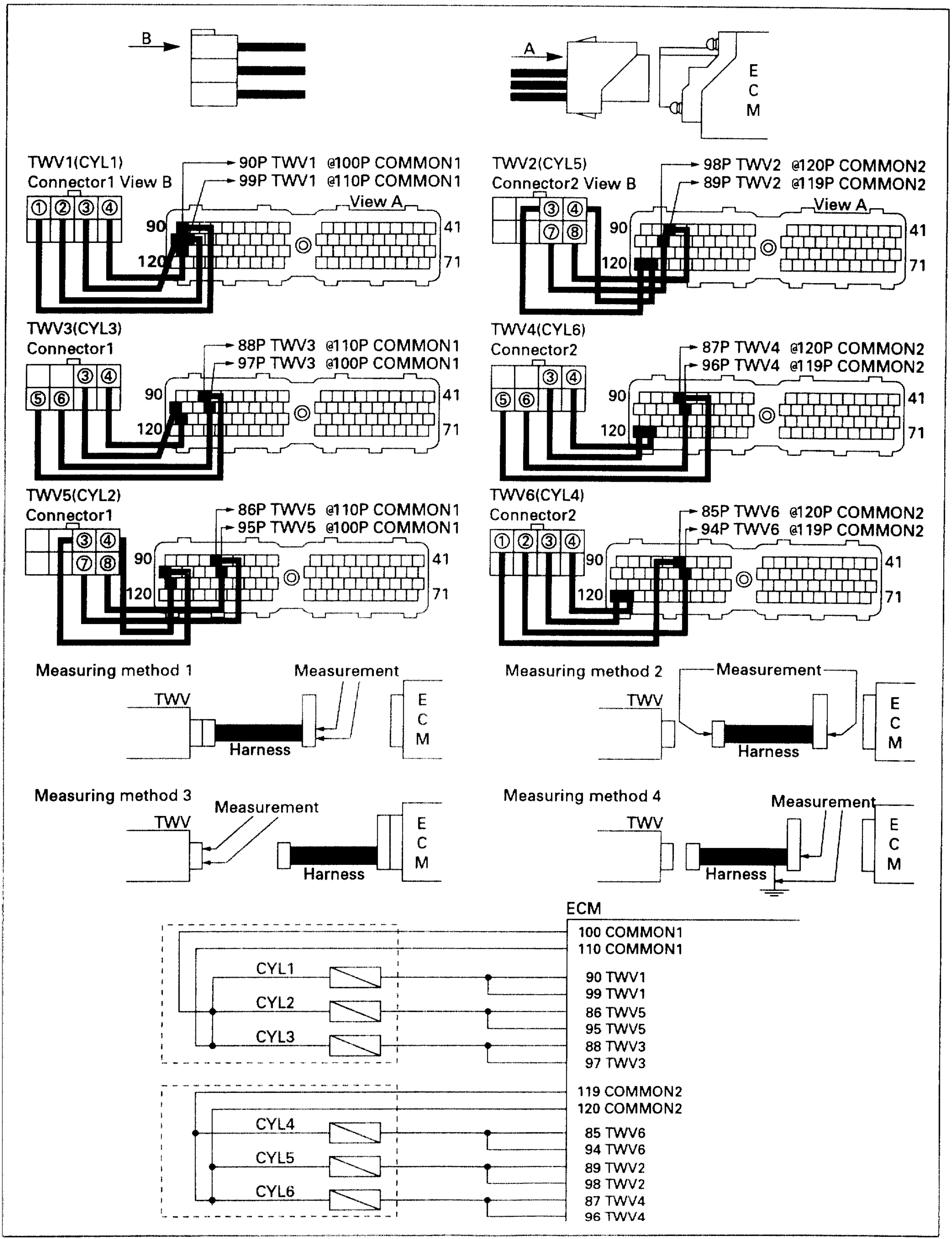
STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does the scan tool display DTC 0158 or DTC 0159 while key switch "ON" or engine is running?	—	Go to step 3	—
3	1. Key switch "OFF". 2. Disconnect TWV harness from both ECM and TWV connector at cylinder head. 3. Key switch "ON". 4. Measure voltage following points on the TWV harness. (Measuring method 4) • Between pin number 100, 110 (COMMON1) and GND at ECM side connector. • Between pin number 119, 120 (COMMON2) and GND at ECM side connector. In this case, assume there is a short circuit with an other B+ line. Is voltage within value?	1V or less	Go to step 4	Repair common1 and/or common2 of TWV harness. Then go to step 6
4	1. Key switch "ON". 2. Measure voltage at the following points at the ECM connector on the TWV harness. (Measuring method 4) • Between pin number 90, 99 (TWV1) and GND (CYL#1). • Between pin number 89, 98 (TWV2) and GND (CYL#5). • Between pin number 88, 97 (TWV3) and GND (CYL#3). • Between pin number 87, 96 (TWV4) and GND (CYL#6). • Between pin number 86, 95 (TWV5) and GND (CYL#2). • Between pin number 85, 94 (TWV6) and GND (CYL#4). In this case, assume there is a short circuit with other GND line. Is voltage within value?	1V or less	Go to step 5	Repair/replace TWV harness. Then go to step 7
5	1. Key switch "OFF". 2. Measure resistance at the following points at the ECM connector on the TWV harness. (Measuring method 4) • Between pin number 119, 120 (COMMON2) and GND. • Between pin number 100, 110 (COMMON1) and GND. Is resistance within value?	10MΩ or more	Go to step 6	Repair/replace TWV harness. Then go to step 7
6	Measure resistance following points at ECM side connector on the TWV harness. • Between pin number 90, 99 (TWV1) and ECM body GND (CYL#1). • Between pin number 89, 98 (TWV2) and ECM body GND (CYL#5). • Between pin number 88, 97 (TWV3) and ECM body GND (CYL#3). • Between pin number 87, 96 (TWV4) and ECM body GND (CYL#6). • Between pin number 86, 95 (TWV5) and ECM body GND (CYL#2). • Between pin number 85, 94 (TWV6) and ECM body GND (CYL#4). Is voltage within value?	10MΩ or more	Go to step 8	Repair/replace TWV harness. Then go to step 9

DTC 0158 TWV Driving System Error (Common 1)

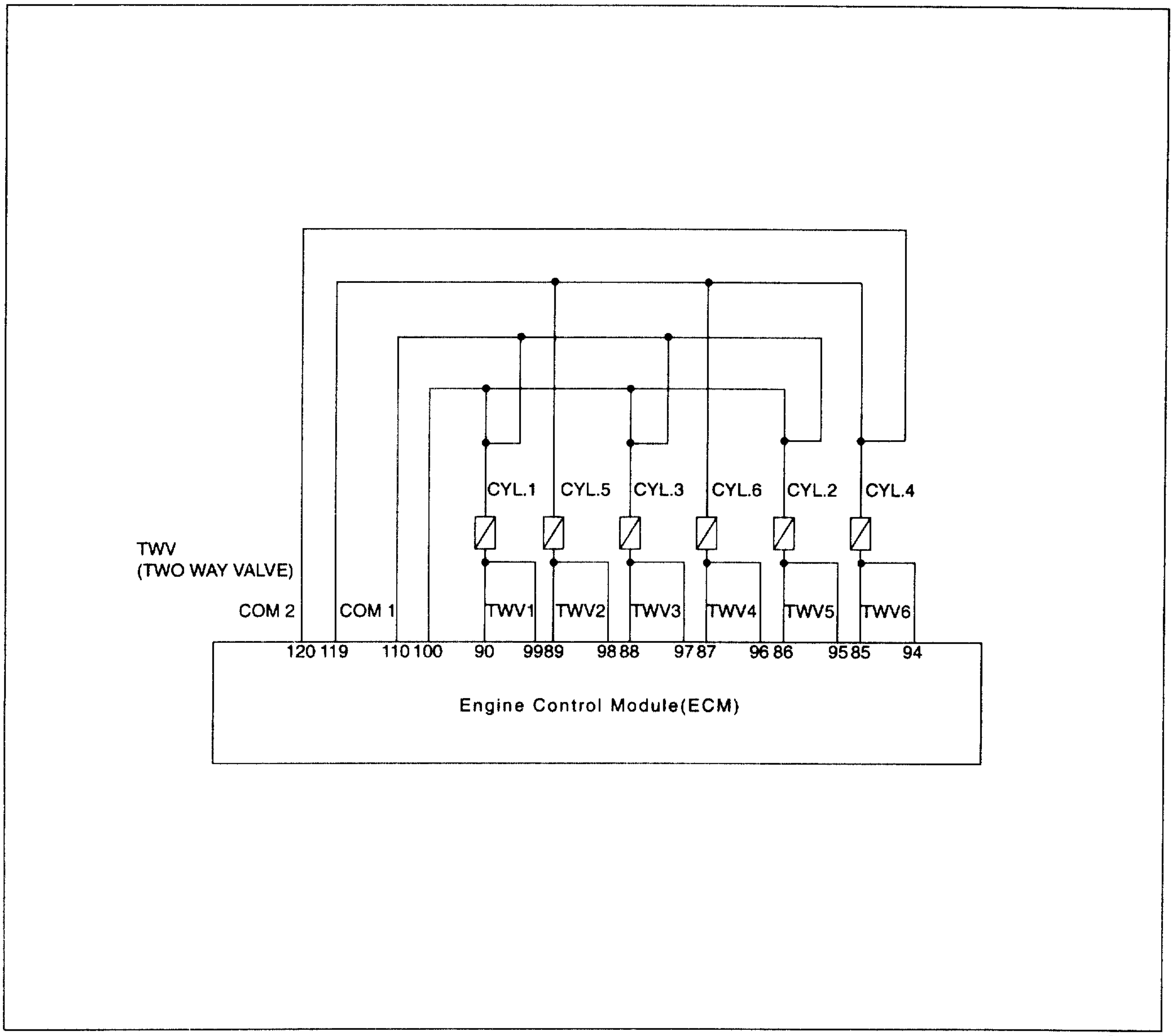
STEP	ACTION	VALUE	YES	NO
7	1. Key switch "OFF". 2. Disconnect injector (Coil unit resistance). 3. Measure resistance following points. (Measuring method 1) • Between pin number 1 and 2 on the Injector. • Between pin number 100, 110 (COMMON1) and GND. Is resistance within value?	0.4Ω to 0.8Ω (about 20°C)	Go to step 8	Replace injector assembly. Then go to step 8
8	1. Clear DTC. 2. Start engine. Does DTC 0158 or DTC 0159 display?	—	Replace ECM assembly. Then go to step 9	System OK
9	1. Clear all DTCs. 2. Start engine. Does DTC 0158 or DTC 0159 display?	—	Go back to step 3	System OK

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

DTC 0158 TWV Driving System Error (Common 1)



DTC 0159 TWV Driving System Error (Common 2)



D06M200013

Circuit Description

A hydraulic piston and TWV (solenoid valve) have been added to the conventional nozzle. Receiving signals from ECM, the TWV opens and closes to change the pressure in the pressure adjustment chamber on top of the hydraulic piston so that the hydraulic piston operates, thereby to inject the fuel from the nozzle.

Conditions for Setting the DTC

Common 2

TWV Driving System B+ shorted.

- TWV harness B+ shorted and/or common harness B+ shorted and battery voltage is higher than 10V except when an over speed condition occurs.

TWV Driving System Ground shorted.

- TWV harness ground shorted and/or common harness ground shorted and battery voltage is higher than 10V except when an over speed condition occurs.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Constant current control by common 1 or common 2 circuits whichever normal (Abnormal system separated)
- Injection amount limited maximum 80 mm^3/st and boost becomes 0.
- Engine running

Conditions for Clearing the MIL/DTC

DTC 0159 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

DTC 0159 TWV Driving System Error (Common 2)

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Poor condition of fuse, relay.
- No smooth rotation.
- Hard starting.
- Excessive smoke, etc.
- Lack of engine power.
- If Common 1 line and common 2 lines short-circuit, ECM will set both of DTCs 158, 159.
- If harness (Injector to ECM) short-circuits between Injectors circuit belonging to Common 1, DTC is not set but engine may carry out hunching.
- If the harness between ECMs short-circuits from Injector to GND, Engine may stop, DTC is set at this time.
- DTC is not set when the harness between ECMs short-circuits on a battery line from Injector.

DTC 0159 TWV Driving System Error (common 2)

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does the scan tool display DTC 0158 or DTC 0159 while key switch "ON" or engine is running?	—	Go to step 3	—
3	1. Key switch "OFF". 2. Disconnect TWV harness from both ECM and TWV connector at cylinder head. 3. Key switch "ON". 4. Measure voltage following points on the TWV harness. (Measuring method 4) • Between pin number 100, 110 (COMMON1) and GND at ECM side connector. • Between pin number 119, 120 (COMMON2) and GND at ECM side connector. In this case, assume there is a short circuit with an other B+ line. Is voltage within value?	1V or less	Go to step 4	Repair common1 and/or common2 of TWV harness. Then go to step 6
4	1. Key switch "ON". 2. Measure voltage at the following points at the ECM connector on the TWV harness. (Measuring method 4) • Between pin number 90, 99 (TWV1) and GND (CYL#1). • Between pin number 89, 98 (TWV2) and GND (CYL#5). • Between pin number 88, 97 (TWV3) and GND (CYL#3). • Between pin number 87, 96 (TWV4) and GND (CYL#6). • Between pin number 86, 95 (TWV5) and GND (CYL#2). • Between pin number 85, 94 (TWV6) and GND (CYL#4). In this case, assume there is a short circuit with other GND line. Is voltage within value?	1V or less	Go to step 5	Repair/replace TWV harness. Then go to step 7
5	1. Key switch "OFF". 2. Measure resistance at the following points at the ECM connector on the TWV harness. (Measuring method 4) • Between pin number 119, 120 (COMMON2) and GND. • Between pin number 100, 110 (COMMON1) and GND. Is resistance within value?	10MΩ or more	Go to step 6	Repair/replace TWV harness. Then go to step 7
6	Measure resistance following points at ECM side connector on the TWV harness. • Between pin number 90, 99 (TWV1) and ECM body GND (CYL#1). • Between pin number 89, 98 (TWV2) and ECM body GND (CYL#5). • Between pin number 88, 97 (TWV3) and ECM body GND (CYL#3). • Between pin number 87, 96 (TWV4) and ECM body GND (CYL#6). • Between pin number 86, 95 (TWV5) and ECM body GND (CYL#2). • Between pin number 85, 94 (TWV6) and ECM body GND (CYL#4). Is voltage within value?	10MΩ or more	Go to step 7	Repair/replace TWV harness. Then go to step 9

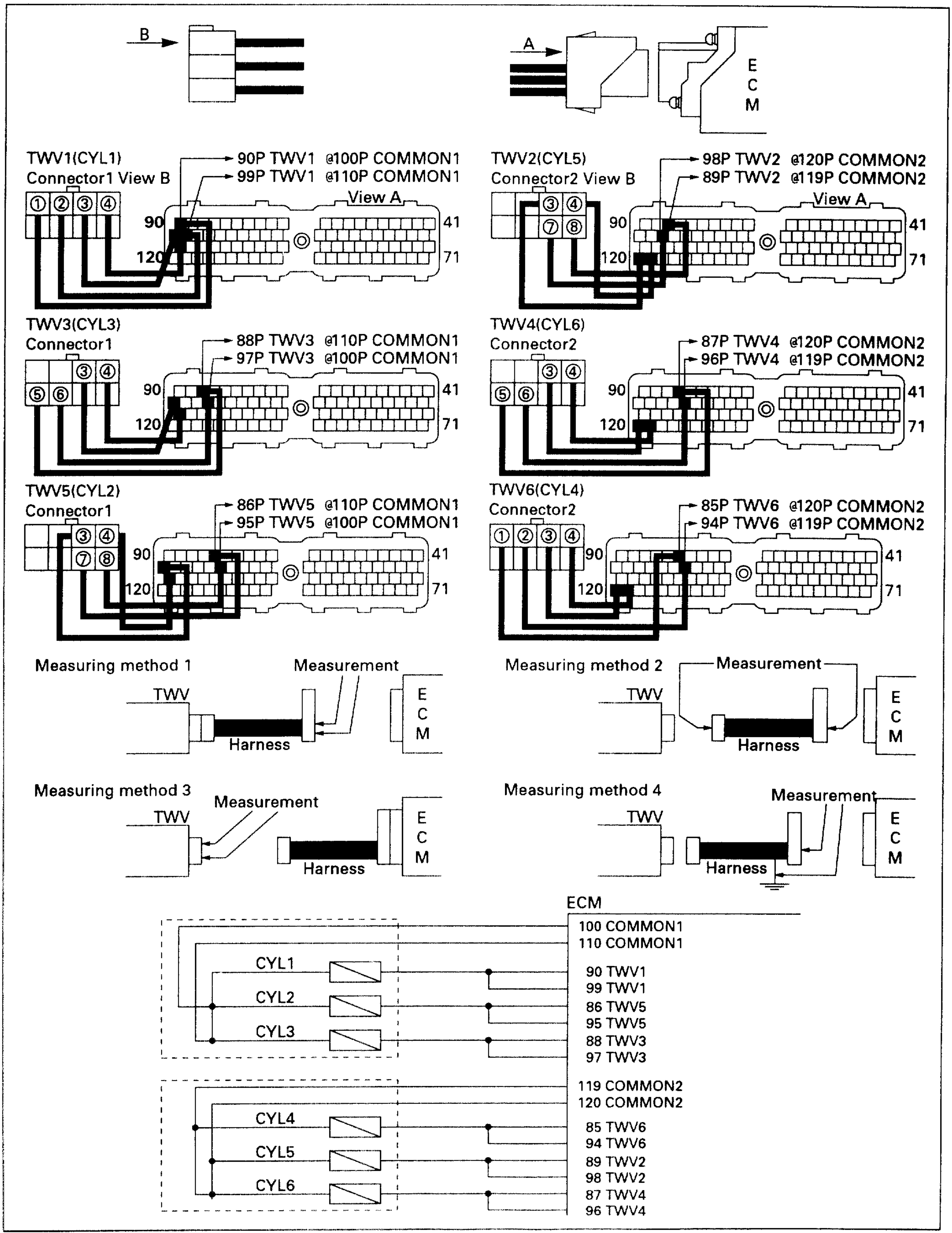
IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

DTC 0159 TWV Driving System Error (common 2)

STEP	ACTION	VALUE	YES	NO
7	1. Key switch "OFF". 2. Disconnect injector (Coil unit resistance). 3. Measure resistance following points. (Measuring method 1) • Between pin number 1 and 2 on the Injector. • Between pin number 100, 110 (COMMON1) and GND. Is resistance within value?	0.4Ω to 0.8Ω (about 20°C)	Go to step 8	Replace injector assembly. Then go to step 8
8	1. Clear DTC. 2. Start engine. Does DTC 0158 or DTC 0159 display?	—	Replace ECM assembly. Then go to step 9	System OK
9	1. Clear all DTCs. 2. Start engine. Does DTC 0158 or DTC 0159 display?	—	Go back to step 3	System OK

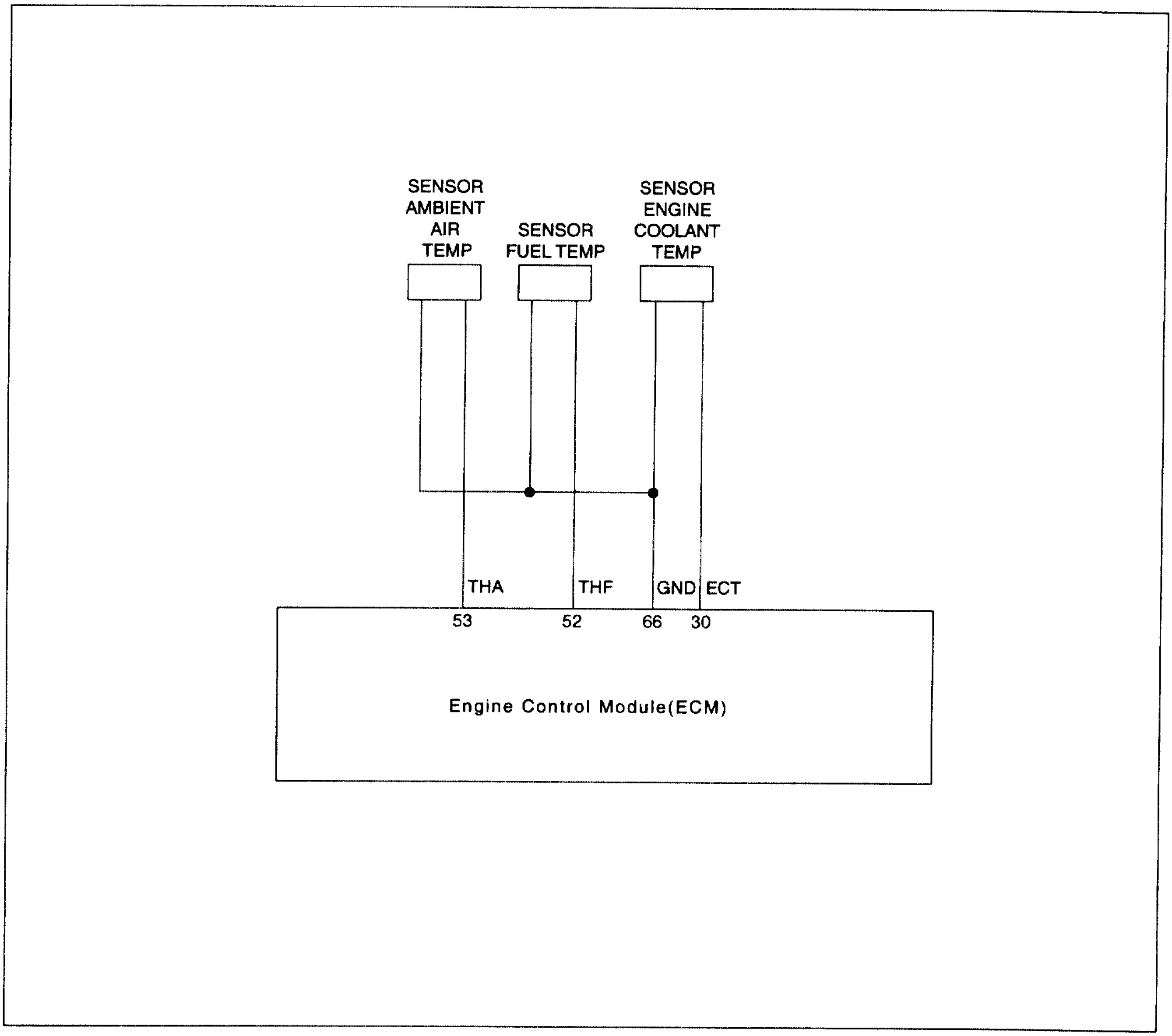
IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

DTC 0159 TWV Driving System Error (common 2)



056MV005

DTC 0211 Fuel Temperature Sensor Error



Circuit Description

The Fuel Temp. sensor (THF) is a thermister type sensor installed in the casing of the fuel return (from the injector) circuit.

Change in fuel temperature is converted into a resistance signal and sent to ECM for optimization of fuel injection control.

Diagnostic Trouble Code 0211 will set when the ECM detects an excessively high or low signal voltage on the THF sensor signal circuit.

Conditions for Setting the DTC

- A fuel temperature sensor voltage exceeding 4.8V or lower than 0.1V detected for 1 sec. or more.
  (4.8V = –50°C, 0.1V = 130°C)

Action Taken When the DTC Sets

- Backup control by ECT
  starting at a fuel temperature of –20°C
  Other = 80°C

Conditions for Clearing the MIL/DTC

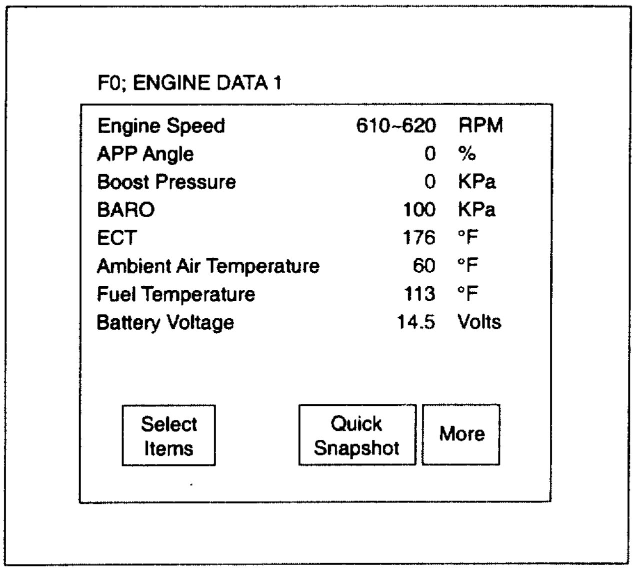
DTC 0211 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

DTC 0211 Fuel Temperature Sensor Error

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to ground, shorts to battery and open circuits. If the harness appears to be OK, observe the Fuel Temperature display on the scan tool while moving connectors and wiring harnesses related to the Fuel Temperature sensor. A change in the Fuel Temperature display will indicate the location of the fault.



F0; ENGINE DATA 1

Engine Speed	610~620	RPM
APP Angle	0	%
Boost Pressure	0	KPa
BARO	100	KPa
ECT	176	°F
Ambient Air Temperature	60	°F
Fuel Temperature	113	°F
Battery Voltage	14.5	Volts

060M200056

- No symptom in particular

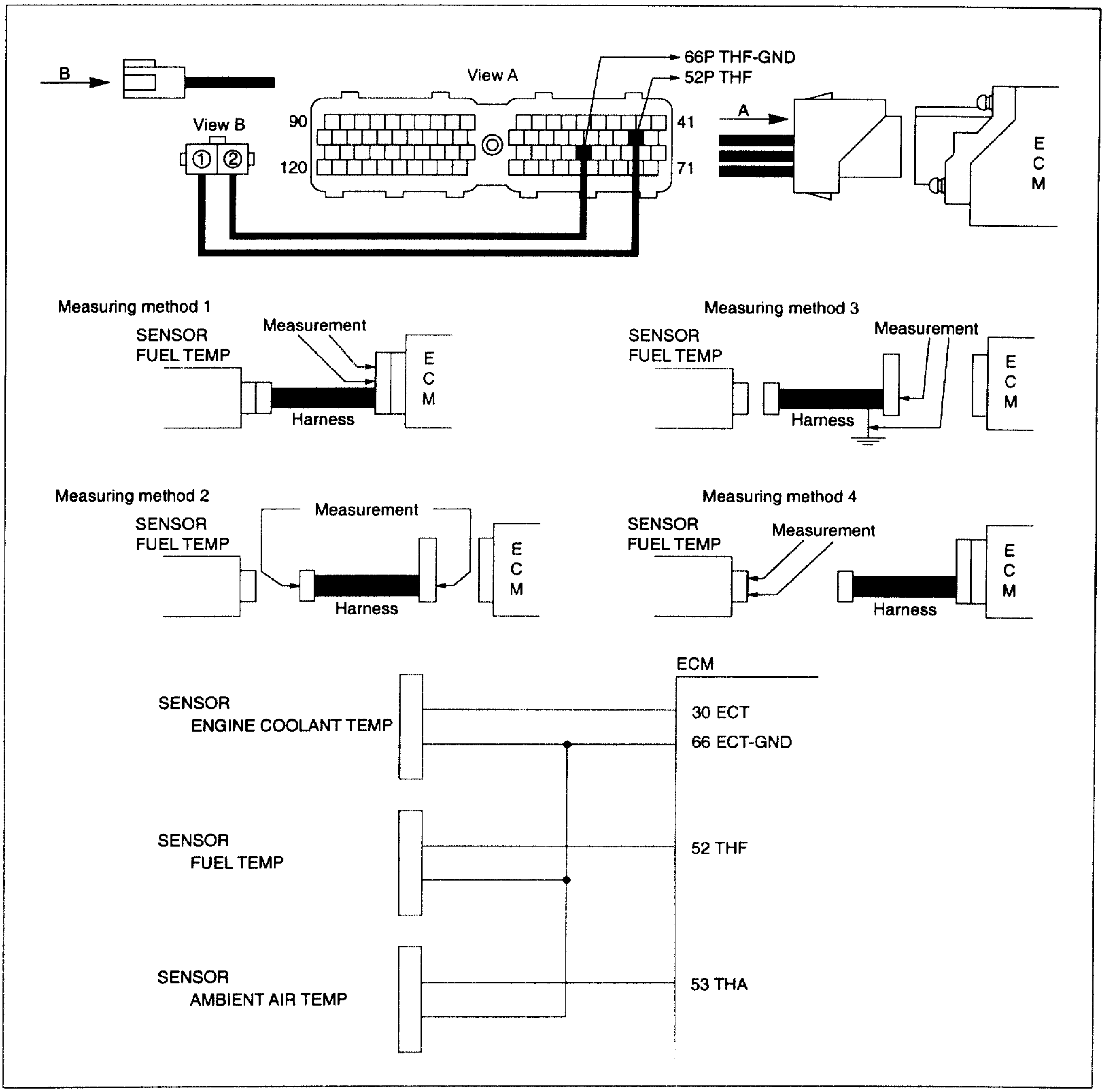
DTC 0211 Fuel Temperature Sensor Error

<table>
<tr><th>STEP</th><th>ACTION</th><th>VALUE</th><th>YES</th><th>NO</th></tr>
<tr><td>1</td><td>Was the “On-Board Diagnostic (OBD) System Check” performed?</td><td>—</td><td>Go to step 2</td><td>Go to OBD System Check</td></tr>
<tr><td>2</td><td>Does the scan tool display DTC 0211 while key switch “ON” or engine running?</td><td>—</td><td>Go to step 3</td><td>—</td></tr>
<tr><td>3</td><td>Measure the voltage between pin number 52 (THF) and pin number 66 (sensor – GND) at the ECM while key switch “ON” and engine is running. (Measuring method 1)
Is the voltage outside the specifical value?
(1.5V when fuel temp. about 60°C)</td><td>0.1V
to
4.8V</td><td>Go to step 5</td><td>Go to step 4</td></tr>
<tr><td>4</td><td>Check for poor connection at connector.
Is there incomplete connection?</td><td>—</td><td>Correct to complete connection.</td><td>Go to step 5</td></tr>
<tr><td>5</td><td>Is there abnormally high fuel temperature?</td><td>More than 212°F (100°C)</td><td>Repair fuel system</td><td>Go to step 6</td></tr>
<tr><td>6</td><td>1. Key switch “OFF”.
2. Disconnect fuel temp sensor harness from both ECM and fuel temp sensor.
3. Measure resistance following points.
• Between pin number 52 (THF) at ECM side and pin number 1 at fuel temp sensor side on the THF sensor harness.
• Between pin number 66 (THF–GND) at ECM side and pin number 2 at THF sensor side on the THF sensor harness. (Measuring method 2)
Is resistance within value?</td><td>2Ω or less</td><td>Go to step 7</td><td>Repair/replace THF sensor harness.</td></tr>
<tr><td>7</td><td>Measure resistance between pin number 52 and GND.
(Measuring method 3)
Is resistance within value?</td><td>10MΩ or more</td><td>Go to step 8</td><td>Repair/replace THF sensor harness</td></tr>
<tr><td>8</td><td>Measure the resistance of THF sensor unit.
(Measuring method 4)
Is resistance within value?

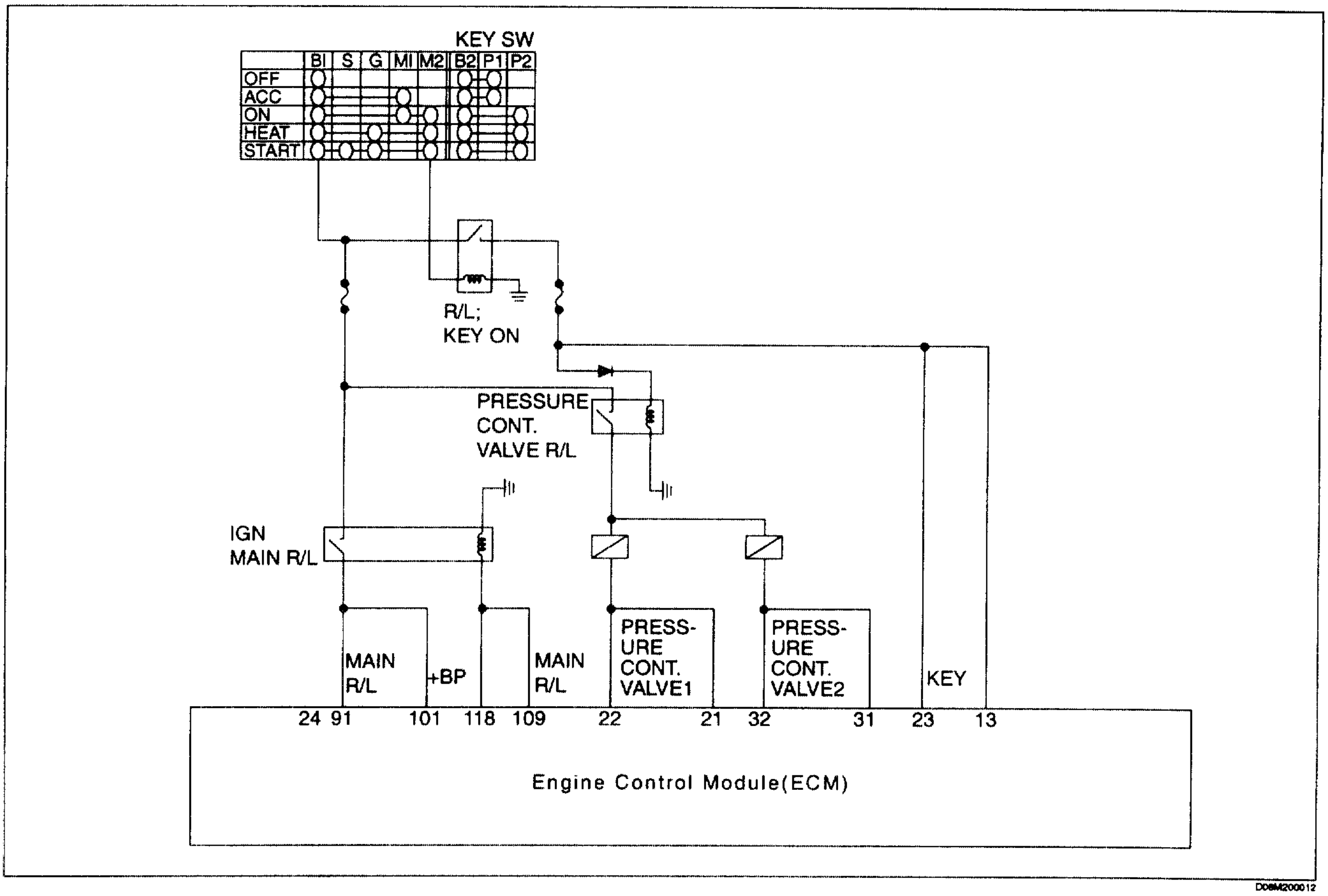
Resistance for THF sensor unit
<table>
<tr><th>Fuel temperature (°C)</th><th>Resistance (kΩ)</th></tr>
<tr><td>20</td><td>About 2.7 (3V)</td></tr>
<tr><td>40</td><td>1.3 (2.2V)</td></tr>
<tr><td>60</td><td>0.6 (1.5V)</td></tr>
<tr><td>80</td><td>0.4 (1V)</td></tr>
</table></td><td>See table on left</td><td>Go to step 9</td><td>Replace THF sensor</td></tr>
<tr><td>9</td><td>1. Reconnect THF sensor harness to ECM and THF sensor.
2. Clear all DTCs.
Is DTC 0211 displayed?</td><td>—</td><td>Replace ECM assembly then Go to step 10</td><td>System OK</td></tr>
<tr><td>10</td><td>Clear all DTCs.
Is DTC 0211 displayed?</td><td>—</td><td>Go back to step 3</td><td>System OK</td></tr>
<tr><td></td><td>Note: The temperature sensor GND is common. If disconnected or short circuited, all sensors become erroneous. (Water, atmospheric and fuel temperature.)</td><td></td><td></td><td></td></tr>
</table>

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2.
Refer to “Capture and Restore Fuel Rate Data” of “Tech 2 Scan Tool” in this manual.

DTC 0211 Fuel Temperature Sensor Error



DTC 0217 PCV1 (Coil or Harness) B+ Shortage



Circuit Description

The PCV is used to adjust supply pump discharge amount so as to adjust common rail pressure. Discharge amount from the supply pump to the common rail is determined by PCV current timing.

Diagnostic Trouble Code 0217 will set when the ECM detects an excessively high signal voltage on the PCV1 sensor signal circuit.

Conditions for Setting the DTC

PCV1;

- Abnormally high driving voltage with PCV on, Pump normal mode and battery voltage higher than 10V when key switch ON.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- If abnormally high driving voltage is generated, the PCV will be off. The default pressure is limited to 60 MPa or less.

Conditions for Clearing the MIL/DTC

DTC 0217 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

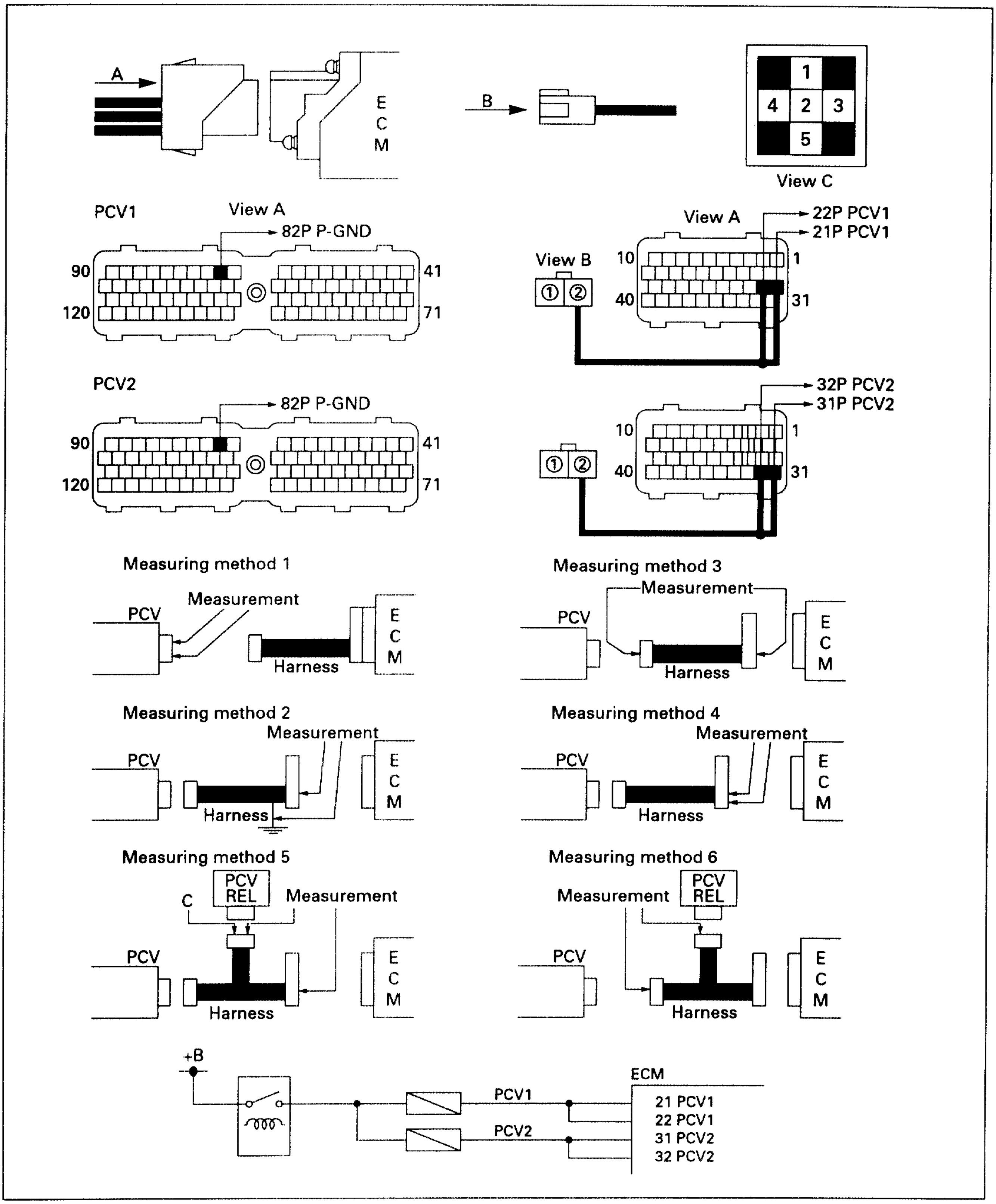
- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to ground, shorts to battery and open circuits. If the harness appears to be OK, observe the PCV display on the scan tool while moving connectors and wiring harnesses related to the PCV sensor A change in the PCV display will indicate the location of the fault.

DTC 0217 PCV1 (Coil or Harness) B+ Shortage

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does DTC 0217 display while key switch "ON" or engine is running?	—	Go to step 3	—
3	1. Key switch "OFF". 2. Disconnect PCV1 and PCV2 connector. 3. Measure resistance following points. (Measuring method 1) • Between pin number 1 and 2 on the PCV1. Is resistance within value?	0.9Ω to 1.3Ω (about 20°C)	Go to step 4	Replace PCV assembly. Then go to step 8
4	1. Key switch "OFF". 2. Disconnect ECM connector. (PCV connector remains connected) 3. Key switch "ON". 4. Measure voltage at the following points. (Measuring method 4) • Between pin number 21, 22 PCV1 side and pin number 81 and 82 (P–GND) ECM side on the PCV1 harness. Is voltage within value?	1V or less	Go to step 6	Go to step 5
5	Repair the short to battery positive (B+) on the PCV input circuit to ECM on the PCV harness Did you repair them?	—	Go to step 6	Repair them. Then go to step 6
6	1. Key switch "OFF". 2. Reconnect all connector to ECM and PCV harness. 3. Key switch "ON". Is DTC 0217 displayed?	—	Replace ECM. Then go to step 8	Go to step 7
7	1. Key switch "OFF". 2. Disconnect PCV harness from PCV, PCV relay and ECM. 3. Measure voltage between pin number 1 at PCV relay side of PCV harness and pin number 82 (P–GND) at ECM side of PCV harness. (Measuring method 5) Is voltage within value?	Less than 1V	Go to step 8	Repair/replace PCV harness. Then go to step 8
8	1. Disconnect of ECM harness. 2. Measure resistance between ECM connector (Ground circuit) and Ground Point. Is resistance within value?	Less than 1Ω	Go to step 9	Repair/replace ECM Ground harness. Then go to step 9
9	Clear all DTCs. Does DTC 0217 display while key "ON" or engine is running?	—	Go back to step 3	System OK

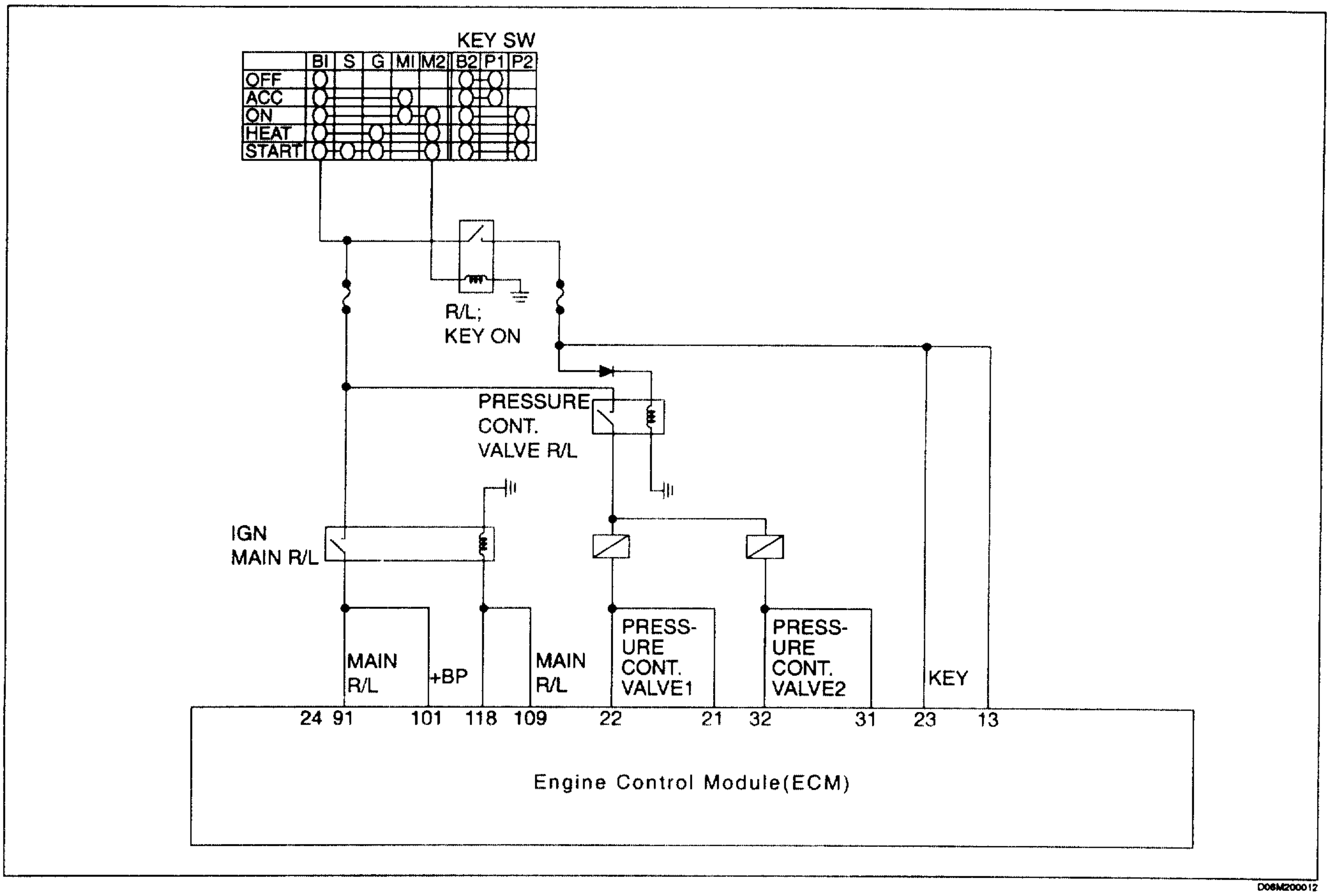
IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

DTC 0217 PCV1, 2 (Coil or Harness) B+ Shortage



056MV011

DTC 0218 PCV2 (Coil or Harness) B+ Shortage



Circuit Description

PCV is used to adjust supply pump discharge amount so as to adjust common rail pressure. Discharge amount from the supply pump to the common rail is determined by PCV current timing.

Diagnostic Trouble Code 0218 will set when the ECM detects an excessively high signal voltage on the PCV2 sensor signal circuit.

Conditions for Setting the DTC

PCV2;

- Abnormally high driving voltage with PCV on, Pump normal mode and battery voltage higher than 10V when key switch ON.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- If abnormally high driving voltage is generated, the PCV will be off. The target pressure is limited to 60 MPa or less.

Conditions for Clearing the MIL/DTC

DTC 0218 can be cleared by using the “Clear Info” by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

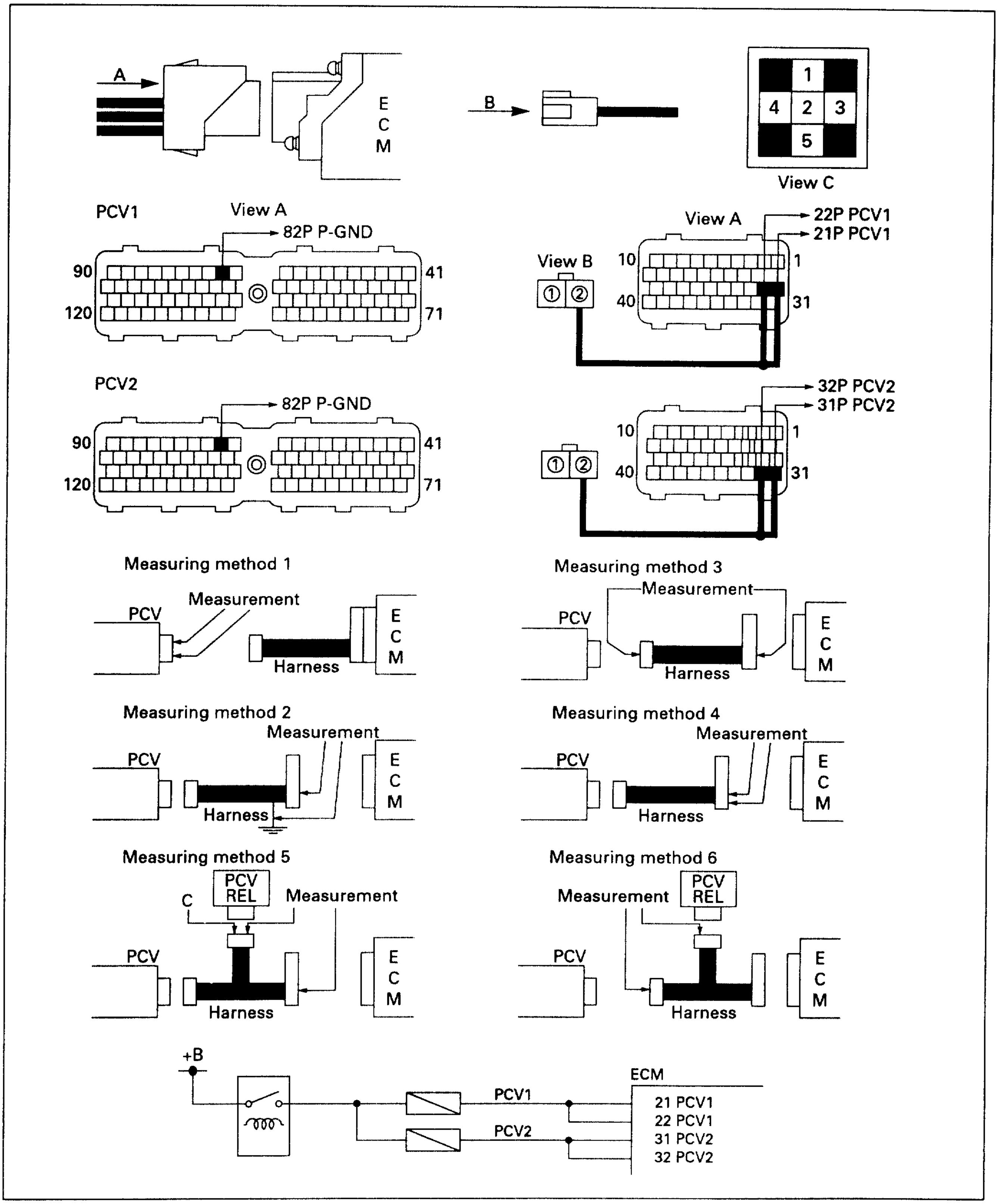
- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to ground, shorts to battery and open circuits. If the harness appears to be OK, observe the PCV display on the scan tool while moving connectors and wiring harnesses related to the PCV sensor A change in the PCV display will indicate the location of the fault.

DTC 0218 PCV2 (Coil or Harness) B+ Shortage

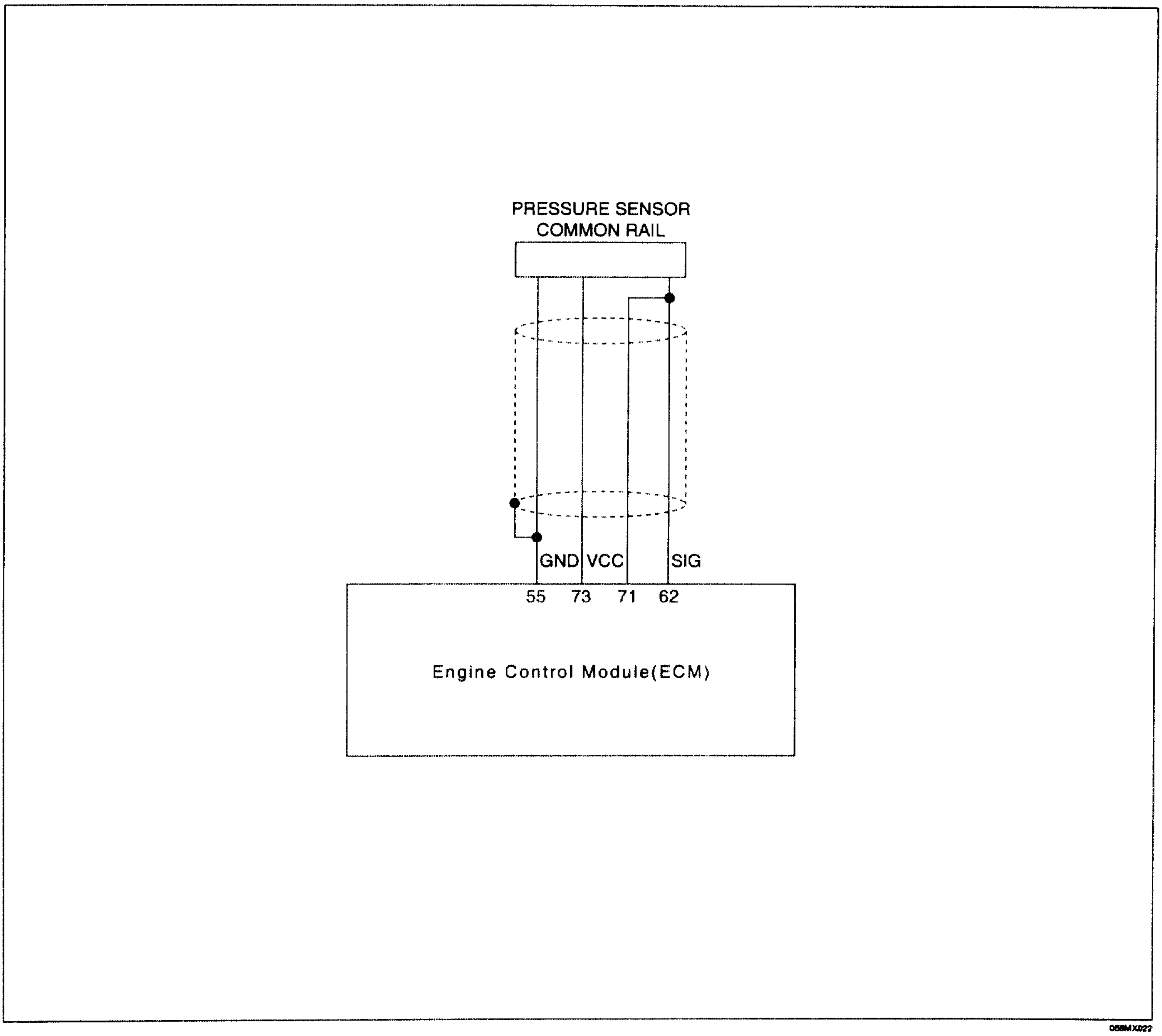
STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does DTC 0218 display while key switch "ON" or engine is running?	—	Go to step 3	—
3	1. Key switch "OFF". 2. Disconnect PCV1 and PCV2 connector. 3. Measure resistance following points. (Measuring method 1) • Between pin number 1 and 2 on the PCV2. Is resistance within value?	0.9Ω to 1.3Ω (about 20°C)	Go to step 4	Replace PCV assembly. Then go to step 8
4	1. Key switch "OFF". 2. Disconnect ECM connector. (PCV connector remains connection) 3. Key switch "ON". 4. Measure voltage at the following points. (Measuring method 4) • Between pin number 31, 32 PCV2 side and pin number 81 and 82 (P–GND) ECM side on the PCV2 harness. Is voltage within value?	1V or less	Go to step 6	Go to step 5
5	Repair the short to battery positive (B+) on the PCV input circuit to ECM on the PCV harness Did you repair them?	—	Go to step 6	Repair them. Then go to step 6
6	1. Key switch "OFF". 2. Reconnect all connector to ECM and PCV harness. 3. Key switch "ON". Is DTC 0218 displayed?	—	Replace ECM. Then go to step 8	Go to step 7
7	1. Key switch "OFF". 2. Disconnect PCV harness from PCV, PCV relay and ECM. 3. Measure voltage between pin number 1 at PCV relay side of PCV harness and pin number 82 (P–GND) at ECM side of PCV harness. (Measuring method 5) Is voltage within value?	Less than 1V	Go to step 8	Repair/replace PCV harness. Then go to step 8
8	1. Disconnect of ECM harness. 2. Measure resistance between ECM connector (Ground circuit) and Ground Point. Is resistance within value?	Less than 1Ω	Go to step 9	Repair/replace ECM Ground harness. Then go to step 9
9	Clear all DTCs. Does DTC 0218 display while key "ON" or engine is running?	—	Go back to step 3	System OK

***IMPORTANT:** The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.*

DTC 0218 PCV1, 2 (Coil or Harness) B+ Shortage



DTC 0226 Supply Pump Non Pressure Supply or Pressure Limiter Activation



Circuit Description

The pressure limiter opens when abnormally high pressure is generated, releasing the pressure. When the common rail pressure reaches approx. 170 MPa (1,734 kg/cm^2), the pressure limiter is actuated (opens), and when the pressure drops to approx. 30 MPa (310 kg/cm^2) later, it works to maintain the pressure, thereby enabling continuous running.

The common rail pressure sensor, installed at left end of the common rail, is used to detect fuel pressure. It is a semiconductor type pressure sensor utilizing silicon's property that the electric resistance of pressurized silicone is varied.

Further, a special gasket is used at the connection part with the common rail body so as to seal high pressure fuel.

Conditions for Setting the DTC

- Desired ISC speed as detected by scan tool and common rail pressure not controlled.
- DTC 0245, 0217, 218, 0247 and 0248 are not set.
- CKP sensor normal condition.
- Pump normal mode, battery voltage is higher than 8V.
- Pump speed is higher than 450 rpm.
- ECT is higher than 60°C.
- PCV opening timing reached the limited value or feedback value reaches –60CA deg.
- PCV close interval: more than 98°CA.
- When above condition continues for 60 times.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Injection amount is limited for 60 mm^3/st.
- Target common rail pressure is lower than 25 MPa.

DTC 0226 Supply Pump Non Pressure Supply or Pressure Limiter Activation

Conditions for Clearing the MIL/DTC

DTC 0226 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Smoke, power shortage etc., due to lack of common rail pressure (Pressure limiter activated)
- Check Fuel Filter.

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does the scan tool display DTC 226 while Ignition "ON", or engine at idle?	—	Go to step 3	—
3	1. After warming up the engine (at 60°C or more), turn engine "OFF", clear the DTC. 2. Restart the engine and let idle for 60 seconds. Does the DTC reset?	—	Go to step 4	See Note on Intermittent
4	Check the fuel lines from supply pump to common rail for broken, loose, or restriction. Also check fuel filter for restriction. Was a problem found?	—	Repair or replace Go back to step 3	Go to step 5
5	Check the ECM and common rail fuel pressure sensor connectors, ECM ground, and wiring harness for looseness, bent terminals, or chafed wires. Was a problem found?	—	Repair or replace Go back to step 3	Go to step 6
6	1. Ignition"ON", engine "ON". 2. Record actual common rail fuel pressure at idle. Is the pressure lower than the specified value?	25 MPa	Go to step 7	See Note on Intermittent
7	Disconnect PCV#1 connector while engine is idling. Does engine shut down?	—	Replace supply pump. Go back to step 3	Go to step 8
8	1. Reconnect the PCV#1 connector. 2. Disconnect PCV#2 connector while engine is idling. Does engine shut down?	—	Replace supply pump. Go back to step 3	Go to step 9
9	1. Reconnect the PCV#2 connector. 2. Operate on acceleration pedal at 2,500 to 3,000 rpm on engine speed, and observe the actual common rail fuel pressure. Did the actual common rail fuel pressure have a pressure reading above the specified value?	More than 60MPa	Go to step 11	Replace common rail pressure sensor Go back to step 3

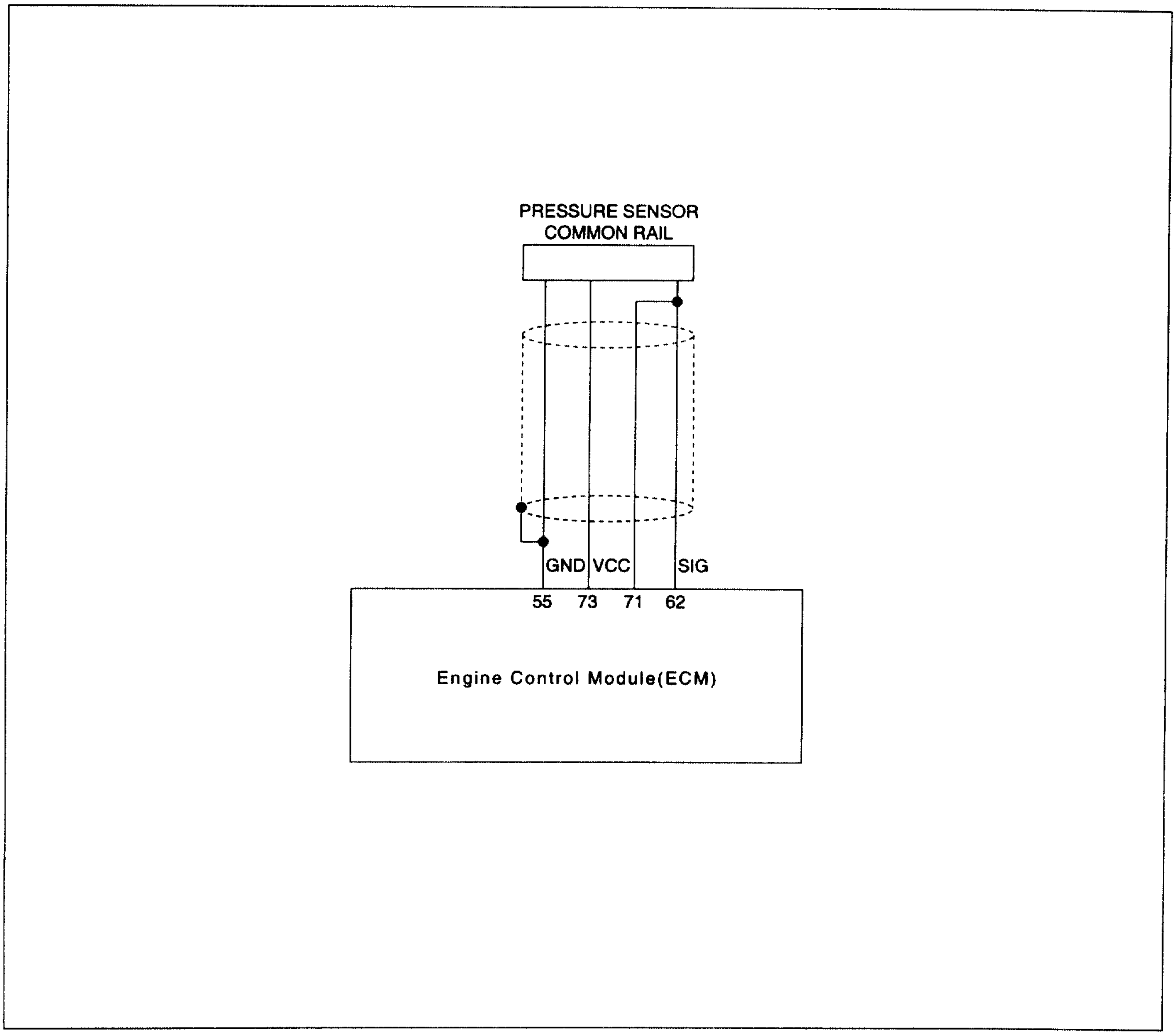
STEP	ACTION	VALUE	YES	NO
10	Using the scan tool, check the value for "PCV closed interval". 1. Engine is idling. 2. Disconnect the PCV1 harness. 3. Check the value for "PCV closed interval". 4. Reconnect the PCV1 harness. 5. Disconnect the PCV2 harness. 6. Check the value for "PCV closed interval". 7. Reconnect the PCV2 harness. Is "PCV closed interval" within value?	120°CA to 180°CA	Go to step 11	Go to system check (Common Rail system check: Fuel system)
11	1. Ignition "OFF", engine "OFF" 2. Remove the fuel return line at pressure limiter. 3. Block off fuel return line. 4. Restart engine. Is a fuel leak present at the pressure limiter?	—	Replace pressure limiter Go back to step 3	Go to step 12
12	Is ECM properly grounded?	—	Replace ECM Go back to step 3	Replace ground Go back to step 3
	NOTE:A test run is performed, DTC checked again, and a pressure limiter is replaced when DTC is detected.			

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

NOTE: This system operates at extremely high fuel pressure.
Take caution when loosening or removing fuel lines during service.
Intermittents can be caused by the following:

- **Air in the fuel system**
- **Fuel leaks**
- **Restricted fuel lines or filter**
- **Faults in wiring connector and harness**
- **Fuel quality**
- **Dust in the fuel system**

DTC 0227 Supply Pump Non Pressure Supply



Circuit Description

The common rail pressure sensor, installed at left end of the common rail, is used to detect fuel pressure. It is a semiconductor type pressure sensor utilizing silicon's property that the electric resistance of pressurized silicone is varied.

Further, a special gasket is used at the connection part with the common rail body so as to seal high pressure fuel.

Conditions for Setting the DTC

- ISC target speed, common rail pressure not controlled.
- DTC 0245, 0217, 0218, 0247 and 0248 are not appear.
- CKP sensor normal condition.
- Pump normal mode, battery voltage is higher than 8V.
- Pump speed higher than 450 rpm.
- ECT higher than 60°C.
- DTC 0226 detected, common rail pressure higher than target pressure plus 5 MPa.
- PCV opening timing reaches the limit or feedback value –50CA.
- PCV closed interval is more than 98°CA.
- When above condition continues 255 times.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Fuel injection value lower than 60 mm^3/st.
- Common rail pressure lower than 25 MPa.
- Time required for running into backup is varied with the difference in common rail pressure against target pressure.
- Engine stop

Conditions for Clearing the MIL/DTC

DTC 0227 can be cleared by using the “Clear Info” by scan tool or using by the Diag Clear Switch.

DTC 0227 Supply Pump Non Pressure Supply

Check leakage injection line. When common rail pressure sensor output fixed at engine idling, does it occur? (DTC 0115)

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Lack of power due to fuel leakage, fuel pressure and injection amount limited.
- Check Fuel Filter.

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does the scan tool display DTC 227 while Ignition "ON", or engine at idle?	—	Go to step 3	—
3	1. After warming up the engine (at 60°C or more), turn engine "OFF", clear the DTC. 2. Restart the engine and let idle for 60 seconds. Does the DTC reset?	—	Go to step 4	See Note on Intermittent
4	Check the fuel lines from supply pump to common rail for broken, loose, or restriction. Also check fuel filter for restriction. Was a problem found?	—	Repair or replace Go back to step 3	Go to step 5
5	Check the ECM and common rail fuel pressure sensor connectors, ECM ground, and wiring harness for looseness, bent terminals, or chafed wires. Was a problem found?	—	Repair or replace Go back to step 3	Go to step 6
6	1. Ignition"ON", engine "ON". 2. Record actual common rail fuel pressure at idle. Is the pressure lower than the specified value?	25 MPa	Go to step 7	See Note on Intermittent
7	Disconnect PCV#1 connector while engine is idling. Does engine shut down?	—	Replace supply pump. Go back to step 3	Go to step 8
8	1. Reconnect the PCV#1 connector. 2. Disconnect PCV#2 connector while engine is idling. Does engine shut down?	—	Replace supply pump. Go back to step 3	Go to step 9
9	1. Reconnect the PCV#2 connector. 2. Operate on acceleration pedal at 2,500 to 3,000 rpm on engine speed, and observe the actual common rail fuel pressure. Did the actual common rail fuel pressure have a pressure reading above the specified value?	More than 60 MPa	Go to step 10	Replace common rail pressure sensor Go back to step 3

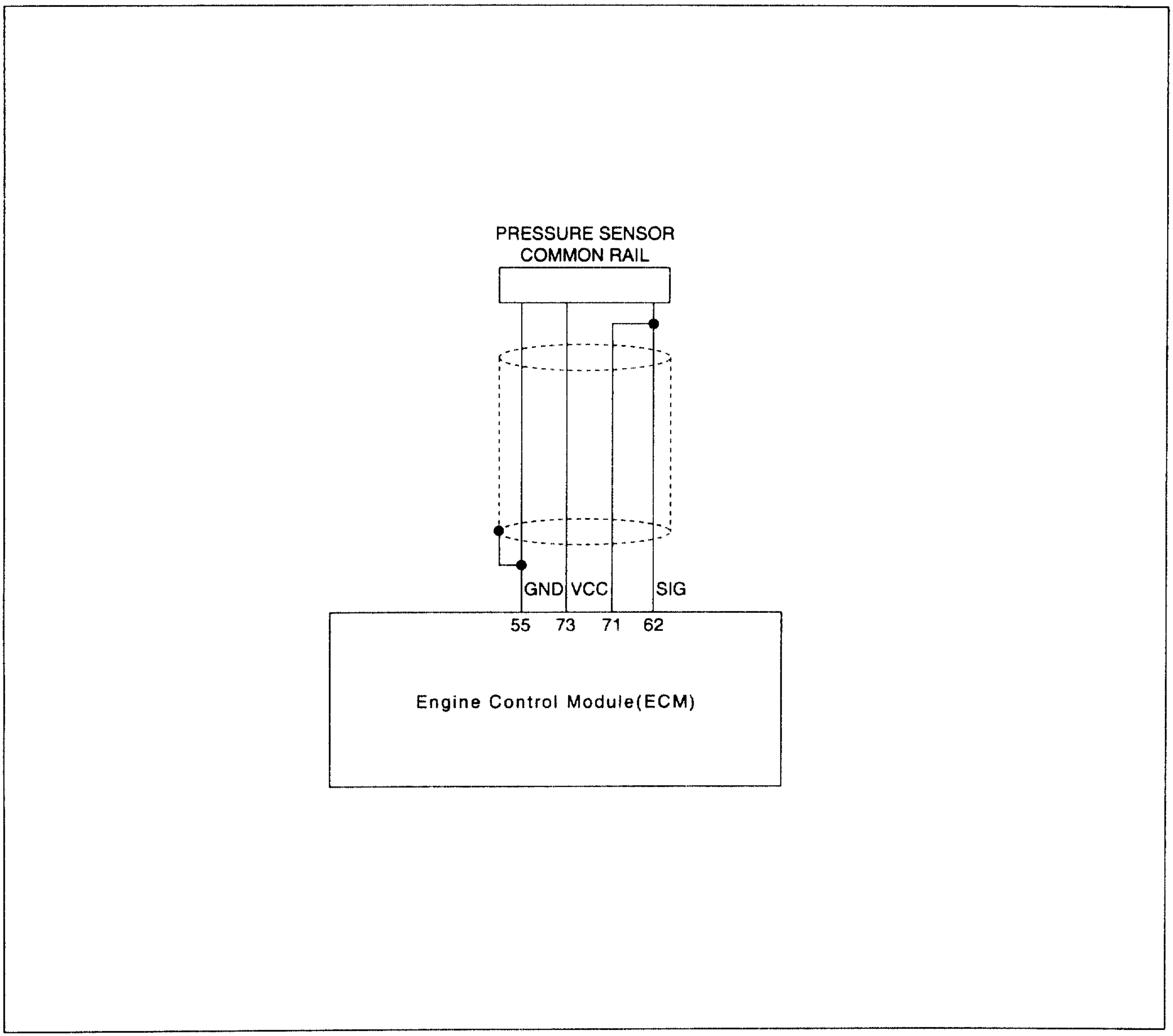
STEP	ACTION	VALUE	YES	NO
10	Using the scan tool, check the value for "PCV closed interval". 1. Engine is idling. 2. Disconnect the PCV1 harness. 3. Check the value for "PCV closed interval". 4. Reconnect the PCV1 harness. 5. Disconnect the PCV2 harness. 6. Check the value for "PCV closed interval". 7. Reconnect the PCV2 harness. Is "PCV closed interval" within value?	120°CA to 180°CA	Go to step 11	Go to system check (Common Rail system check: Fuel system)
11	1. Ignition "OFF", engine "OFF" 2. Remove the fuel return line at pressure limiter. 3. Block off fuel return line. 4. Restart engine. Is a fuel leak present at the pressure limiter?	—	Replace pressure limiter Go back to step 3	Go to step 12
12	Is ECM properly grounded?	—	Replace ECM Go back to step 3	Replace ground Go back to step 3
	NOTE:A test run is performed, DTC checked again, and a pressure limiter is replaced when DTC is detected.			

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

NOTE: This system operates at extremely high fuel pressure.
Take caution when loosening or removing fuel lines during service.
Intermittents can be caused by the following:

- **Air in the fuel system**
- **Fuel leaks**
- **Restricted fuel lines or filter**
- **Faults in wiring connector and harness**
- **Fuel quality**
- **Dust in the fuel system**

DTC 0245 Abnormal Common Rail Pressure (PC sensor system)



Circuit Description

The common rail pressure sensor, installed at left end of the common rail, is used to the detect fuel pressure. It is a semiconductor type pressure sensor utilizing silicon's property that the electric resistance of pressurized silicone is varied.

Further, a special gasket is used at the connection part with the common rail body so as to seal high pressure fuel.

If the ECM detects a rail pressure signal voltage that is excessively low or high, Diagnostic Trouble Code 0245 will be set.

Conditions for Setting the DTC

- When sensor voltage is lower than 0.7V.
- When sensor voltage is over than 4.7V.
  (The pressure is 0 MPa = 0.93V · 160 MPa = 4.02V)

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Limits are set to common rail pressure open loop control, common rail pressure and injection amount.
- Common rail pressure; 60 MPa maximum Injection amount is limited for 50 mm^3/st.

Conditions for Clearing the MIL/DTC

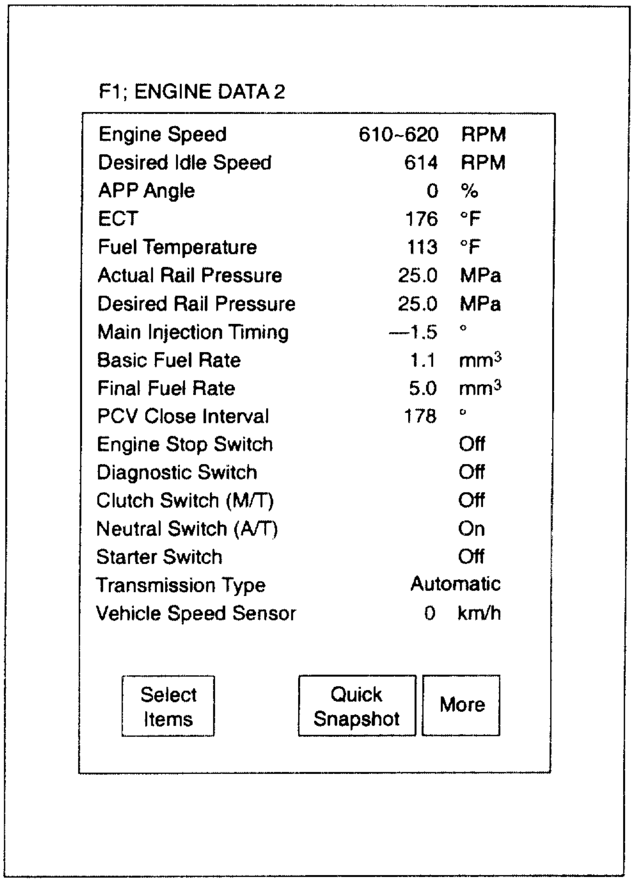
DTC 0245 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

DTC 0245 Abnormal Common Rail Pressure (PC sensor system)

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to ground, shorts to battery and open circuits. If the harness appears to be OK, observe the rail pressure display on the scan tool while moving connectors and wiring harnesses related to the rail pressure sensor. A change in the rail pressure display will indicate the location of the fault.



F1; ENGINE DATA 2

Engine Speed	610~620	RPM
Desired Idle Speed	614	RPM
APP Angle	0	%
ECT	176	°F
Fuel Temperature	113	°F
Actual Rail Pressure	25.0	MPa
Desired Rail Pressure	25.0	MPa
Main Injection Timing	—1.5	°
Basic Fuel Rate	1.1	mm^3
Final Fuel Rate	5.0	mm^3
PCV Close Interval	178	°
Engine Stop Switch		Off
Diagnostic Switch		Off
Clutch Switch (M/T)		Off
Neutral Switch (A/T)		On
Starter Switch		Off
Transmission Type		Automatic
Vehicle Speed Sensor	0	km/h

- No powerfulness felt.
- Hard to start on a steep slope.
- Hard to get maximum speed on the flat road.

DTC 0245 Abnormal Common Rail Pressure (PC sensor system)

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	When key switch on, does DTC 0245 display?	—	Go to step 3	—
3	Measure voltage between pin number 62 and 71 (PFUEL) and pin number 55 (PFUEL – GND) at ECM side (Measuring method 1) Is voltage within specified value? (The voltage is about 1.4V more or less at idling with pressure 25 MPa)	0.7V to 4.7V	Go to step 4	Go to step 5
4	Clear all DTCs. Is DTC 0245 display?	—	Go to step 5	Refer to Diagnostic Aids
5	1. Key switch "ON". 2. Measure voltage between pin number 73 (PFUEL – VCC) and pin number 55 (PFUEL – GND) (Measuring method 1) Is voltage within value?	4.5V to 5.5V	Go to step 9	Go to step 6
6	1. Key switch "ON". 2. Disconnect harness connector from ECM. 3. Measure resistance as below. • Between pin number 73 (PFUEL – VCC) of ECM side and pin number 1 sensor side on common rail pressure sensor harness. (Measuring method 2) • Between pin number 55 (PFUEL – GND) ECM side and pin number 3 sensor side on common rail pressure sensor harness. (Measuring method 2) Is resistance within value?	2Ω or less	Go to step 7	Repair or replace the common rail pressure sensor harness then Go to step 15
7	Measure resistance as below. • Between pin number 73 (PFUEL – VCC) and GND on the common rail pressure sensor harness. • Between pin number 55 (PFUEL – GND) and GND on the common rail pressure sensor harness. (Measuring method 3) Is resistance within value?	10MΩ or more	Go to step 8	Repair or replace common rail pressure sensor harness then Go to step 15
8	1. Reconnect harness connector to ECM. 2. Measure the voltage between pin number 1 and pin number 3 at sensor side on the common rail pressure sensor harness. (Measuring method 4) Is voltage within value?	4.5V to 5.5V	Go to step 9	Check, Repair harness and/or connector for poor connections then Go to step 15

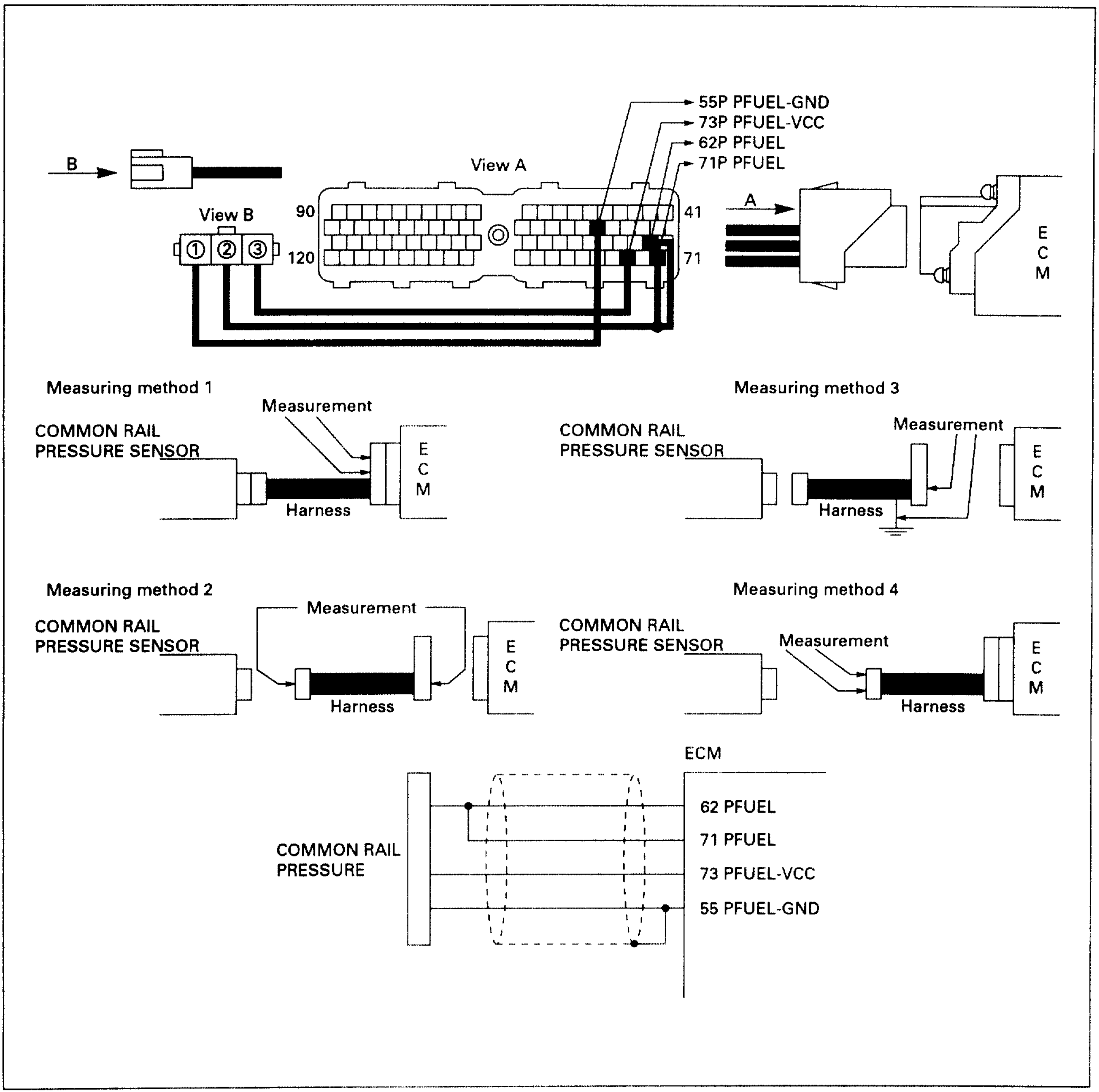
IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

DTC 0245 Abnormal Common Rail Pressure (PC sensor system)

STEP	ACTION	VALUE	YES	NO
9	1. Key switch "OFF". 2. Disconnect common rail pressure sensor harness connector from ECM. 3. Measure resistance as below. • Between pin number 62 (PFUEL – SIG) of ECM side and pin number 2 sensor side on common rail pressure sensor harness. (Measuring method 2) • Between pin number 71 (PFUEL) of ECM side and pin number 2 sensor side on common rail pressure sensor harness. (Measuring method 2) • Between pin number 55 (PFUEL – GND) of ECM side and pin number 3 sensor side on common rail pressure sensor harness. (Measuring method 2) Is resistance within value?	2Ω or less	Go to step 10	Repair/ or replace the common rail pressure sensor harness then go to step 16
10	Measure the resistance between pin number 71 (PFUEL) and GND. Is resistance within value?	10MΩ or more	Go to step 11	Repair or replace common rail pressure sensor harness then Go to step 13
11	1. Reconnect both ECM and common rail pressure sensor connector to common rail pressure sensor harness connector. 2. Observe common rail pressure sensor output waveform using oscilloscope. 3. Check for floating common rail pressure sensor output waveform by noise etc. Is result OK?	—	Go to step 13	Go to step 12
12	Clear DTCs and recheck DTC. Is DTC 0245 displayed?	—	Replace common rail pressure sensor then Go to step 15	Go to step 13
13	Check common rail pressure sensor harness connector for a poor connection? Was there a problem?	—	Make complete contact then Go to step 14	System OK
14	Clear all DTCs. Is DTC 0245 displayed?	—	Replace ECM assembly then Go to step 15	System OK
15	Clear all DTCs. Is DTC 0245 displayed?	—	Go back to step 3	System OK
	Note: Sometimes DTCs 0261 through DTC 0266 will set when common rail pressure sensor fails.			

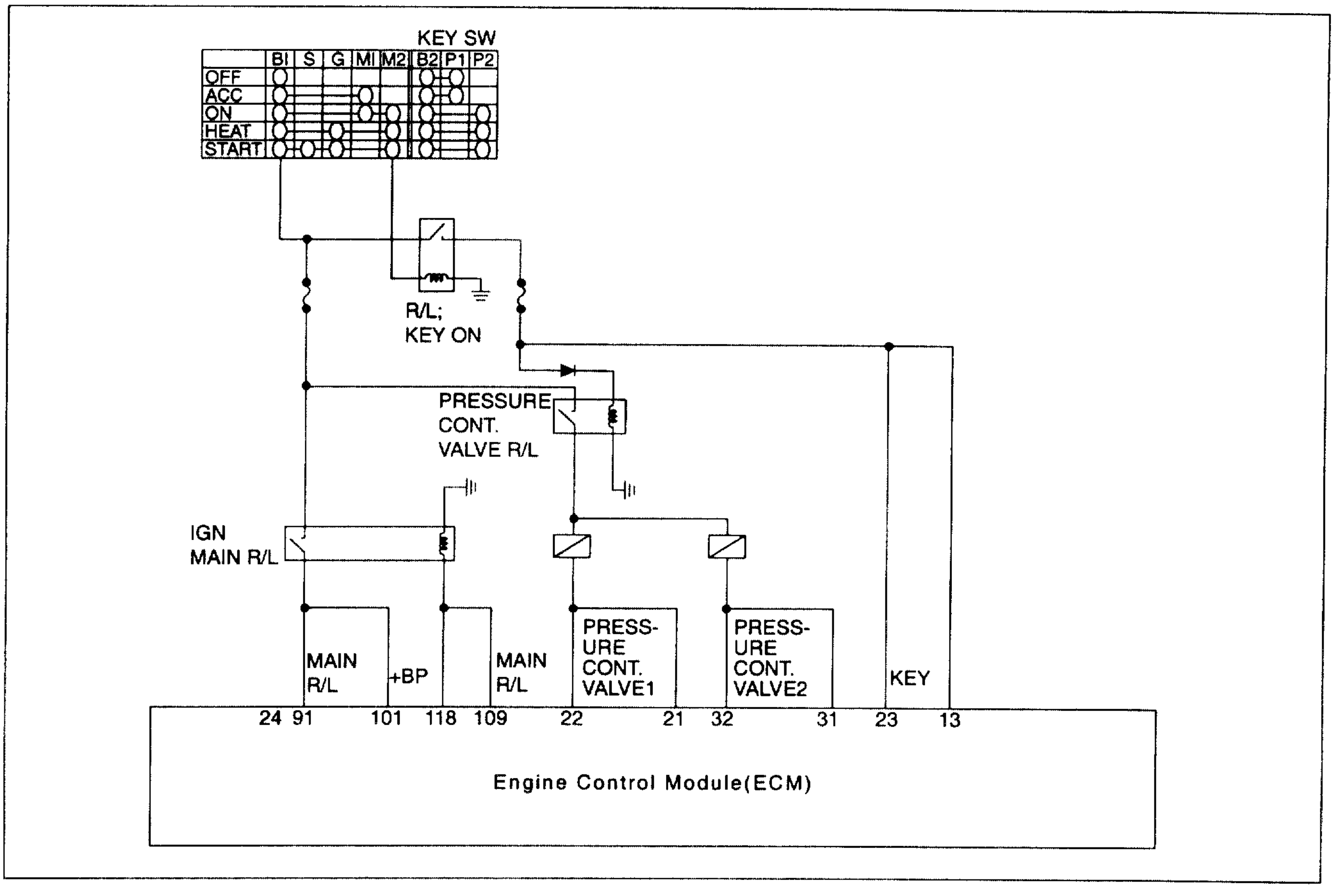
IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

DTC 0245 Abnormal Common Rail Pressure



D06M200022

DTC 0247 PCV1 (Coil or Harness) Disconnect or GND Shorted



Circuit Description

The PCV is used to adjust supply pump discharge amount so as to adjust common rail pressure. Discharge amount from the supply pump to the common rail is determined by PCV current timing.

If the ECM detects a PCV1 signal voltage that is excessively high, Diagnostic Trouble Code 0247 will be set.

Conditions for Setting the DTC

- Abnormally low driving voltage with PCV off, pump normal mode, battery voltage higher than 10V and no CKP sensor faults with key switch ON.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Common rail pressure is limited to 60 MPa or less.

Conditions for Clearing the MIL/DTC

DTC 0247 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to ground, shorts to battery and open circuits. If the harness appears to be OK, observe the PCV display on the scan tool while moving connectors and wiring harnesses related to the PCV sensor. A change in the PCV sensor display will indicate the location of the fault.

DTC 0247 PCV1 (Coil or Harness) Disconnect or GND Shorted

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does DTC 0247 display while key switch "ON" or engine is running?	—	Go to step 3	—
3	1. Key switch "OFF". 2. Disconnect PCV harness connector from ECM. 3. Key switch "ON". 4. Measure voltage at the ECM side of the PCV harness at the following points. (Measuring method 4) • Between pin number 21, 22 for PCV1 and pin number 82 (P–GND). Is voltage within value?	10V to 14V	Go to step 9	Go to step 4
4	If DTC 0421 is also present, inspect voltage before measuring the resistance. 1. Key switch "OFF". 2. Disconnect PCV connector. 3. Measure resistance at the following points. (Measuring method 2). • Between pin number 21, 22 for PCV1 and pin number 82 (P–GND). Is resistance within value?	10MΩ or more	Go to step 6	Repair PCV harness Go to step 5
5	1. Key switch "OFF". 2. Disconnect PCV harness from PCV 1, 2, PCV relay and ECM. 3. Measure resistance from pin number 1 at PCV relay side of PCV harness and pin number 82 (P–GND) at ECM. (Measuring method 5) Is resistance within value?	Less than 10MΩ	Repair/replace PCV harness. Then go to step 13	Go to step 6
6	Measure resistance on PCV harness as following points. (Measuring method 3) • Between pin number 21, 22 for PCV1 and pin number 2. Is resistance within value?	2Ω or less	Go to step 7	Repair PCV harness. Then go to step 13
7	1. Key switch "OFF". 2. Disconnect PCV harness from PCV 1, 2, PCV relay and ECM. 3. Measure resistance from pin number 1 at PCV relay side of PCV harness and pin number 82 (P–GND) at ECM. (Measuring method 5) Is resistance within value?	More than 10MΩ	Go to step 8	Go to step 13
8	1. Key switch "OFF". 2. Disconnect PCV harness from PCV 1, 2, PCV relay and ECM. 3. Measure resistance following points. • Between pin number 1 at PCV 1 side of PCV harness and pin number 1 at PCV relay of PCV harness. (Measuring method 6) Is resistance within value?	Less than 2Ω	Go to step 9	Repair/replace PCV harness. Then go to step 13

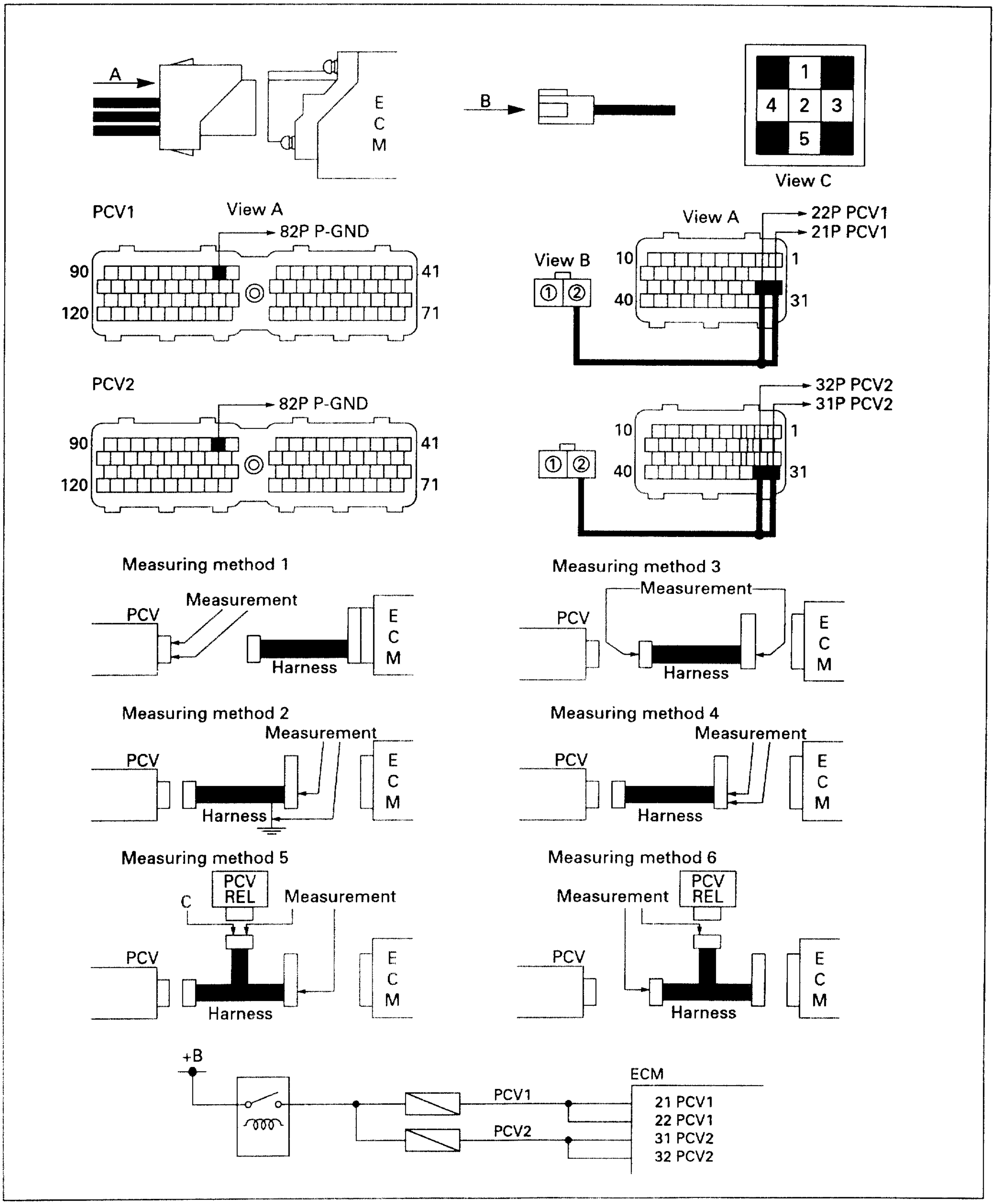
DTC 0247 PCV1 (Coil or Harness) Disconnect or GND Shorted

STEP	ACTION	VALUE	YES	NO
9	Measure PCV coil resistance. (Measuring method 1) Is resistance within value?	0.9Ω to 1.3Ω (about 20°C)	Go to step 10	Replace PCV and/or supply pump. Then go to step 13
10	1. Key switch "ON". 2. Measure voltage at the following points. (Measuring method 2) • Between pin number 1 for PCV1 and GND. Is voltage within value?	10V to 14V	Go to step 12	Repair wire harness in between power supply and relay. Then go to step 11
11	Inspect for poor connection at the connector on PCV harness. Was a problem found?	—	Repair it. Go to step 12	System OK
12	Clear all DTCs. Does DTC 0247 display?	—	Replace ECM assembly. Go to step 13	System OK
13	Clear DTCs. Does DTC 0247 display?	—	Go back to step 3	System OK

IMPORTANT:* *The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

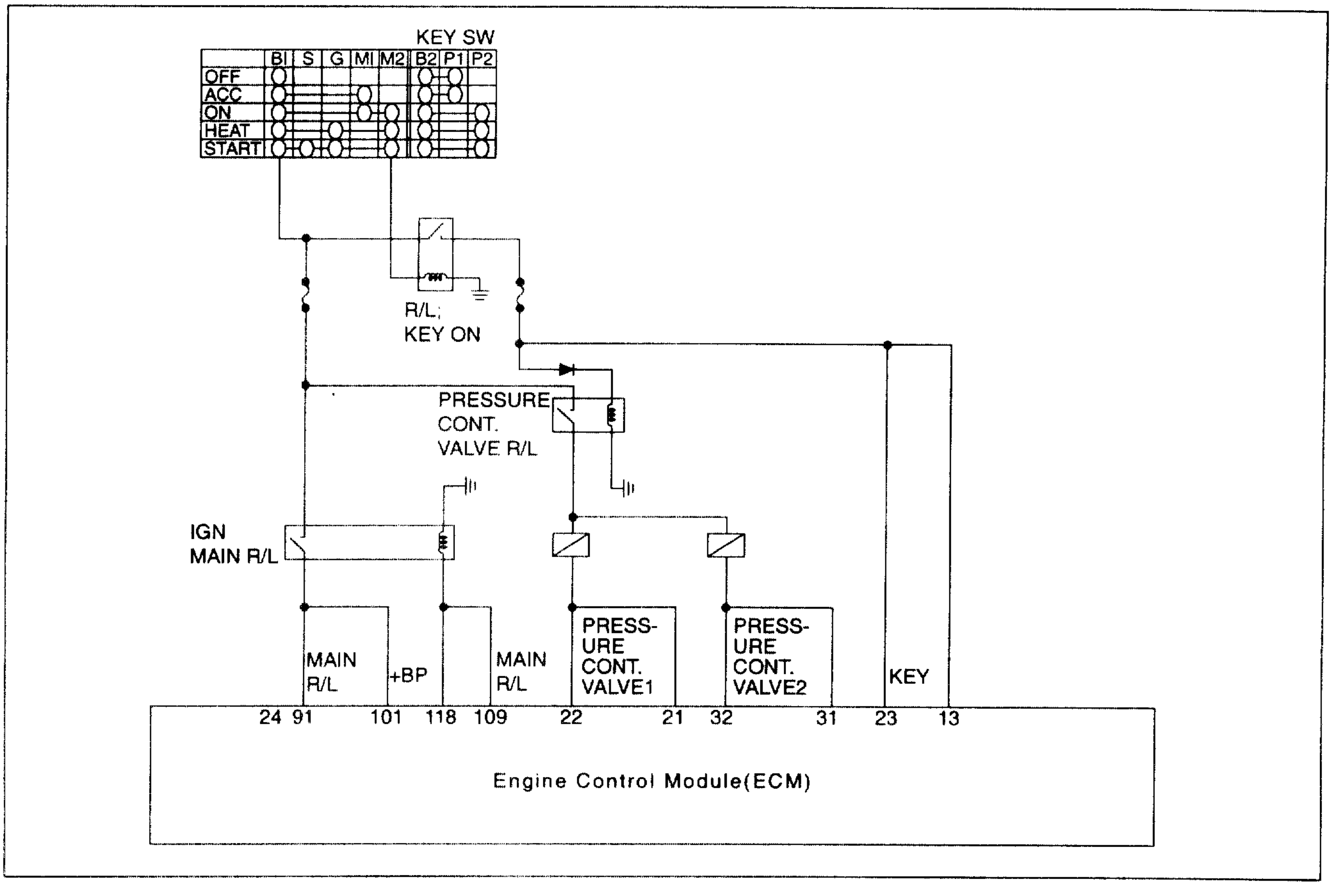
NOTE: If PCV1 and PCV2 connectors are switched, engine will not start.

DTC 0247 PCV1, 2 (Coil or Harness) Disconnect or GND Shorted



058MV011

DTC 0248 PCV2 (Coil or Harness) Disconnect or GND Shorted



Circuit Description

The PCV is used to adjust supply pump discharge amount so as to adjust common rail pressure. Discharge amount from the supply pump to the common rail is determined by PCV current timing.

If the ECM detects a PCV2 signal voltage that is excessively high, Diagnostic Trouble Code 0248 will be set.

Conditions for Setting the DTC

- Abnormally low driving voltage with PCV off, pump normal mode, battery voltage higher than 10V and no CKP sensor faults with key switch ON.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Common rail pressure is limited to 60 MPa or less.

Conditions for Clearing the MIL/DTC

DTC 0248 can be cleared by using the “Clear Info” by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness – Inspect the wiring harness for damage, shorts to ground, shorts to battery and open circuits. If the harness appears to be OK, observe the PCV display on the scan tool while moving connectors and wiring harnesses related to the PCV sensor. A change in the PCV sensor display will indicate the location of the fault.

DTC 0248 PCV2 (Coil or Harness) Disconnect or GND Shorted

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does DTC 0248 display while key switch "ON" or engine is running?	—	Go to step 3	—
3	1. Key switch "OFF". 2. Disconnect PCV harness connector from ECM. 3. Key switch "ON". 4. Measure voltage at the ECM side of the PCV harness at the following points. (Measuring method 4) • Between pin number 31, 32 for PCV2 and pin number 82 (P–GND). Is voltage within value?	10V to 14V	Go to step 9	Go to step 4
4	If DTC 421 is also present, inspect voltage before measuring the resistance. 1. Key switch "OFF". 2. Disconnect PCV connector. 3. Measure resistance at the following points. (Measuring method 2). • Between pin number 31, 32 for PCV2 and pin number 82 (P–GND). Is resistance within value?	10MΩ or more	Go to step 6	Repair PCV harness Go to step 5
5	1. Key switch "OFF". 2. Disconnect PCV harness from PCV 1, 2, PCV relay and ECM. 3. Measure resistance from pin number 1 at PCV relay side of PCV harness and pin number 82 (P–GND) at ECM. (Measuring method 5) Is resistance within value?	Less than 10MΩ	Repair/replace PCV harness. Then go to step 13	Go to step 6
6	Measure resistance on PCV harness as following points. (Measuring method 3) • Between pin number 31, 32 for PCV2 and pin number 2. Is resistance within value?	2Ω or less	Go to step 7	Repair PCV harness. Then go to step 13
7	1. Key switch "OFF". 2. Disconnect PCV harness from PCV 1, 2, PCV relay and ECM. 3. Measure resistance from pin number 1 at PCV relay side of PCV harness and pin number 82 (P–GND) at ECM side of PCV harness. (Measuring method 5) Is resistance within value?	More than 10MΩ	Go to step 8	Go to step 13
8	1. Key switch "OFF". 2. Disconnect PCV harness from PCV 1, 2, PCV relay and ECM. 3. Measure resistance following points. • Between pin number 1 at PCV 2 side of PCV harness and pin number 1 at PCV relay of PCV harness. (Measuring method 6) Is resistance within value?	Less than 2Ω	Go to step 9	Repair/replace PCV harness. Then go to step 13

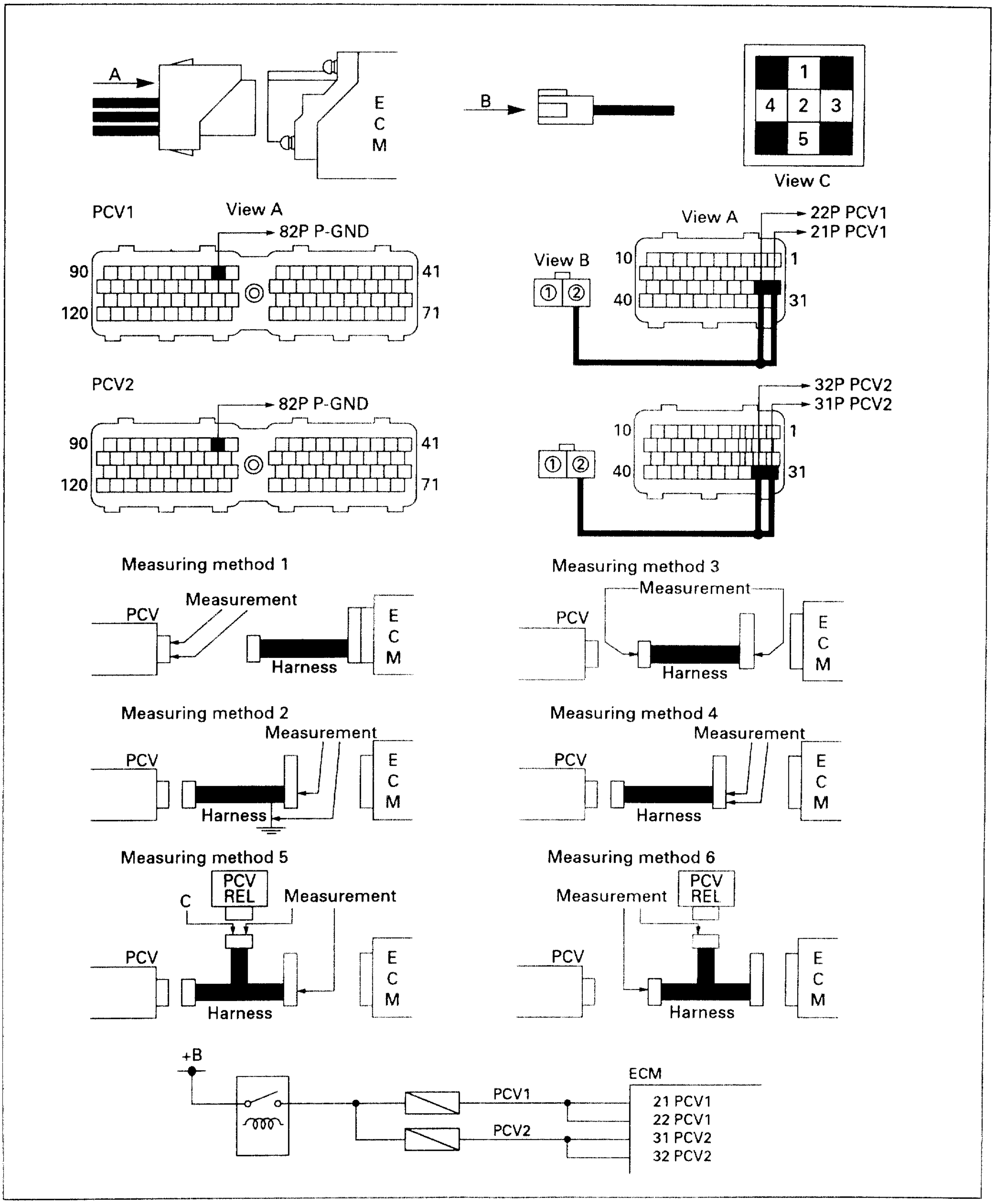
DTC 0248 PCV2 (Coil or Harness) Disconnect or GND Shorted

STEP	ACTION	VALUE	YES	NO
9	Measure PCV coil resistance. (Measuring method 1) Is resistance within value?	0.9Ω to 1.3Ω	Go to step 10	Replace PCV and/or supply pump. Then go to step 13
10	1. Key switch "ON". 2. Measure voltage at the following points. (Measuring method 2) • Between pin number 1 for PCV2 and GND. Is voltage within value?	10V to 14V —	Go to step 12	Repair wire harness in between power supply and relay. Then go to step 11
11	Inspect for poor connection at the connector on PCV harness. Was a problem found?	—	Repair it. Go to step 11	System OK
12	Clear all DTCs. Does DTC 0248 display?		Replace ECM assembly. Go to step 13	System OK
13	Clear all DTCs. Does DTC 0248 display?	—	Go back to step 3	System OK

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

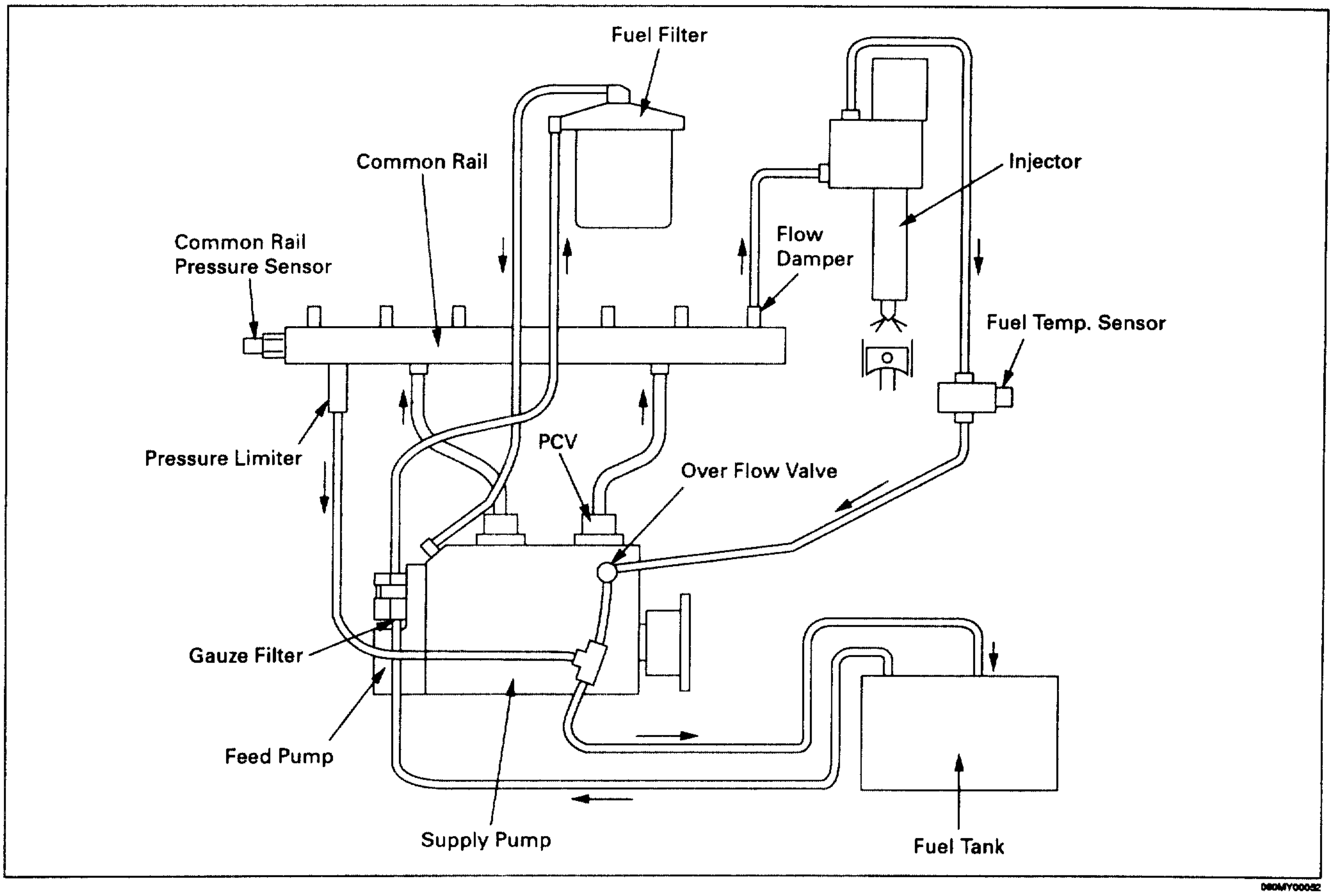
NOTE: If PCV1 and PCV2 connectors are switched, engine will not starts.

DTC 0248 PCV1, 2 (Coil or Harness) Disconnect or GND Shorted



056MV011

DTC 0261 (Cylinder No. 1) Flow Damper Activated



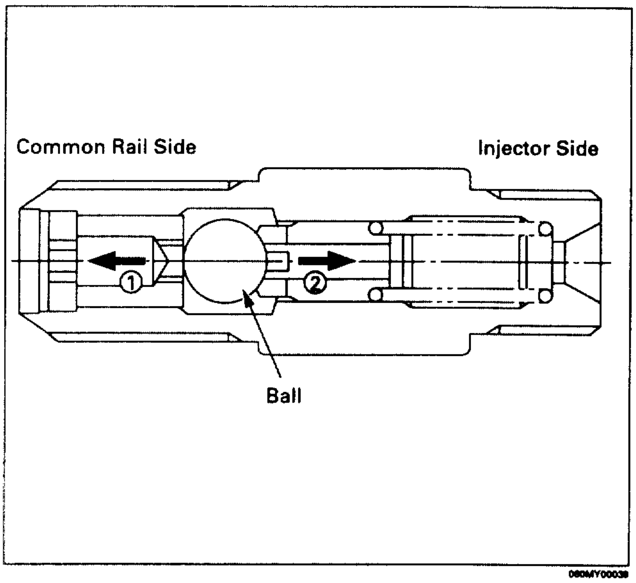
Operation Description

The flow damper comprises a piston, ball, spring seat, and spring.

The flow damper is used to damp the pressure pulsating in the common rail and the injection pipe.

During driving the flow of fuel makes the piston, ball, and spring seat move a little to the injector side and float.

Should too much fuel pass the flow damper, the ball moves further toward the injector until the ball comes into contact with the seat surface of the flow damper unit, thereby shutting the fuel passages.



① Common Rail Side < Fuel Pressure < Injector Side
② Common Rail Side > Fuel Pressure > Injector Side

DTC 0261 (Cylinder No. 1) Flow Damper Activated

Conditions for Setting the DTC

Cylinder No. 1

- No DTC 0271 to DTC 0276, DTC 0158 and DTC 0159.
- ECT higher than 60°C.
- Correction of uneven injection amount exceeding 5 mm^3/st and continues for 65535 times.
  (Balancing Fuel Rate Data)

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Cylinder injection stops

Conditions for Clearing the MIL/DTC

DTC 0261 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

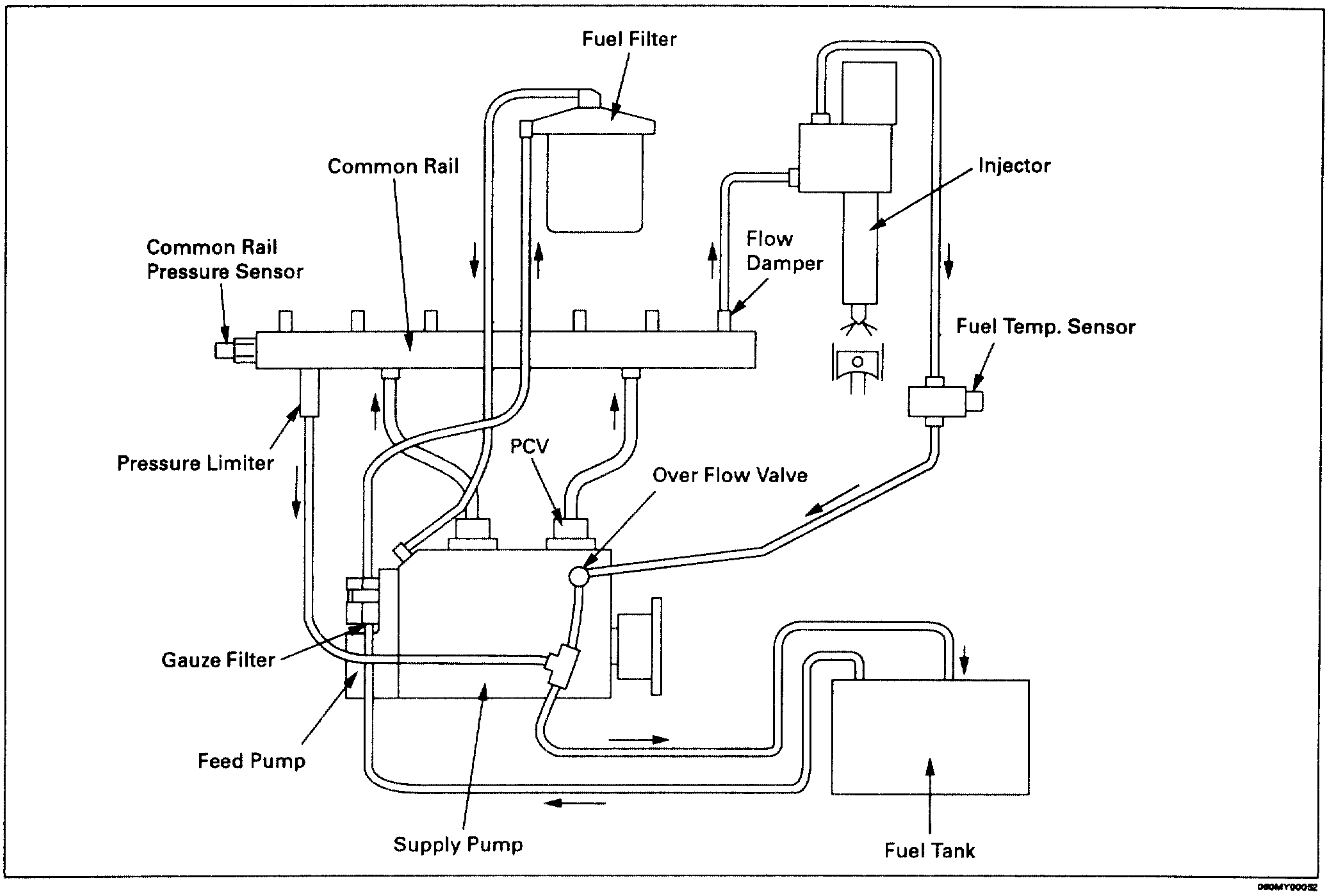
- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Check Fuel Filter.
- Injector is checked, when the numerical valve of balancing fuel data does not go into the regulation range, after engine warms up.

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does the scan tool display DTC 261 while Ignition "ON", or engine at idle?	—	Go to step 3	—
3	1. After warming up engine (at 60°C or more), turn engine "OFF", clear DTC. 2. Restart the engine and let idle for 60 seconds Does the DTC reset?	—	Go to step 4	See Note on Intermittent
4	Perform Tech2 cylinder power balance test to confirm cylinder #1 is misfiring? Is the action completed?	—	Go to step 5	Go to step 4
5	Ignition "OFF", engine "OFF" and listen for flow damper to reset ("click" sound). This may take 120 seconds. Was "click" sound heard?	—	Go to step 6	Go to step 7
6	Check for fuel leak in line between flow damper and fuel injector. Was fuel leak found?	—	Repair or replace Go back to step 3	Go to step 7
7	Replace #1 injector with known good injector. Does #1 injector misfire?	—	Go to step 8	Replace injector Go back to step 3
8	Check for restriction in fuel line between flow damper and injector. Was restriction found:	—	Repair or replace Go back to step 3	Go to step 9
9	1. Replace flow damper. 2. Clear the DTC and start engine. Does scan tool display any DTC codes?	—	Go to step 2	System OK

NOTE: Use scan tool Common rail pressure control to check for fuel leakage, etc.
Sometimes DTC 261 will be displayed due to engine hunting when the common rail pressure sensor fails.
Intermittents codes are activated by:

- **Clutch shudder**
- **Clutch shock Disengagement**
- **Air In Fuel Line**

DTC 0262 (Cylinder No. 2) Flow Damper Activated



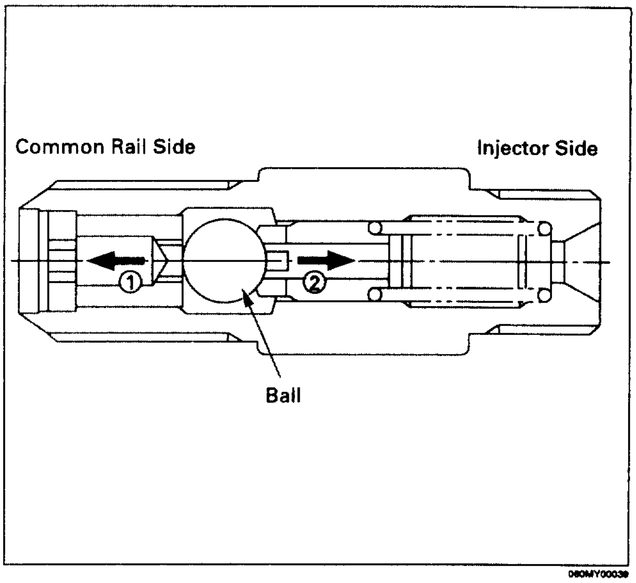
Operation Description

The flow damper comprises a piston, ball, spring seat, and spring.

The flow damper is used to damp the pressure pulsating in the common rail and the injection pipe.

During driving the flow of fuel makes the piston, ball, and spring seat move a little to the injector side and float.

Should too much fuel pass the flow damper, the ball moves further toward the injector until the ball comes into contact with the seat surface of the flow damper unit, thereby shutting the fuel passages.



① Common Rail Side < Fuel Pressure < Injector Side
② Common Rail Side > Fuel Pressure > Injector Side

DTC 0262 (Cylinder No. 2) Flow Damper Activated

Conditions for Setting the DTC

Cylinder No. 2

- No DTC 0271 to DTC 0276, DTC 0158 and DTC 0159.
- ECT higher than 60°C.
- Correction of uneven injection amount exceeding 5 mm^3/st and continues for 65535 times.
  (Balancing Fuel Rate Data)

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Cylinder injection stops

Conditions for Clearing the MIL/DTC

DTC 0262 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

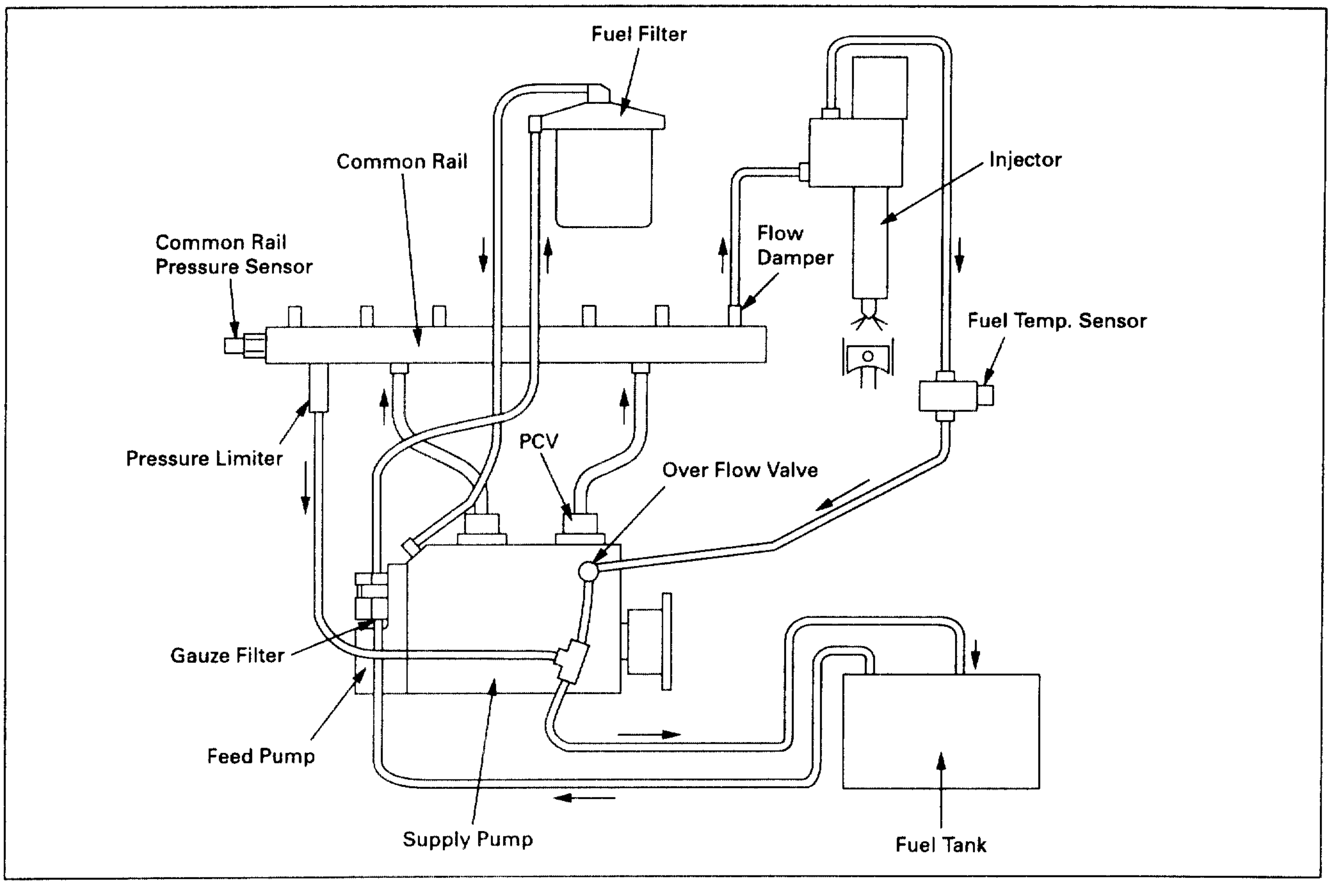
- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Check Fuel Filter.
- Injector is checked, when the numerical valve of balancing. fuel rate data does not go into the regulation range, after engine warms up.

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does the scan tool display DTC 262 while Ignition "ON", or engine at idle?	—	Go to step 3	—
3	1. After warming up engine (at 60°C or more), turn engine "OFF", clear DTC. 2. Restart the engine and let idle for 60 seconds Does the DTC reset?	—	Go to step 4	See Note on Intermittent
4	Perform Tech2 cylinder power balance test to confirm cylinder #2 is misfiring? Is the action completed?	—	Go to step 5	Go to step 4
5	Ignition "OFF", engine "OFF" and listen for flow damper to reset ("click" sound). This may take 120 seconds. Was "click" sound heard?	—	Go to step 6	Go to step 7
6	Check for fuel leak in line between flow damper and fuel injector. Was fuel leak found?	—	Repair or replace Go back to step 3	Go to step 7
7	Replace #2 injector with known good injector. Does #2 injector misfire?	—	Go to step 8	Replace injector Go back to step 3
8	Check for restriction in fuel line between flow damper and injector. Was restriction found:	—	Repair or replace Go back to step 3	Go to step 9
9	1. Replace flow damper. 2. Clear the DTC and start engine. Does scan tool display any DTC codes?	—	Go to step 2	System OK

NOTE: Use scan tool Common rail pressure control to check for fuel leakage, etc.
Sometimes DTC 262 will be displayed due to engine hunting when the common rail pressure sensor fails.
Intermittents codes are activated by:

- **Clutch shudder**
- **Clutch shock Disengagement**
- **Air in Fuel Line**

DTC 0263 (Cylinder No. 3) Flow Damper Activated



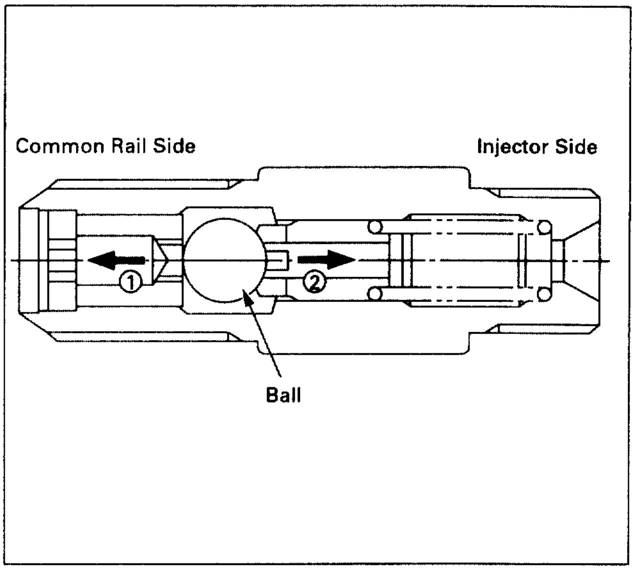
Operation Description

The flow damper comprises a piston, ball, spring seat, and spring.

The flow damper is used to damp the pressure pulsating in the common rail and the injection pipe.

During driving the flow of fuel makes the piston, ball, and spring seat move a little to the injector side and float.

Should too much fuel pass the flow damper, the ball moves further toward the injector until the ball comes into contact with the seat surface of the flow damper unit, thereby shutting the fuel passages.



① Common Rail Side < Fuel Pressure < Injector Side
② Common Rail Side > Fuel Pressure > Injector Side

DTC 0263 (Cylinder No. 3) Flow Damper Activated

Conditions for Setting the DTC

Cylinder No. 3

- No DTC 0271 to DTC 0276, DTC 0158 and DTC 0159.
- ECT higher than 60°C.
- Correction of uneven injection amount exceeding 5 mm^3/st and continues for 65535 times.
  (Balancing Fuel Rate Data)

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Cylinder injection stops

Conditions for Clearing the MIL/DTC

DTC 0263 can be cleared by using the "Clear info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

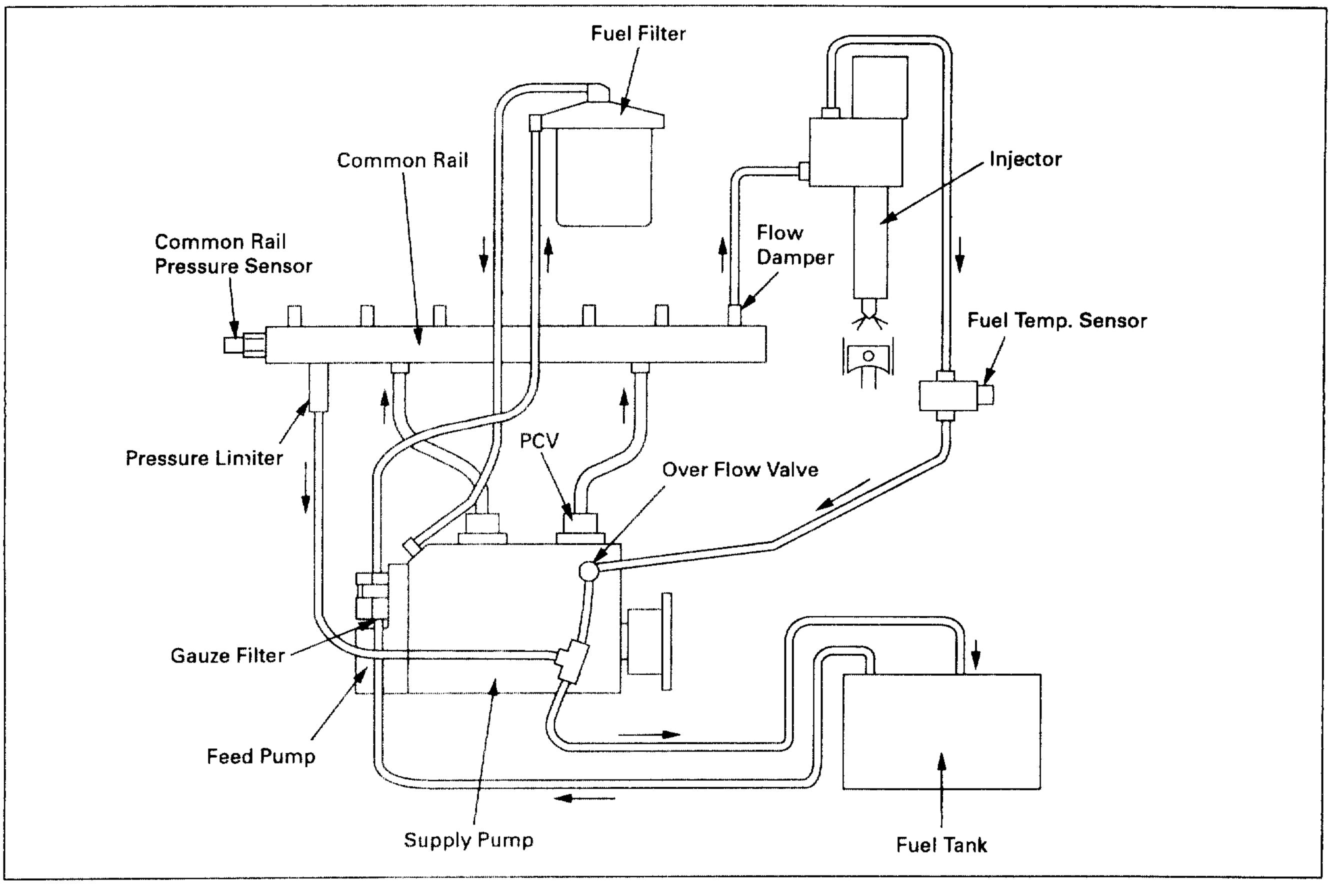
- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Injector is checked, when the numerical valve of balancing. fuel rate data does not go into the regulation range, after engine warms up.

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does the scan tool display DTC 263 while Ignition "ON", or engine at idle?	—	Go to step 3	—
3	1. After warming up engine (at 60°C or more), turn engine "OFF", clear DTC. 2. Restart the engine and let idle for 60 seconds Does the DTC reset?	—	Go to step 4	See Note on Intermittent
4	Perform Tech2 cylinder power balance test to confirm cylinder #3 is misfiring? Is the action completed?	—	Go to step 5	Go to step 4
5	Ignition "OFF", engine "OFF" and listen for flow damper to reset ("click" sound). This may take 120 seconds. Was "click" sound heard?	—	Go to step 6	Go to step 7
6	Check for fuel leak in line between flow damper and fuel injector. Was fuel leak found?	—	Repair or replace Go back to step 3	Go to step 7
7	Replace #3 injector with known good injector. Does #3 injector misfire?	—	Go to step 8	Replace injector Go back to step 3
8	Check for restriction in fuel line between flow damper and injector. Was restriction found:	—	Repair or replace Go back to step 3	Go to step 9
9	1. Replace flow damper. 2. Clear the DTC and start engine. Does scan tool display any DTC codes?	—	Go to step 2	System OK

NOTE: Use scan tool Common rail pressure control to check for fuel leakage, etc.
Sometimes DTC 263 will be displayed due to engine hunting when the common rail pressure sensor fails.
Intermittents codes are activated by:

- **Clutch shudder**
- **Clutch shock Disengagement**
- **Air in Fuel Line**

DTC 0264 (Cylinder No. 4) Flow Damper Activated



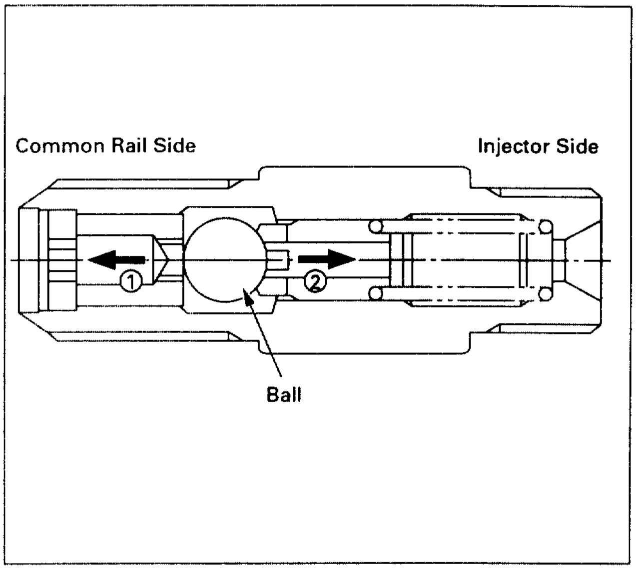
Operation Description

The flow damper comprises a piston, ball, spring seat, and spring.

The flow damper is used to damp the pressure pulsating in the common rail and the injection pipe.

During driving the flow of fuel makes the piston, ball, and spring seat move a little to the injector side and float.

Should too much fuel pass the flow damper, the ball moves further toward the injector until the ball comes into contact with the seat surface of the flow damper unit, thereby shutting the fuel passages.



① Common Rail Side < Fuel Pressure < Injector Side
② Common Rail Side > Fuel Pressure > Injector Side

DTC 0264 (Cylinder No. 4) Flow Damper Activated

Conditions for Setting the DTC

Cylinder No. 4

- No DTC 0271 to DTC 0276, DTC 0158 and DTC 0159.
- ECT higher than 60°C.
- Correction of uneven injection amount exceeding 5 mm^3/st and continues for 65535 times. (Balancing Fuel Rate Data)

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Cylinder injection stops

Conditions for Clearing the MIL/DTC

DTC 0264 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

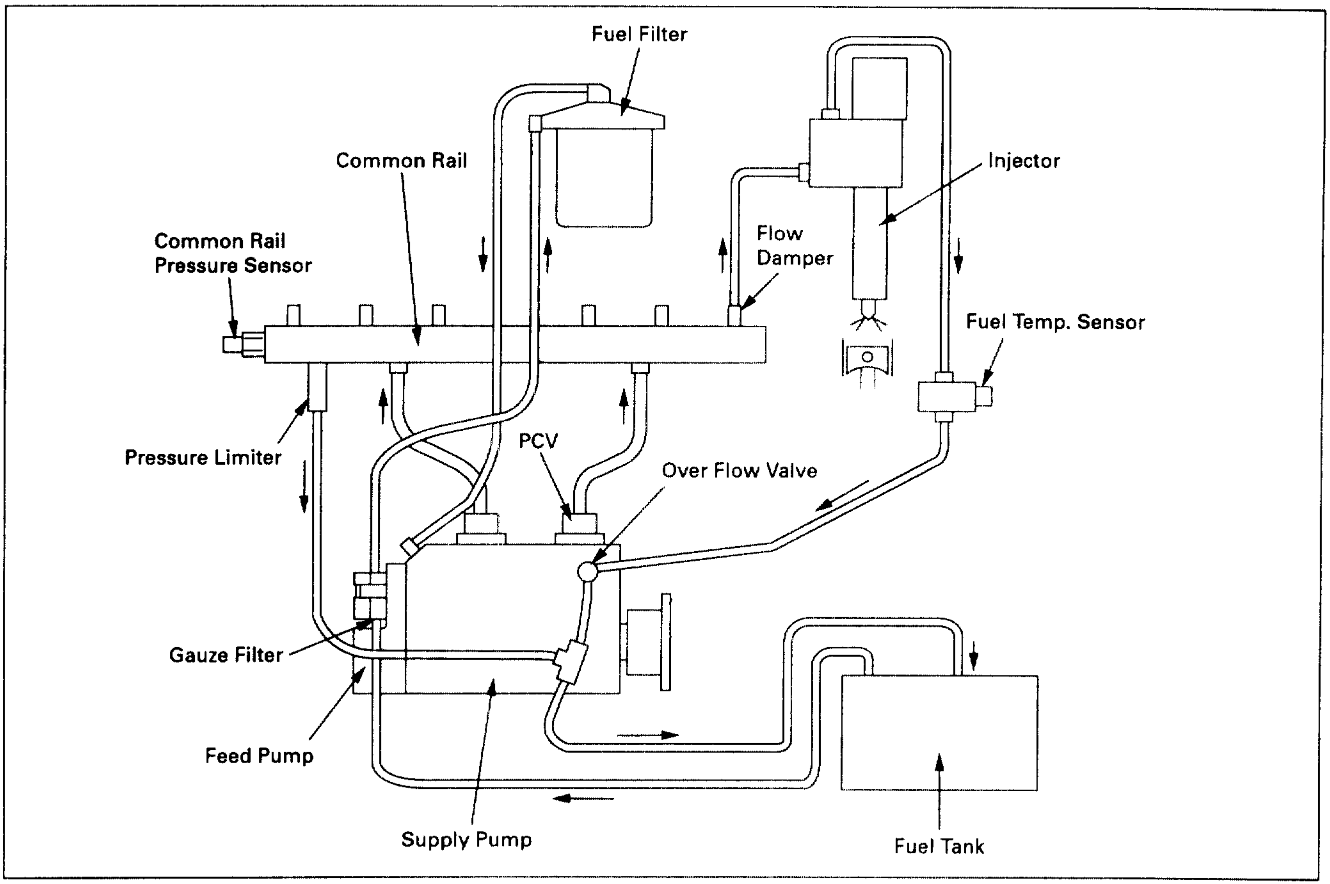
- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Check Fuel Filter.
- Injector is checked, when the numerical valve of balancing. fuel rate data does not go into the regulation range, after engine warms up.

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does the scan tool display DTC 264 while Ignition "ON", or engine at idle?	—	Go to step 3	—
3	1. After warming up engine (at 60°C or more), turn engine "OFF", clear DTC. 2. Restart the engine and let idle for 60 seconds Does the DTC reset?	—	Go to step 4	See Note on Intermittent
4	Perform Tech2 cylinder power balance test to confirm cylinder #4 is misfiring? Is the action completed?	—	Go to step 5	Go to step 4
5	Ignition "OFF", engine "OFF" and listen for flow damper to reset ("click" sound). This may take 120 seconds. Was "click" sound heard?	—	Go to step 6	Go to step 7
6	Check for fuel leak in line between flow damper and fuel injector. Was fuel leak found?	—	Repair or replace Go back to step 3	Go to step 7
7	Replace #4 injector with known good injector. Does #4 injector misfire?	—	Go to step 8	Replace injector Go back to step 3
8	Check for restriction in fuel line between flow damper and injector. Was restriction found:	—	Repair or replace Go back to step 3	Go to step 9
9	1. Replace flow damper. 2. Clear the DTC and start engine. Does scan tool display any DTC codes?	—	Go to step 2	System OK

NOTE: Use scan tool Common rail pressure control to check for fuel leakage, etc.
Sometimes DTC 264 will be displayed due to engine hunting when the common rail pressure sensor fails.
Intermittents codes are activated by:

- **Clutch shudder**
- **Clutch shock Disengagement**
- **Air in Fuel Line**

DTC 0265 (Cylinder No. 5) Flow Damper Activated



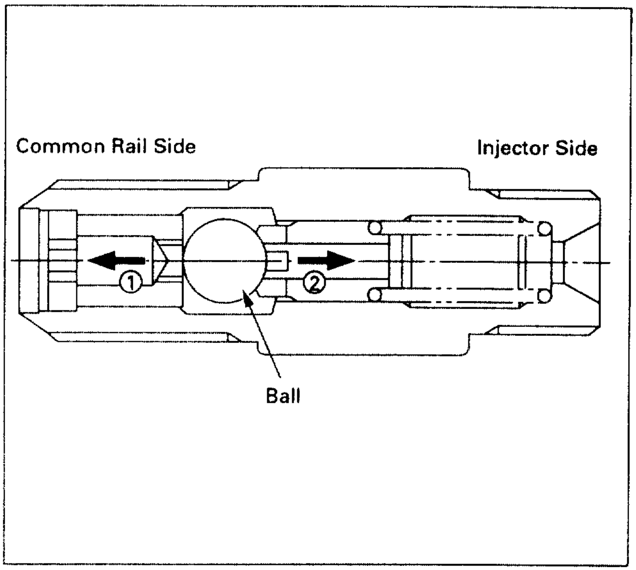
Operation Description

The flow damper comprises a piston, ball, spring seat, and spring.

The flow damper is used to damp the pressure pulsating in the common rail and the injection pipe.

During driving the flow of fuel makes the piston, ball, and spring seat move a little to the injector side and float.

Should too much fuel pass the flow damper, the ball moves further toward the injector until the ball comes into contact with the seat surface of the flow damper unit, thereby shutting the fuel passages.



① Common Rail Side < Fuel Pressure < Injector Side
② Common Rail Side > Fuel Pressure > Injector Side

DTC 0265 (Cylinder No. 5) Flow Damper Activated

Conditions for Setting the DTC

Cylinder No. 5

- No DTC 0271 to DTC 0276, DTC 0158 and DTC 0159.
- ECT higher than 60°C.
- Correction of uneven injection amount exceeding 5 mm^3/st and continues for 65535 times.
  (Balancing Fuel Rate Data)

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Cylinder injection stops

Conditions for Clearing the MIL/DTC

DTC 0265 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

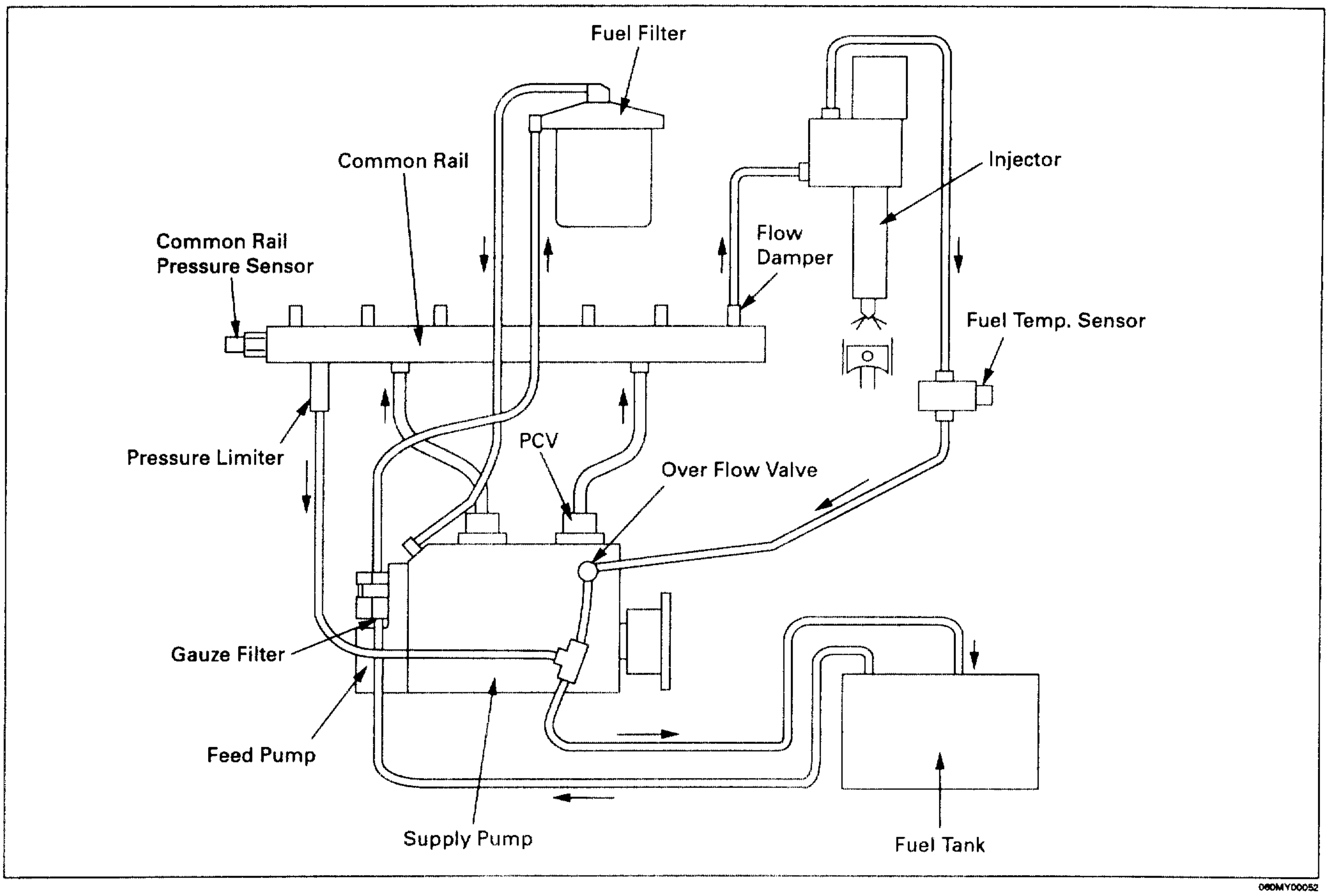
- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Check Fuel Filter.
- Injector is checked, when the numerical valve of balancing. fuel rate data does not go into the regulation range, after engine warms up.

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does the scan tool display DTC 265 while Ignition "ON", or engine at idle?	—	Go to step 3	—
3	1. After warming up engine (at 60°C or more), turn engine "OFF", clear DTC. 2. Restart the engine and let idle for 60 seconds Does the DTC reset?	—	Go to step 4	See Note on Intermittent
4	Perform Tech2 cylinder power balance test to confirm cylinder #5 is misfiring? Is the action completed?	—	Go to step 5	Go to step 4
5	Ignition "OFF", engine "OFF" and listen for flow damper to reset ("click" sound). This may take 120 seconds. Was "click" sound heard?	—	Go to step 6	Go to step 7
6	Check for fuel leak in line between flow damper and fuel injector. Was fuel leak found?	—	Repair or replace Go back to step 3	Go to step 7
7	Replace #5 injector with known good injector. Does #5 injector misfire?	—	Go to step 8	Replace injector Go back to step 3
8	Check for restriction in fuel line between flow damper and injector. Was restriction found:	—	Repair or replace Go back to step 3	Go to step 9
9	1. Replace flow damper. 2. Clear the DTC and start engine. Does scan tool display any DTC codes?	—	Go to step 2	System OK

NOTE: Use scan tool Common rail pressure control to check for fuel leakage, etc.
Sometimes DTC 265 will be displayed due to engine hunting when the common rail pressure sensor fails.
Intermittents codes are activated by:

- **Clutch shudder**
- **Clutch shock Disengagement**
- **Air in Fuel Line**

DTC 0266 (Cylinder No. 6) Flow Damper Activated



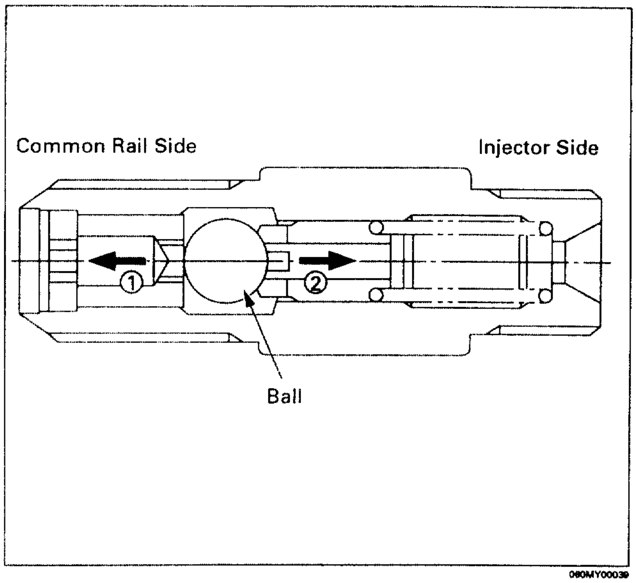
Operation Description

The flow damper comprises a piston, ball, spring seat, and spring.

The flow damper is used to damp the pressure pulsating in the common rail and the injection pipe.

During driving the flow of fuel makes the piston, ball, and spring seat move a little to the injector side and float.

Should too much fuel pass the flow damper, the ball moves further toward the injector until the ball comes into contact with the seat surface of the flow damper unit, thereby shutting the fuel passages.



① Common Rail Side < Fuel Pressure < Injector Side
② Common Rail Side > Fuel Pressure > Injector Side

DTC 0266 (Cylinder No. 6) Flow Damper Activated

Conditions for Setting the DTC

Cylinder No. 6

- No DTC 0271 to DTC 0276, DTC 0158 and DTC 0159.
- ECT higher than 60°C.
- Correction of uneven injection amount exceeding 5 mm^3/st and continues for 65535 times.
  (Balancing Fuel Rate Data)

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Cylinder injection stops

Conditions for Clearing the MIL/DTC

DTC 0266 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

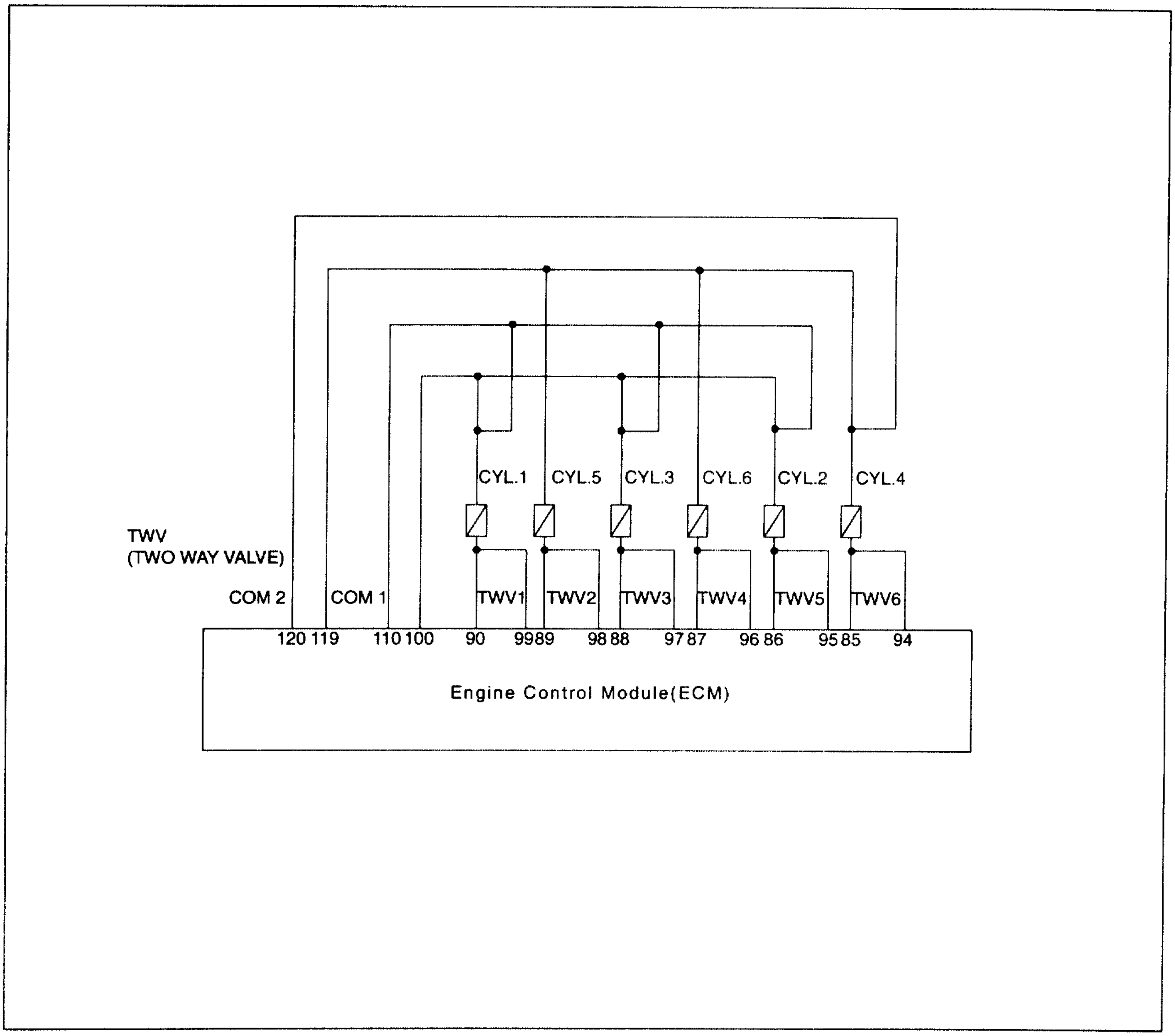
- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Check Fuel Filter.
- Injector is checked, when the numerical valve of balancing. fuel rate data does not go into the regulation range, after engine warms up.

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does the scan tool display DTC 266 while Ignition "ON", or engine at idle?	—	Go to step 3	—
3	1. After warming up engine (at 60°C or more), turn engine "OFF", clear DTC. 2. Restart the engine and let idle for 60 seconds Does the DTC reset?	—	Go to step 4	See Note on Intermittent
4	Perform Tech2 cylinder power balance test to confirm cylinder #6 is misfiring? Is the action completed?	—	Go to step 5	Go to step 4
5	Ignition "OFF", engine "OFF" and listen for flow damper to reset ("click" sound). This may take 120 seconds. Was "click" sound heard?	—	Go to step 6	Go to step 7
6	Check for fuel leak in line between flow damper and fuel injector. Was fuel leak found?	—	Repair or replace Go back to step 3	Go to step 7
7	Replace #6 injector with known good injector. Does #6 injector misfire?	—	Go to step 8	Replace injector Go back to step 3
8	Check for restriction in fuel line between flow damper and injector. Was restriction found:	—	Repair or replace Go back to step 3	Go to step 9
9	1. Replace flow damper. 2. Clear the DTC and start engine. Does scan tool display any DTC codes?	—	Go to step 2	System OK

NOTE: Use scan tool Common rail pressure control to check for fuel leakage, etc.
Sometimes DTC 266 will be displayed due to engine hunting when the common rail pressure sensor fails.
Intermittents codes are activated by:

- **Clutch shudder**
- **Clutch shock Disengagement**
- **Air in Fuel Line**

DTC 0271 (Cylinder No. 1) TWV Side Disconnected



D06M200013

Circuit Description

A hydraulic piston and TWV (solenoid valve) have been added to the conventional nozzle. Receiving signals from ECM, the TWV opens and closes to change the pressure in the pressure adjustment chamber on top of the hydraulic piston so that the hydraulic piston works thereby to inject the fuel from the nozzle.

If No. 1 Cylinder TWV coil or harness is disconnected and battery voltage is over 10V except when in over speed condition, DTC 0271 will be set.

Conditions for Setting the DTC

Cylinder No. 1;

- TWV coil or harness disconnected and battery voltage is over 10V.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Injection amount is limited to maximum 80 mm^3/st.

Conditions for Clearing the MIL/DTC

DTC 0271 can be cleared by using the “Clear Info” by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- No smooth rotation.
- Lack of engine power.

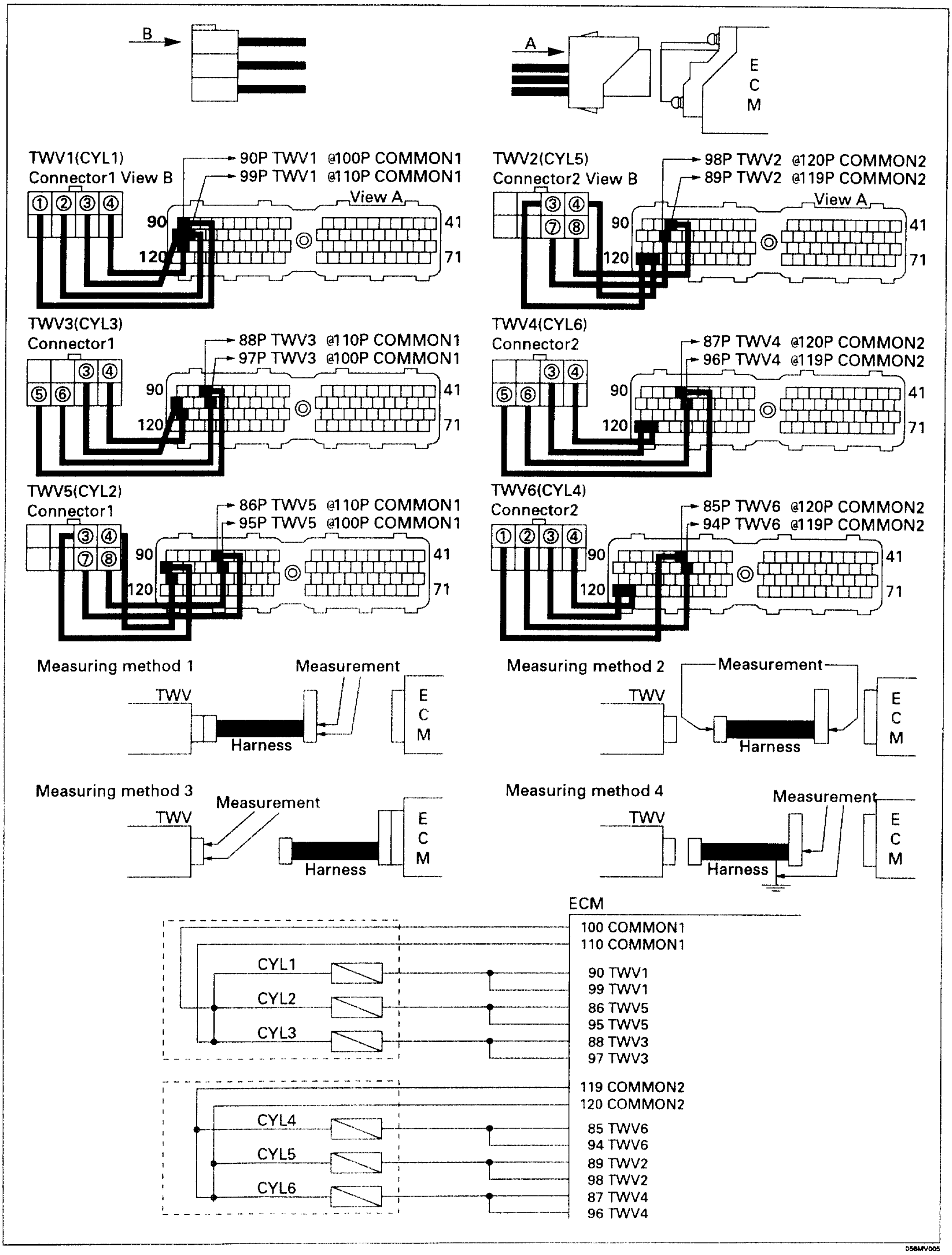
DTC 0271 (Cylinder No. 1) TWV Side Disconnected

Note: If diagnosed simultaneous with flow damper, inspect TWV trouble first.

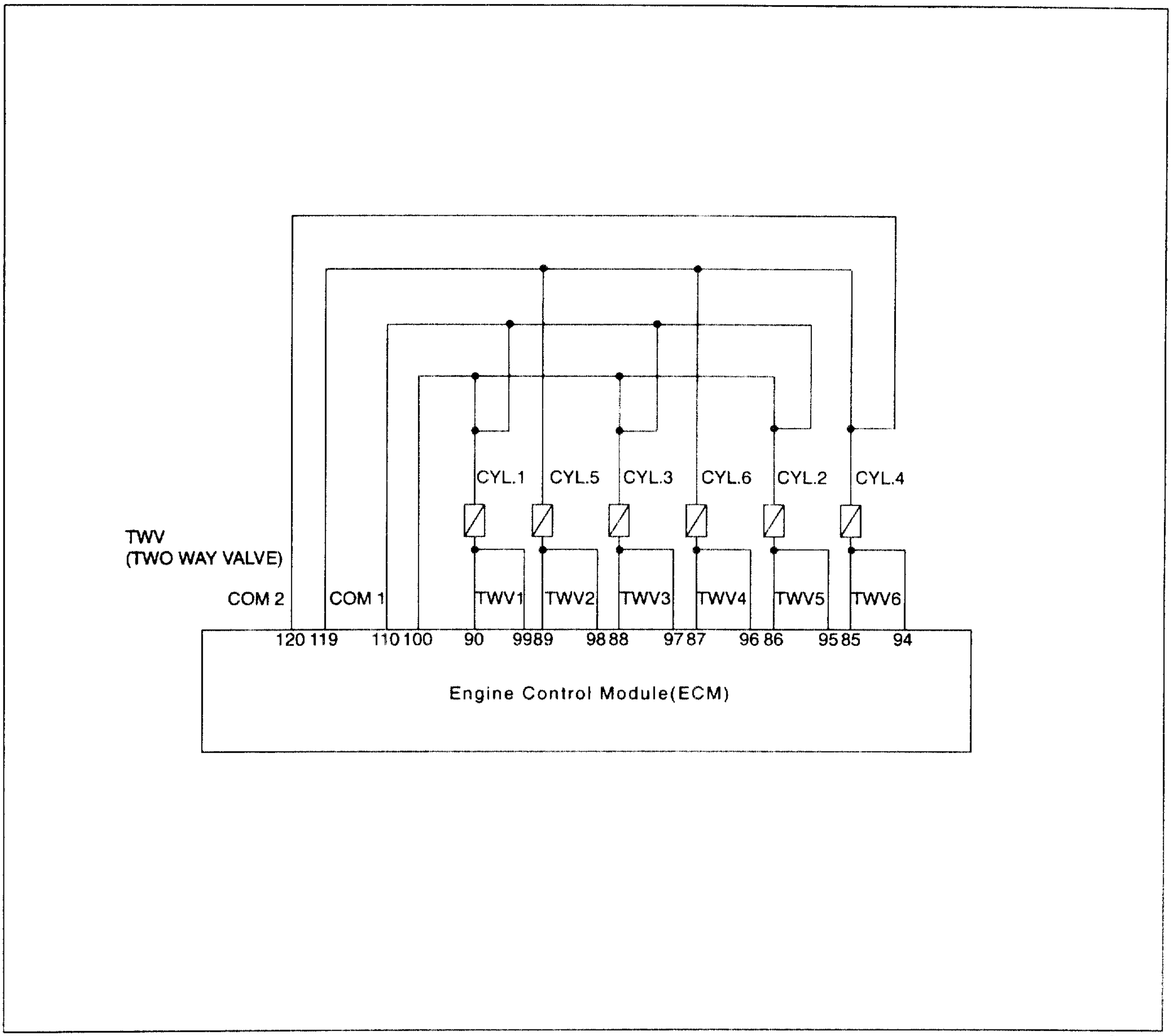
STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does the scan tool display any DTC from DTC 0271 while key switch is "ON" or engine is running?	—	Go to step 3	—
3	1. Key switch "OFF". 2. Disconnect TWV harness connector from ECM side. 3. Measure resistance at the following points at the ECM connector of TWV harness. (Measuring method 1). • Between pin number 90, 99 (TWV1) and pin number 100 (COMMON1). Is resistance within value?	2.0Ω or less for TWV harness resistance. 0.9Ω to 1.3Ω for TWV coil resistance. Thus minimum resistance is 0.9Ω to 1.3Ω. (If harness resistance 0)	Go to step 8 Before going to step 8, recheck incomplete connection on harness connector.	Go to step 4
4	1. Key switch "OFF". 2. Disconnect TWV harness connector from both ECM and TWV (cyl. head side). 3. Measure resistance following points on the TWV harness. (Measuring method 2) • Between pin number 90, 99 (TWV1) at ECM side and pin number 1, 2 (Connector 1) at TWV side. Is resistance within value?	2Ω or less	Go to step 5	Repair/replace TWV harness.
5	Measure resistance at the following points at the TWV side connector. (TWV COIL unit resistance) (Measuring method 3) • Between pin number 1, 2 and 3, 4 at connector 1 for TWV1. Is resistance within value?	0.4Ω to 0.8Ω (about 20°C)	Go to step 7	Go to step 6
6	1. Remove cylinder head cover. 2. Inspect upper portion of cylinder head. Is there any problem? (Example. disconnected harness or broken wire etc.)	—	Repair problem portion. Then go to step 7	Go to step 7
7	1. Reconnect all connector and terminal of TWV harness. 2. Install cylinder head cover. 3. Key switch "ON". Does the scan tool display any DTCs?	—	Replace ECM assembly. Then go to step8	Go to step 8
8	1. Clear all DTCs. 2. Key switch "ON". Does the scan tool display any DTCs?	—	Go back to step 3	System OK

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

Cylinder No. 1 to No. 6 TWV Side Disconnected



DTC 0272 (Cylinder No. 2) TWV Side Disconnected



Circuit Description

A hydraulic piston and TWV (solenoid valve) have been added to the conventional nozzle. Receiving signals from ECM, the TWV opens and closes to change the pressure in the pressure adjustment chamber on top of the hydraulic piston so that the hydraulic piston works thereby to inject the fuel from the nozzle.

If No. 2 Cylinder TWV coil or harness is disconnected and battery voltage is over 10V except when in over speed condition, DTC 0272 will be set.

Conditions for Setting the DTC

Cylinder No. 2;

- TWV coil or harness disconnected and battery voltage is over 10V.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Injection amount is limited to maximum 80 mm^3/st.

Conditions for Clearing the MIL/DTC

DTC 0272 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- No smooth rotation.
- Lack of engine power.

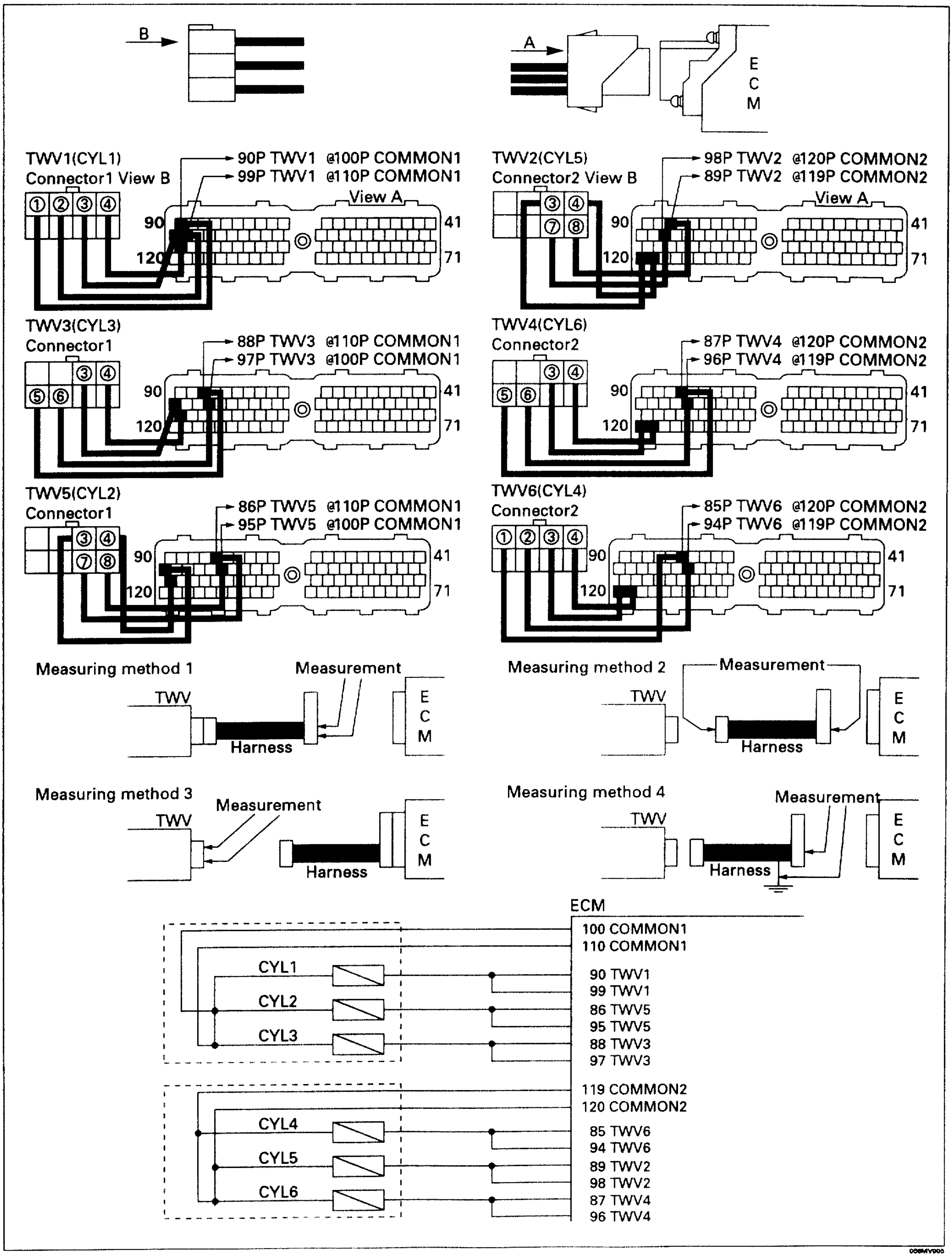
DTC 0272 (Cylinder No. 2) TWV Side Disconnected

Note: If diagnosed simultaneous with flow damper, inspect TWV trouble first.

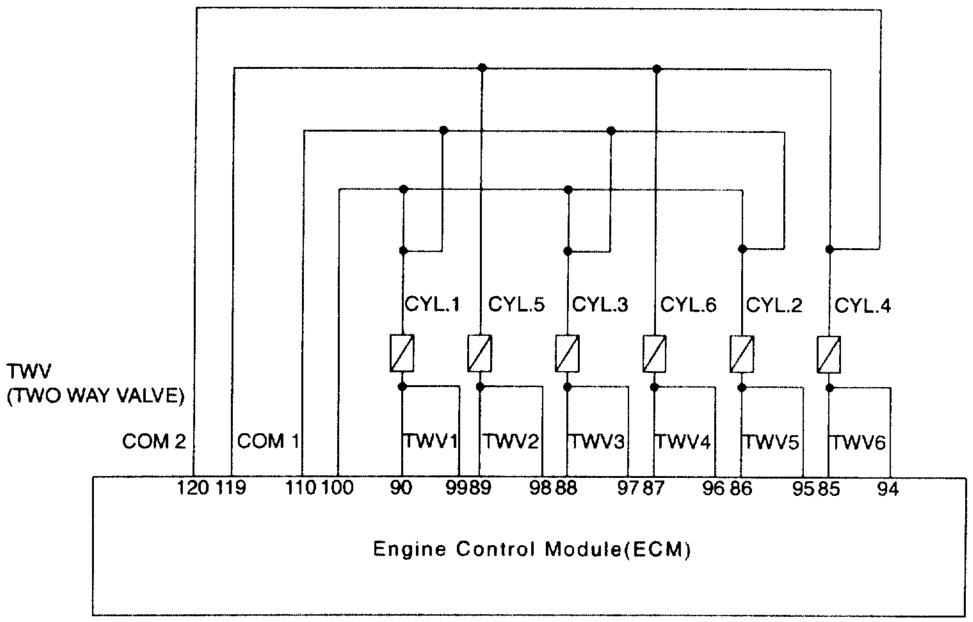
STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does the scan tool display any DTC from DTC 0272 while key switch is "ON" or engine is running?	—	Go to step 3	—
3	1. Key switch "OFF". 2. Disconnect TWV harness connector from ECM side. 3. Measure resistance at the following points at the ECM connector of TWV harness. (Measuring method 1). • Between pin number 86, 95 (TWV5) and pin number 100 (COMMON1). Is resistance within value?	2.0Ω or less for TWV harness resistance. 0.9Ω to 1.3Ω for TWV coil resistance. Thus minimum resistance is 0.9Ω to 1.3Ω. (If harness resistance 0)	Go to step 8 Before going to step 8, recheck incomplete connection on harness connector.	Go to step 4
4	1. Key switch "OFF". 2. Disconnect TWV harness connector from both ECM and TWV (cyl. head side). 3. Measure resistance following points on the TWV harness. (Measuring method 2) • Between pin number 86, 95 (TWV2) at ECM side and pin number 7, 8 (Connector 2) at TWV side. Is resistance within value?	2Ω or less	Go to step 5	Repair/replace TWV harness.
5	Measure resistance at the. following points at the TWV side connector. (TWV COIL unit resistance) (Measuring method 3) • Between pin number 7, 8 and 3, 4 at connector 2 for TWV2. Is resistance within value?	0.4Ω to 0.8Ω (about 20°C)	Go to step 7	Go to step 6
6	1. Remove cylinder head cover. 2. Inspect upper portion of cylinder head. Is there any problem? (Example. disconnected harness or broken wire etc.)	—	Repair problem portion. Then go to step 7	Go to step 7
7	1. Reconnect all connector and terminal of TWV harness. 2. Install cylinder head cover. 3. Key switch "ON". Does the scan tool display any DTCs?	—	Replace ECM assembly. Then go to step 8	Go to step 8
8	1. Clear all DTCs. 2. Key switch "ON". Does the scan tool display any DTCs?	—	Go back to step 3	System OK

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

Cylinder No. 1 to No. 6 TWV Side Disconnected



DTC 0273 (Cylinder No. 3) TWV Side Disconnected



D06M200013

Circuit Description

A hydraulic piston and TWV (solenoid valve) have been added to the conventional nozzle. Receiving signals from ECM, the TWV opens and closes to change the pressure in the pressure adjustment chamber on top of the hydraulic piston so that the hydraulic piston works thereby to inject the fuel from the nozzle.

If No. 3 Cylinder TWV coil or harness is disconnected and battery voltage is over 10V except when in over speed condition, DTC 0273 will be set.

Conditions for Setting the DTC

Cylinder No. 3

- TWV coil or harness disconnected and battery voltage is over 10V.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Injection amount is limited to maximum 80 mm^3/st.

Conditions for Clearing the MIL/DTC

DTC 0273 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- No smooth rotation.
- Lack of engine power.

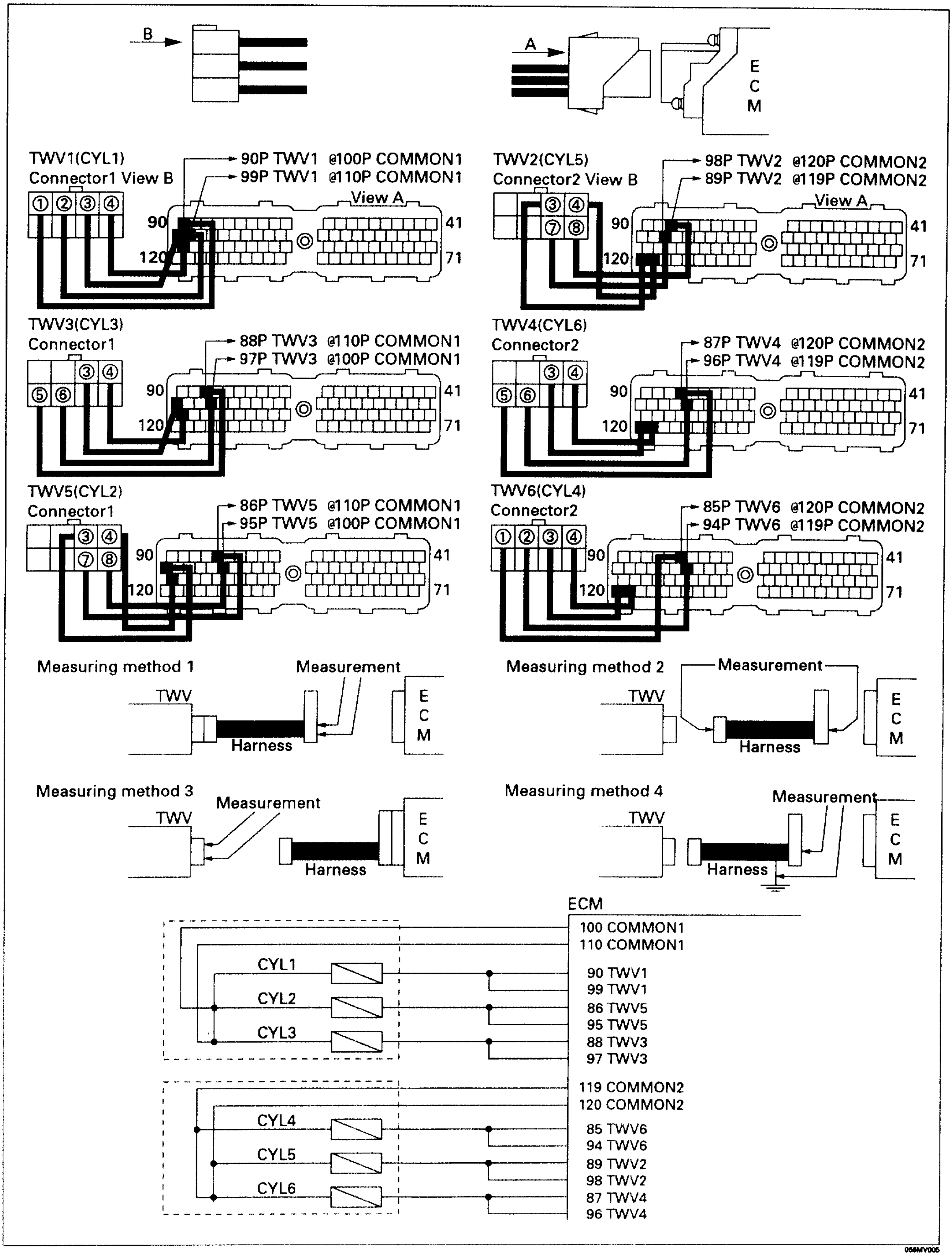
DTC 0273 (Cylinder No. 3) TWV Side Disconnected

Note: If diagnosed simultaneous with flow damper, inspect TWV trouble first.

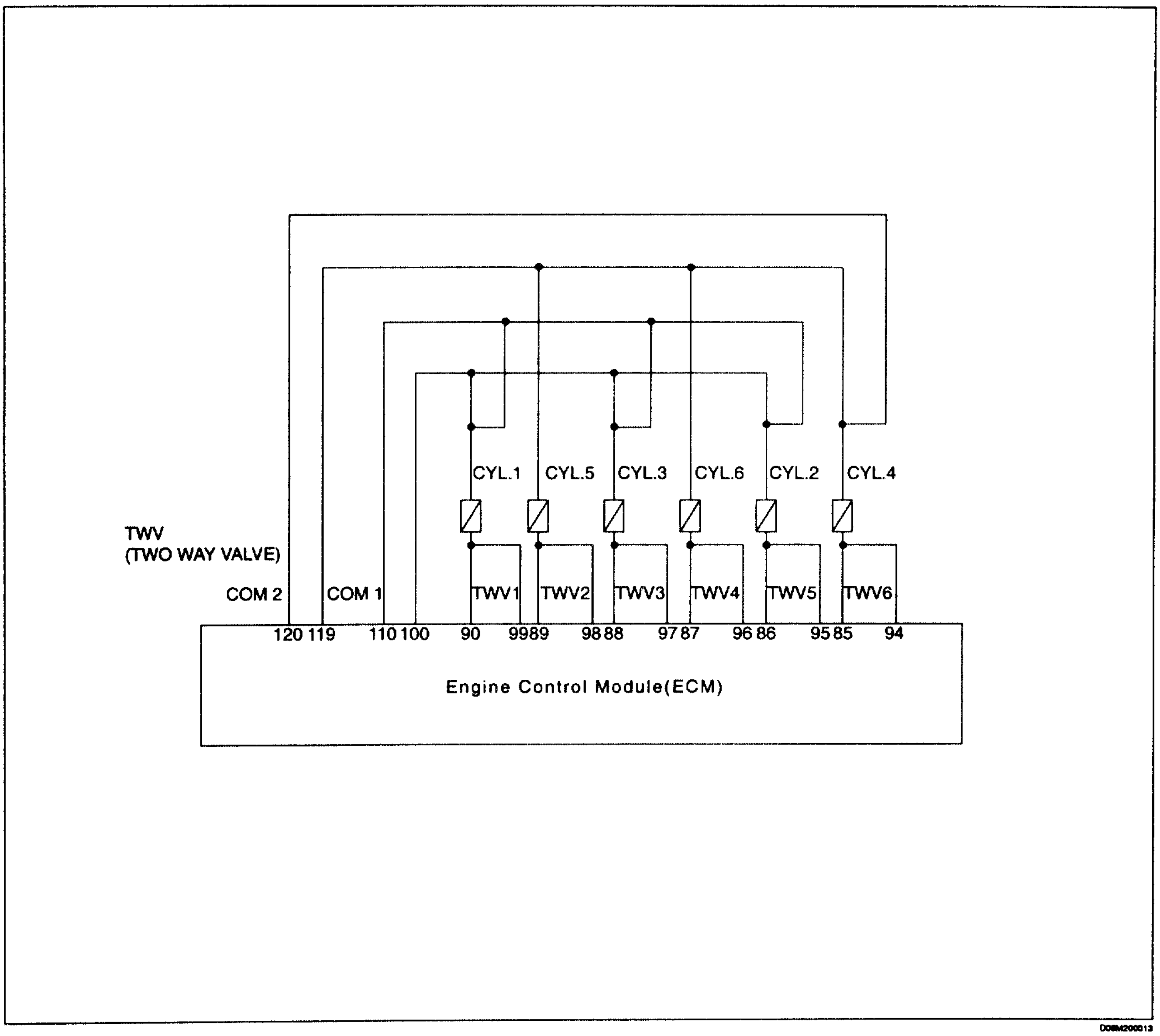
STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does the scan tool display any DTC from DTC 0273 while key switch is "ON" or engine is running?	—	Go to step 3	—
3	1. Key switch "OFF". 2. Disconnect TWV harness connector from ECM side. 3. Measure resistance at the following points at the ECM connector of TWV harness. (Measuring method 1). • Between pin number 88, 97 (TWV3) and pin number 110 (COMMON1). Is resistance within value?	2.0Ω or less for TWV harness resistance. 0.9Ω to 1.3Ω for TWV coil resistance. Thus minimum resistance is 0.9Ω to 1.3Ω. (If harness resistance 0)	Go to step 8 Before going to step 8, recheck incomplete connection on harness connector.	Go to step 4
4	1. Key switch "OFF". 2. Disconnect TWV harness connector from both ECM and TWV (cyl. head side). 3. Measure resistance following points on the TWV harness. (Measuring method 2) • Between pin number 88, 97 (TWV3) at ECM side and pin number 5, 6 (Connector 1) at TWV side. Is resistance within value?	2Ω or less	Go to step 5	Repair/replace TWV harness.
5	Measure resistance at the following points at the TWV side connector. (TWV COIL unit resistance) (Measuring method 3) • Between pin number 5, 6 and 3, 4 at connector 1 for TWV3. Is resistance within value?	0.4Ω to 0.8Ω (about 20°C)	Go to step 7	Go to step 6
6	1. Remove cylinder head cover. 2. Inspect upper portion of cylinder head. Is there any problem? (Example. disconnected harness or broken wire etc.)	—	Repair problem portion. Then go to step 7	Go to step 7
7	1. Reconnect all connector and terminal of TWV harness. 2. Install cylinder head cover. 3. Key switch "ON". Does the scan tool display any DTCs?	—	Replace ECM assembly. Then go to step 8	Go to step 8
8	1. Clear all DTCs. 2. Key switch "ON". Does the scan tool display any DTCs?	—	Go back to step 3	System OK

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2.
Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

Cylinder No. 1 to No. 6 TWV Side Disconnected



DTC 0274 (Cylinder No. 4) TWV Side Disconnected



Circuit Description

A hydraulic piston and TWV (solenoid valve) have been added to the conventional nozzle. Receiving signals from ECM, the TWV opens and closes to change the pressure in the pressure adjustment chamber on top of the hydraulic piston so that the hydraulic piston works thereby to inject the fuel from the nozzle.

If No. 4 Cylinder TWV coil or harness is disconnected and battery voltage is over 10V except when in over speed condition, DTC 0274 will be set.

Conditions for Setting the DTC

Cylinder No. 4;

- TWV coil or harness disconnected and battery voltage is over 10V.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Injection amount is limited to maximum 80 mm^3/st.

Conditions for Clearing the MIL/DTC

DTC 0274 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- No smooth rotation.
- Lack of engine power.

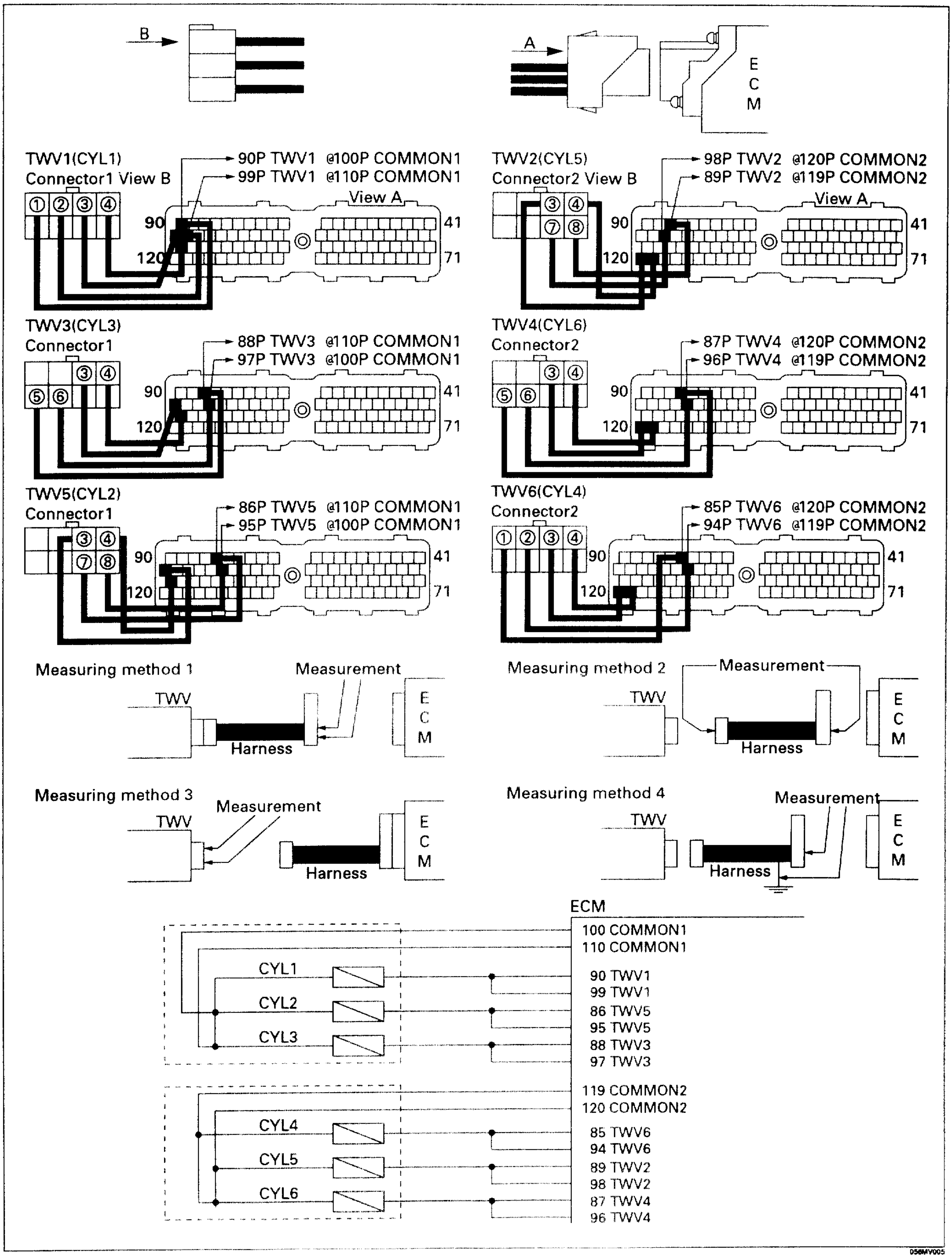
DTC 0274 (Cylinder No. 4) TWV Side Disconnected

Note: If diagnosed simultaneous with flow damper, inspect TWV trouble first.

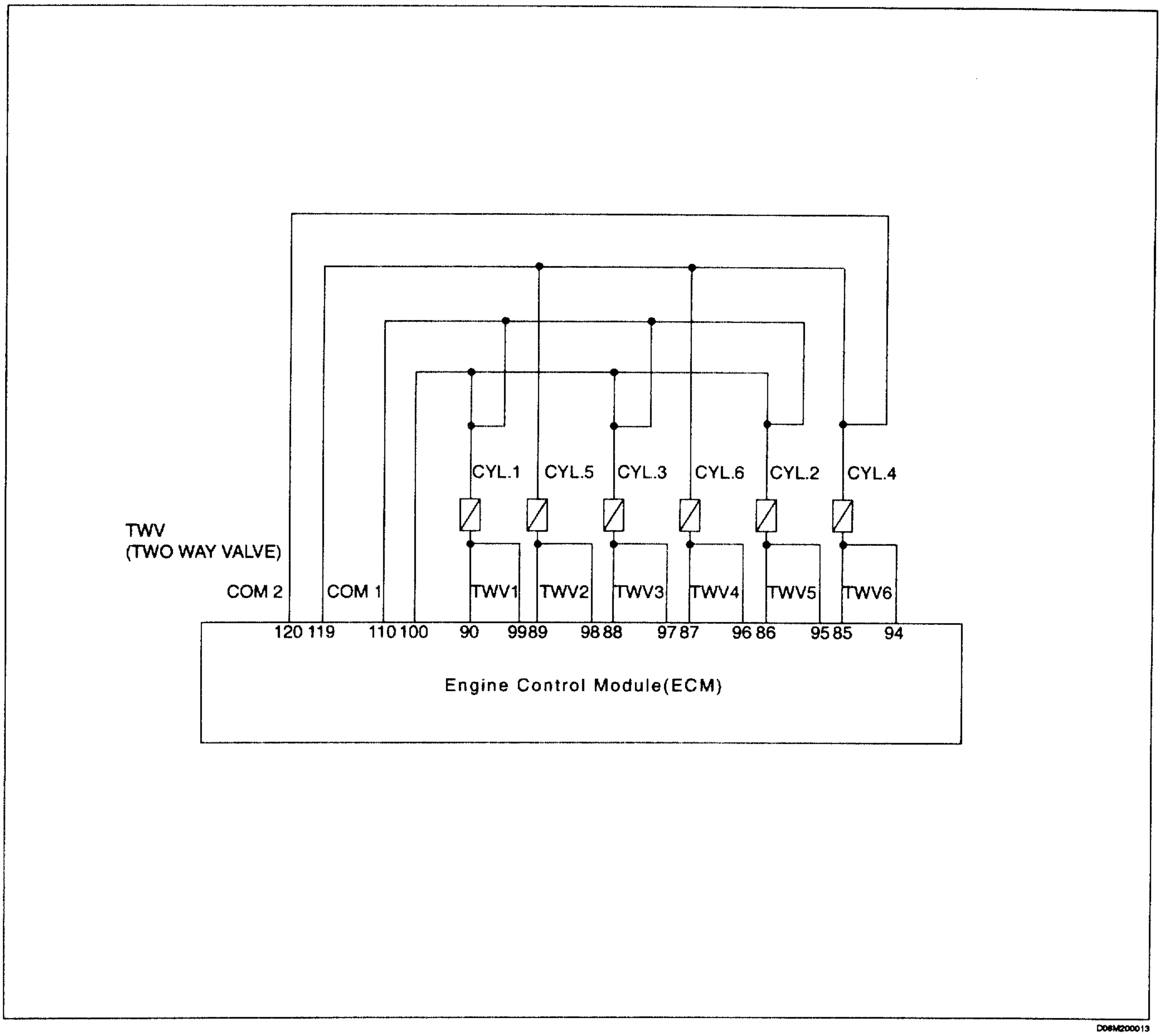
STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does the scan tool display any DTC from DTC 0274 while key switch is "ON" or engine is running?	—	Go to step 3	—
3	1. Key switch "OFF". 2. Disconnect TWV harness connector from ECM side. 3. Measure resistance at the following points at the ECM connector of TWV harness. (Measuring method 1). • Between pin number 85, 94 (TWV6) and pin number 119 (COMMON2). Is resistance within value?	2.0Ω or less for TWV harness resistance. 0.9Ω to 1.3Ω for TWV coil resistance. Thus minimum resistance is 0.9Ω to 1.3Ω. (If harness resistance 0)	Go to step 8 Before going to step 8, recheck incomplete connection on harness connector.	Go to step 4
4	1. Key switch "OFF". 2. Disconnect TWV harness connector from both ECM and TWV (cyl. head side). 3. Measure resistance following points on the TWV harness. (Measuring method 2) • Between pin number 85, 94 (TWV4) at ECM side and pin number 1, 2 (Connector 2) at TWV side. Is resistance within value?	2Ω or less	Go to step 5	Repair/replace TWV harness.
5	Measure resistance at the following points at the TWV side connector. (TWV COIL unit resistance) (Measuring method 3) • Between pin number 1, 2 and 3, 4 at connector 2 for TWV4. Is resistance within value?	0.4Ω to 0.8Ω (about 20°C)	Go to step 7	Go to step 6
6	1. Remove cylinder head cover. 2. Inspect upper portion of cylinder head. Is there any problem? (Example. disconnected harness or broken wire etc.)	—	Repair problem portion. Then go to step 7	Go to step 7
7	1. Reconnect all connector and terminal of TWV harness. 2. Install cylinder head cover. 3. Key switch "ON".	—	Replace ECM assembly. Then go to step 8	Go to step 8
8	1. Clear all DTCs. 2. Key switch "ON". Does the scan tool display any DTCs?	—	Go back to step 3	System OK

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

Cylinder No. 1 to No. 6 TWV Side Disconnected



DTC 0275 (Cylinder No. 5) TWV Side Disconnected



Circuit Description

A hydraulic piston and TWV (solenoid valve) have been added to the conventional nozzle. Receiving signals from ECM, the TWV opens and closes to change the pressure in the pressure adjustment chamber on top of the hydraulic piston so that the hydraulic piston works thereby to inject the fuel from the nozzle.

If No. 5 Cylinder TWV coil or harness is disconnected and battery voltage is over 10V except when in over speed condition, DTC 0275 will be set.

Conditions for Setting the DTC

Cylinder No. 5;

- TWV coil or harness disconnected and battery voltage is over 10V.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Injection amount is limited to maximum 80 mm^3/st.

Conditions for Clearing the MIL/DTC

DTC 0275 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- No smooth rotation.
- Lack of engine power.

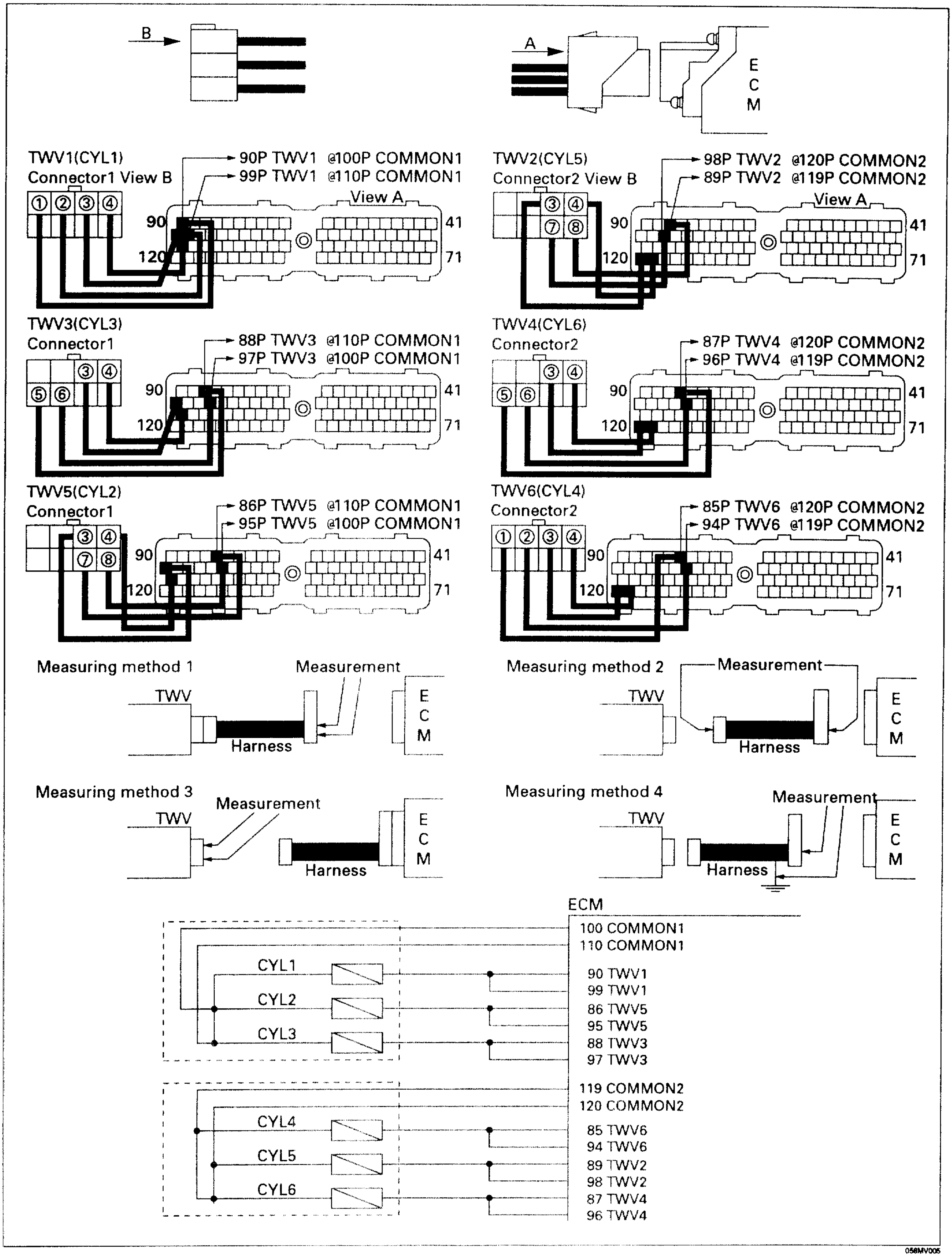
DTC 0275 (Cylinder No. 5) TWV Side Disconnected

Note: If diagnosed simultaneous with flow damper, inspect TWV trouble first.

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD Ssytem Check
2	Does the scan tool display any DTC from DTC 0275 while key switch is "ON" or engine is running?	—	Go to step 3	—
3	1. Key switch "OFF". 2. Disconnect TWV harness connector from ECM side. 3. Measure resistance at the following points at the ECM connector of TWV harness. (Measuring method 1). • Between pin number 89, 98 (TWV2) and pin number 119 (COMMON2). Is resistance within value?	2.0Ω or less for TWV harness resistance. 0.9Ω to 1.3Ω for TWV coil resistance. Thus minimum resistance is 0.9Ω to 1.3Ω. (If harness resistance 0)	Go to step 8 Before going to step 8, recheck incomplete connection on harness connector.	Go to step 4
4	1. Key switch "OFF". 2. Disconnect TWV harness connector from both ECM and TWV (cyl. head side). 3. Measure resistance following points on the TWV harness. (Measuring method 2) • Between pin number 89, 98 (TWV5) at ECM side and pin number 7, 8 (Connector 2) at TWV side. Is resistance within value?	2Ω or less	Go to step 5	Repair/replace TWV harness.
5	Measure resistance at the following points at the TWV side connector. (TWV COIL unit resistance) (Measuring method 3) • Between pin number 7, 8 and 3, 4 at connector 2 for TWV5. Is resistance within value?	0.4Ω to 0.8Ω (about 20°C)	Go to step 7	Go to step 6
6	1. Remove cylinder head cover. 2. Inspect upper portion of cylinder head. Is there any problem? (Example. disconnected harness or broken wire etc.)	—	Repair problem portion. Then go to step 7	Go to step 7
7	1. Reconnect all connector and terminal of TWV harness. 2. Install cylinder head cover. 3. Key switch "ON". Does the scan tool display any DTCs?	—	Replace ECM assembly. Then go to step 8	Go to step 8
8	1. Clear all DTCs. 2. Key switch "ON". Does the scan tool display any DTCs?	—	Go back to step 3	System OK

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2.
Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

Cylinder No. 1 to No. 6 TWV Side Disconnected



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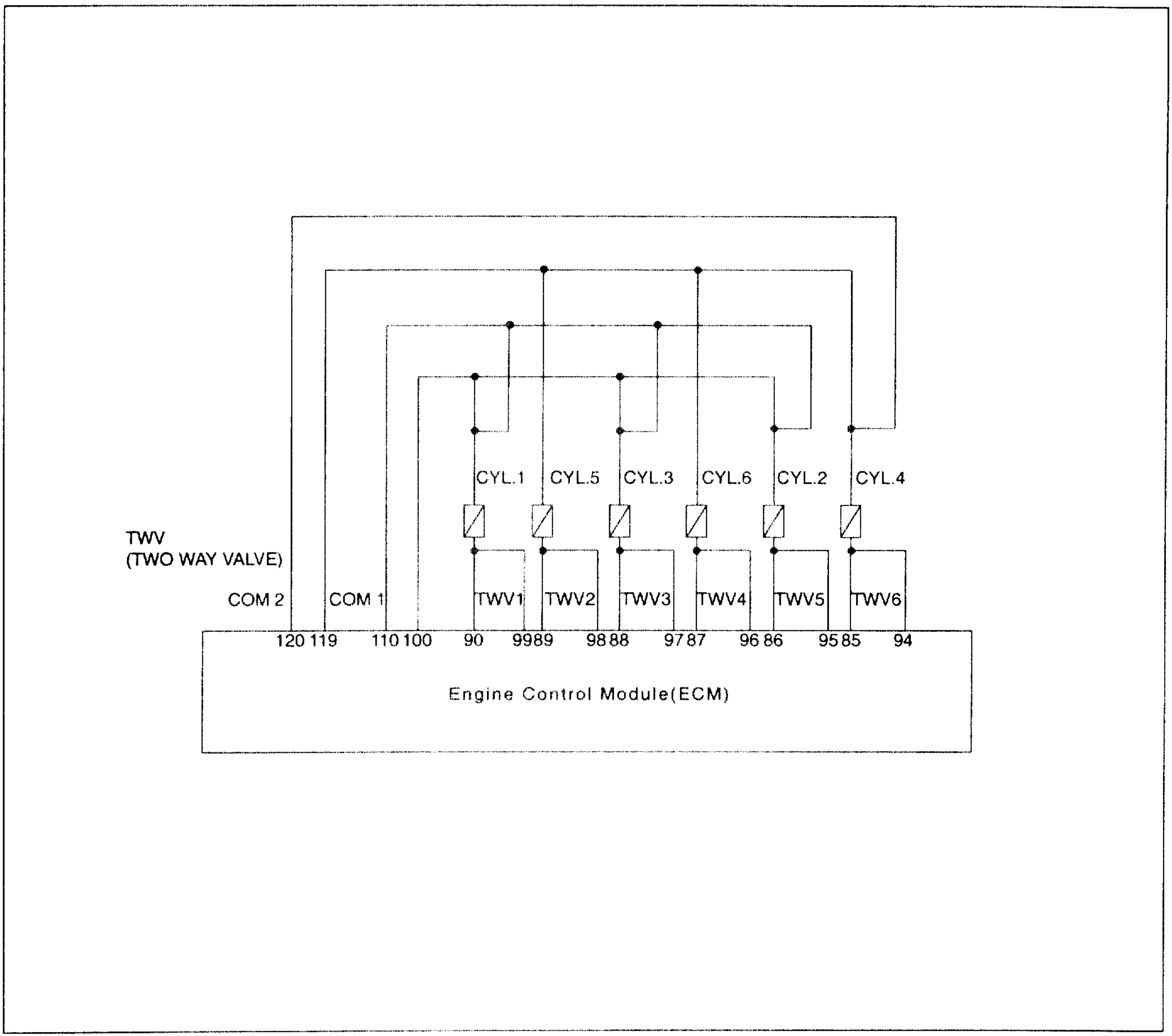
DTC 0276 (Cylinder No. 6) TWV Side Disconnected



Circuit Description

A hydraulic piston and TWV (solenoid valve) have been added to the conventional nozzle. Receiving signals from ECM, the TWV opens and closes to change the pressure in the pressure adjustment chamber on top of the hydraulic piston so that the hydraulic piston works thereby to inject the fuel from the nozzle.

If No. 6 Cylinder TWV coil or harness is disconnected and battery voltage is over 10V except when in over speed condition, DTC 0276 will be set.

Conditions for Setting the DTC

Cylinder No. 6;

- TWV coil or harness disconnected and battery voltage is over 10V.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.
- Injection amount is limited to maximum 80 mm^3/st.

Conditions for Clearing the MIL/DTC

DTC 0276 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- No smooth rotation.
- Lack of engine power.

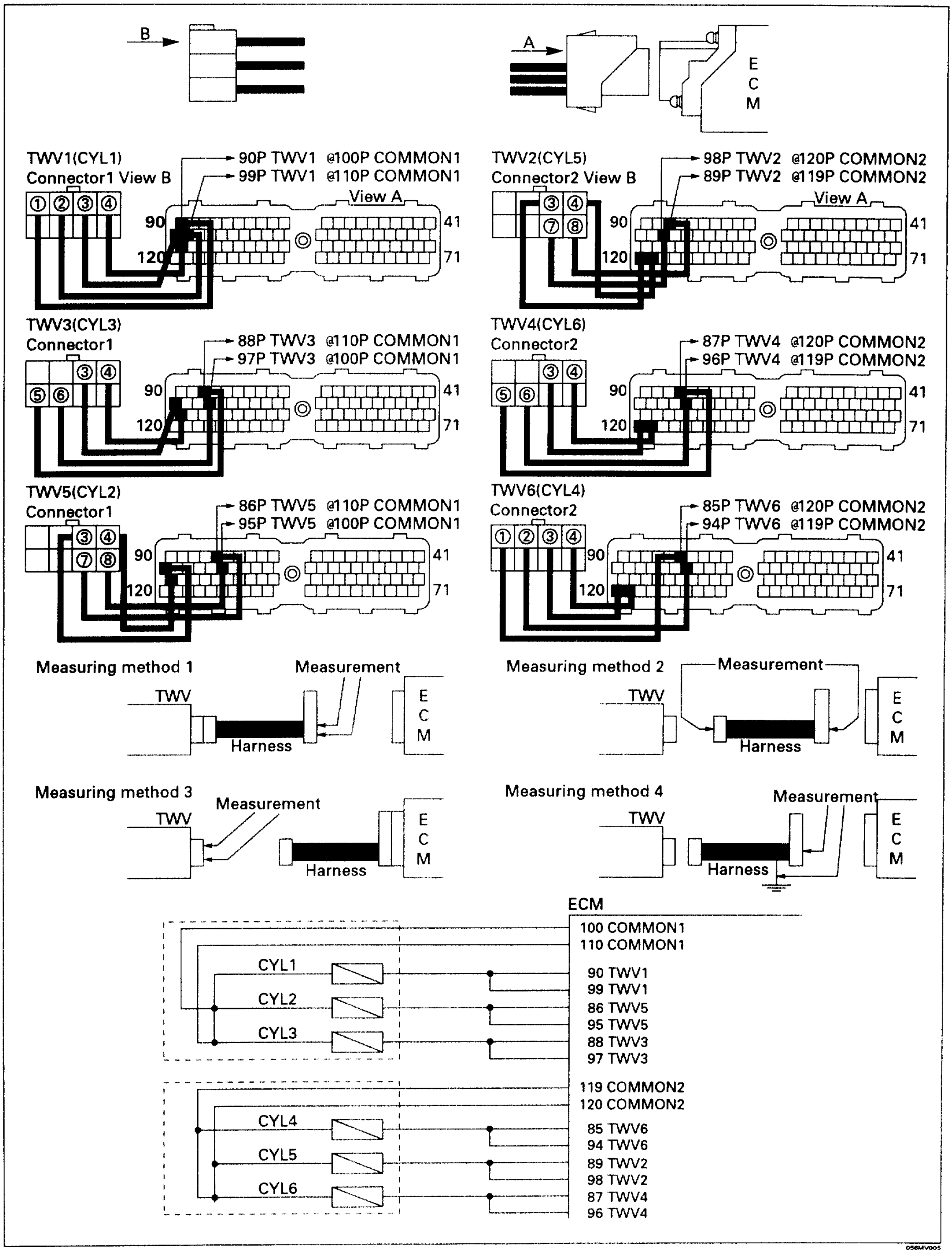
DTC 0276 (Cylinder No. 6) TWV Side Disconnected

Note: If diagnosed simultaneous with flow damper, inspect TWV trouble first.

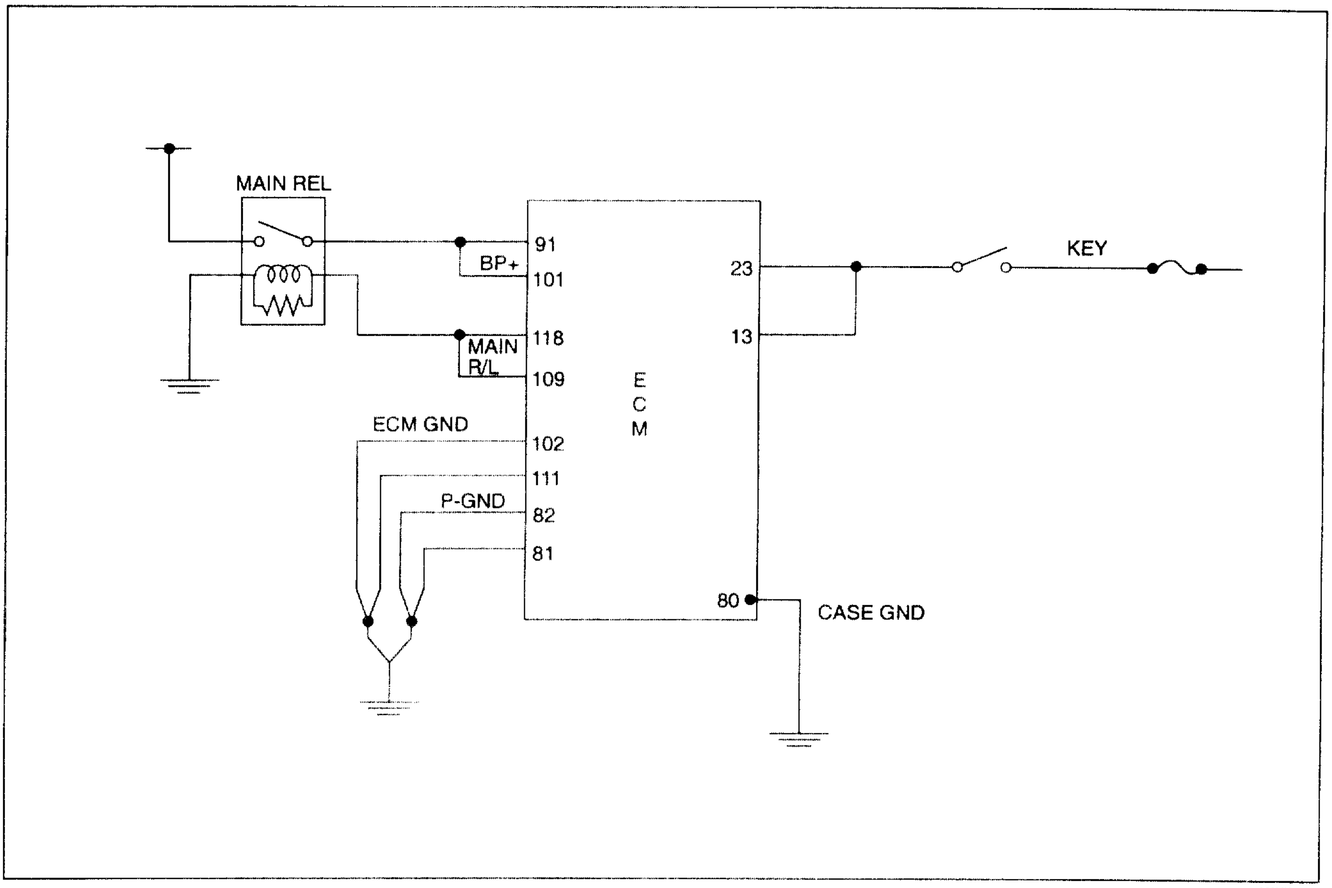
STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Chekc
2	Does the scan tool display any DTC from DTC 0276 while key switch is "ON" or engine is running?	—	Go to step 3	—
3	1. Key switch "OFF". 2. Disconnect TWV harness connector from ECM side. 3. Measure resistance at the following points at the ECM connector of TWV harness. (Measuring method 1). • Between pin number 87, 96 (TWV4) and pin number 120 (COMMON2). Is resistance within value?	2.0Ω or less for TWV harness resistance. 0.9Ω to 1.3Ω for TWV coil resistance. Thus minimum resistance is 0.9Ω to 1.3Ω. (If harness resistance 0)	Go to step 8 Before going to step 8, recheck incomplete connection on harness connector.	Go to step 4
4	1. Key switch "OFF". 2. Disconnect TWV harness connector from both ECM and TWV (cyl. head side). 3. Measure resistance following points on the TWV harness. (Measuring method 2) • Between pin number 87, 96 (TWV6) at ECM side and pin number 5, 6 (Connector 2) at TWV side. Is resistance within value?	2Ω or less	Go to step 5	Repair/replace TWV harness.
5	Measure resistance at the following points at the TWV side connector. (TWV COIL unit resistance) (Measuring method 3) • Between pin number 5, 6 and 3, 4 at connector 2 for TWV6. Is resistance within value?	0.4Ω to 0.8Ω (about 20°C)	Go to step 7	Go to step 6
6	1. Remove cylinder head cover. 2. Inspect upper portion of cylinder head. Is there any problem? (Example. disconnected harness or broken wire etc.)	—	Repair problem portion. Then go to step 7	Go to step 7
7	1. Reconnect all connector and terminal of TWV harness. 2. Install cylinder head cover. 3. Key switch "ON". Does the scan tool display any DTCs?	—	Replace ECM assembly. Then go to step 8	Go to step 8
8	1. Clear all DTCs. 2. Key switch "ON". Does the scan tool display any DTCs?	—	Go back to step 3	System OK

IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

Cylinder No. 1 to No. 6 TWV Side Disconnected



DTC 0416 Main Relay System Error (Short Circuited)



Circuit Description

The ECM is supplied 12 volts through the main relay system.

Starter switch (key switch) is off when main relay is on for 5 sec. or more, DTC 0416 will be set.

Conditions for Setting the DTC

- When key switch is off then main relay is on for 5 sec. or more.

Action Taken When the DTC Sets

- Only MIL (Flashing lamp) can be lighted by key on current.

Conditions for Clearing the MIL/DTC

DTC 0416 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

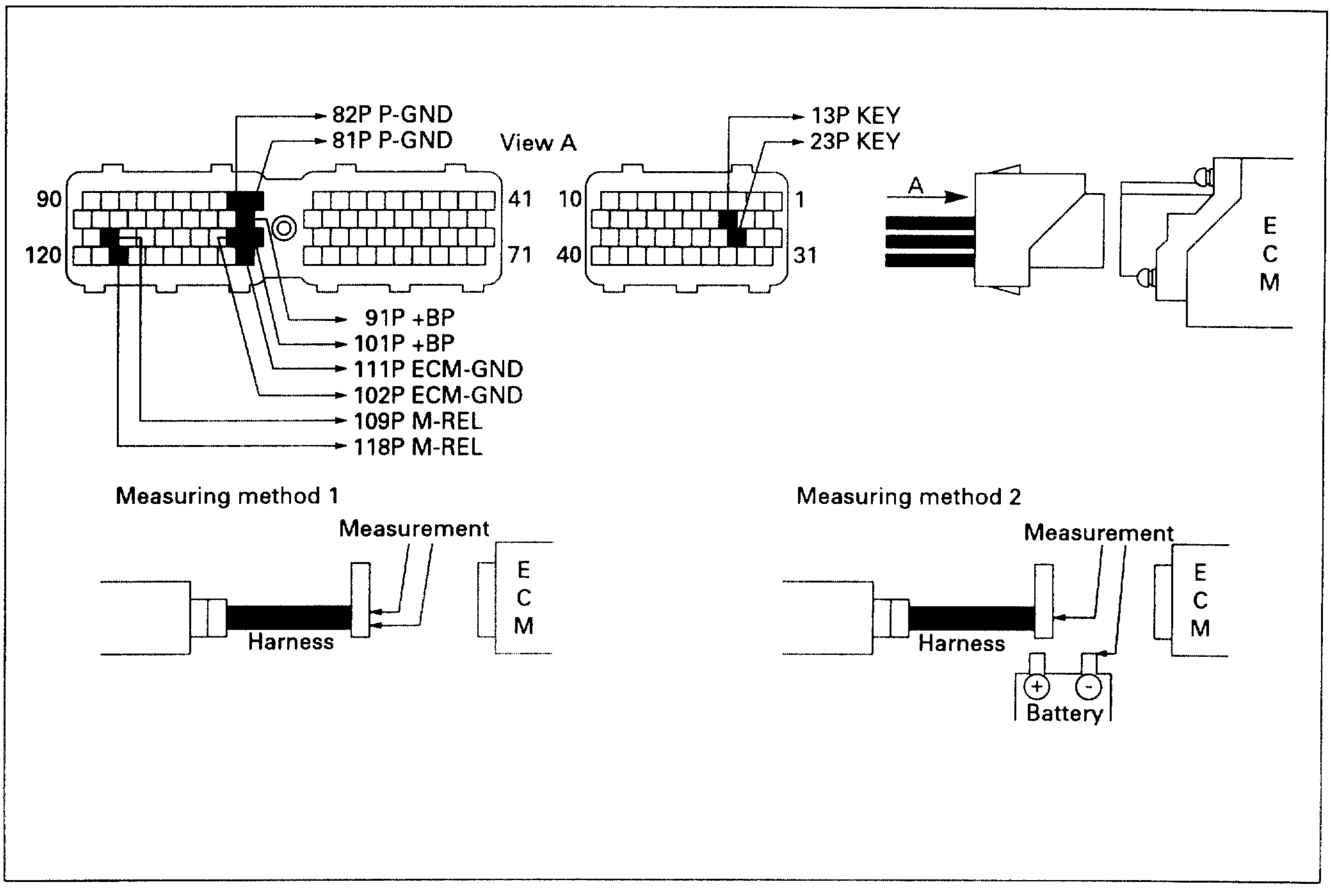
Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Lamp: Light at 700 rpm or less for continuously 20 sec. (Lighted at hard circuit).	—	—	—

DTC 0416 Main Relay System Error (Short Circuited)



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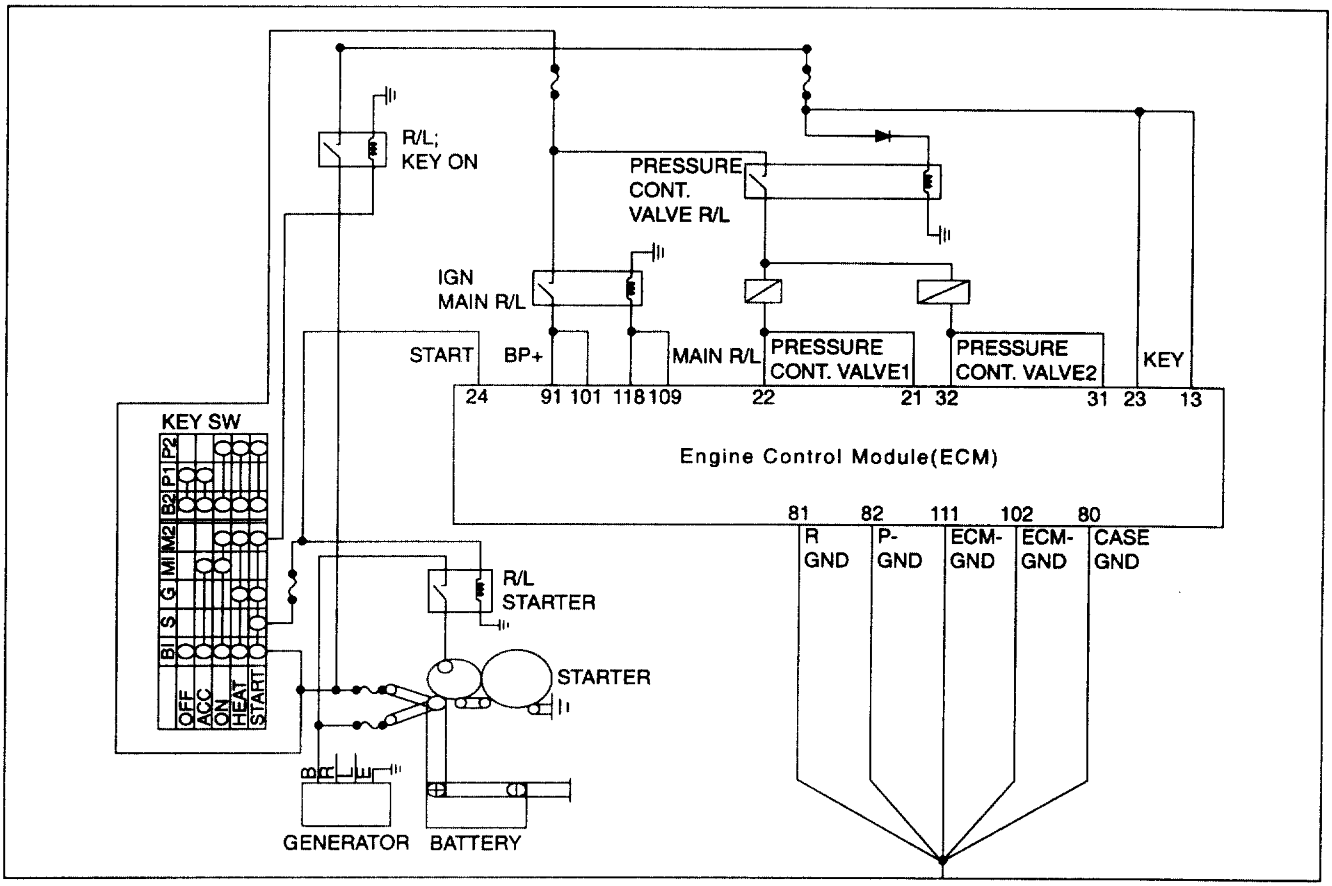
DTC 0417 Starter Switch Abnormal (short circuit)



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Conditions for Setting the DTC

- Starter switch on and idle speed higher than 1000 rpm.
- When these conditions continue for 1.6 sec.
- Starter switch is abnormal condition. (Short circuited)

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.

Conditions for Clearing the MIL/DTC

DTC 0417 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

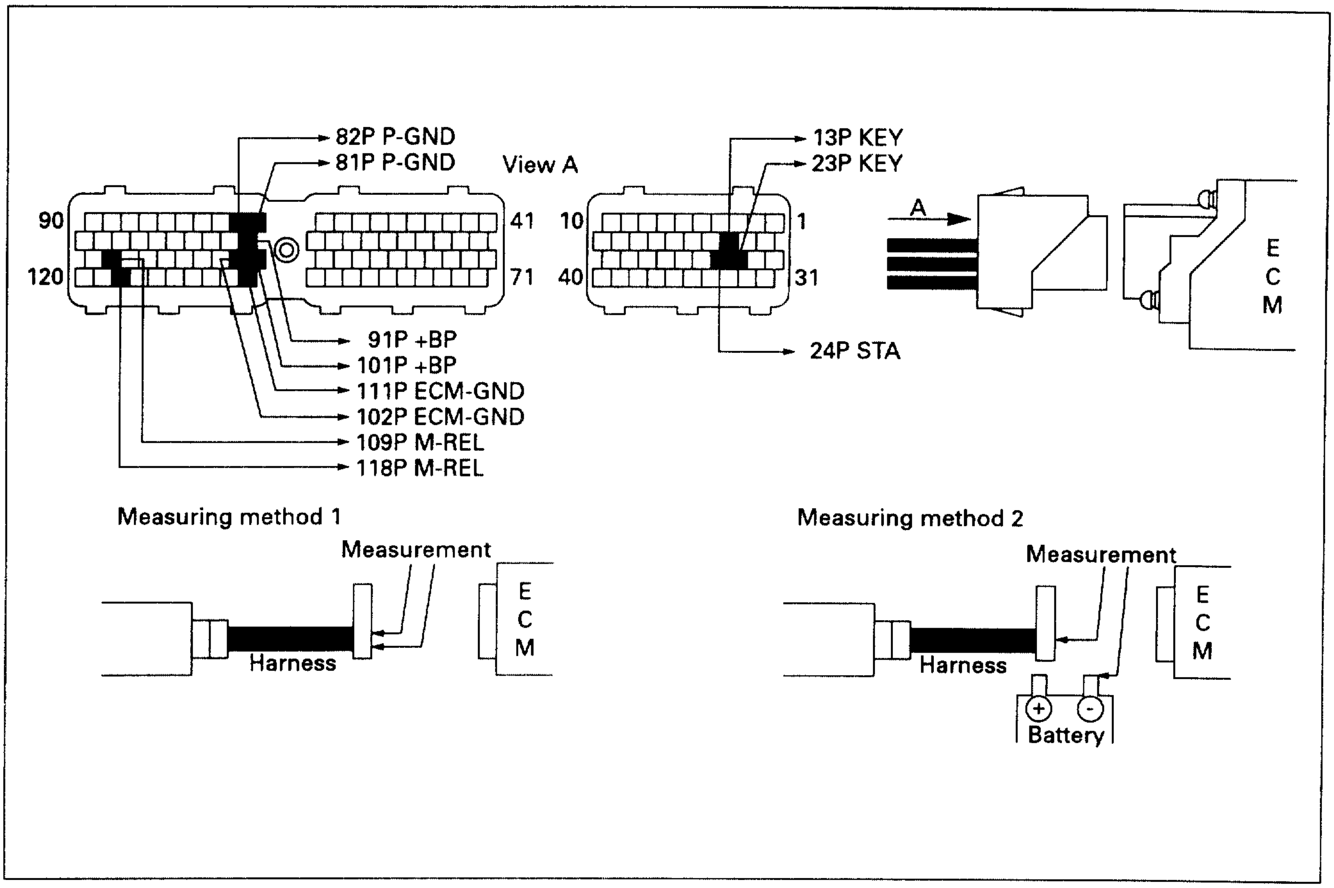
- Poor connection at ECM – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Increase to remains applies on idling when cold start engine.

DTC 0417 Starter Switch Abnormal (short circuit)

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to OBD System Check
2	Does DTC 0417 display while key switch "ON" and engine is running?	—	Go to step 3	—
3	Measure voltage between pin number 24 (STA) and GND while key switch "ON" and engine running. Does voltage indicate 12V.	12V always applied	Go to step 4	Go to step 5
4	Check wire harness and/or starter switch for shortage or starter switch melting (welding). Is any problem found?	—	Repair/replace wire harness starter switch Then go to step 5	Go to step 5
5	Clear all DTCs. Does DTC 0417 display?	—	Replace ECM assembly. Then go to step 6	System OK
6	Does DTC 0417 display?	—	Go back to step 3	System OK

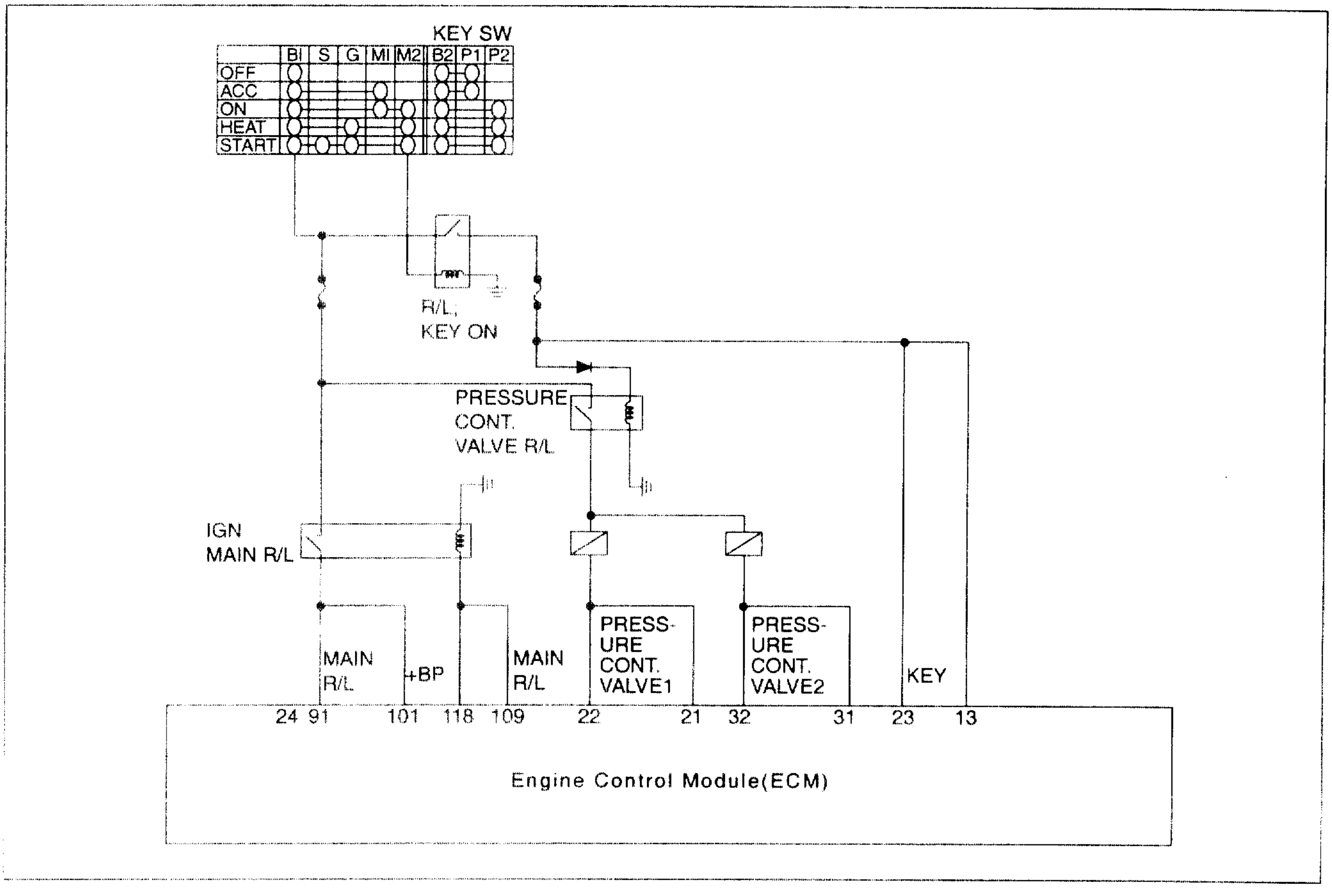
IMPORTANT: The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

DTC 0417 Starter Switch Abnormal (short circuit)



060M200054

DTC 0421 PCV Relay (R/L) System Error (short circuit)



Circuit Description

PCV is used to adjust supply pump discharge amount so as to adjust common rail pressure. Discharge amount from the supply pump to the common rail is determined by PCV current timing.

PCV Relay is used for supply an electric current to the PCV.

Conditions for Setting the DTC

- If PCV driving voltage is present when the key is off it the circuit has a short to voltage condition.

Action Taken When the DTC Sets

- Only diagnostic code memory.

Conditions for Clearing the MIL/DTC

DTC 0421 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

Diagnostic Aids

Check for the following conditions:

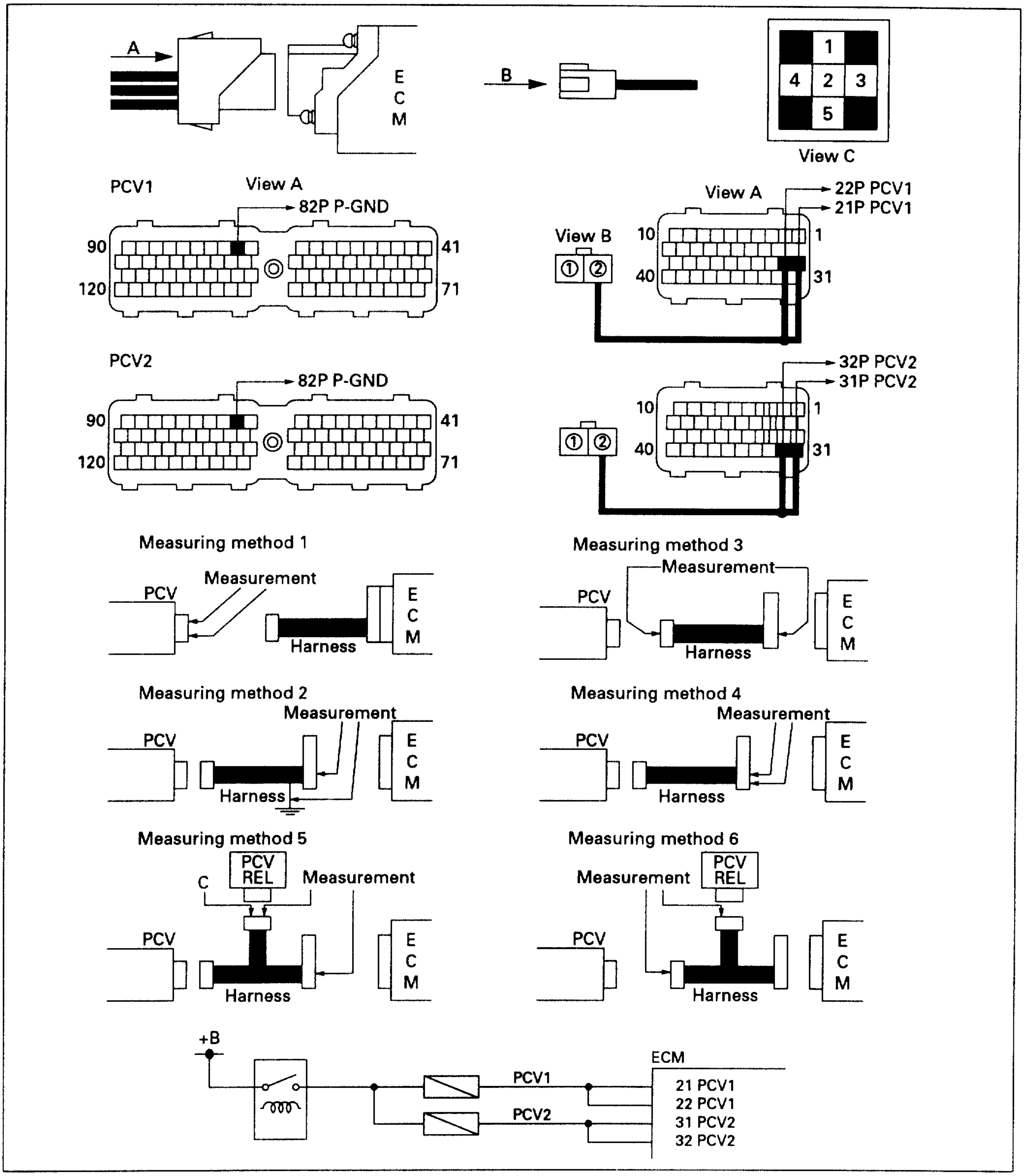
- Poor connection at PCV Relay – Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Poor condition for starter switch and key on signal circuit (Key ON Relay, harness open).

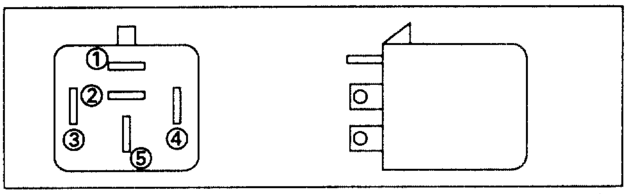
DTC 0421 PCV Relay (R/L) System Error (short circuit)

STEP	ACTION	VALUE	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to step 2	Go to OBD System Check
2	Does DTC 0421 display while key switch is "ON" or engine is running?	—	Go to step 3	—
3	1. Key switch "OFF". 2. Disconnect PCV harness. 3. Measure voltage following points at the ECM connector. • Between pin number 21, 22 for PCV1 and pin number 82 for P–GND. • Between pin number 31, 32 for PCV2 and pin number 82 for P–GND. Is voltage at battery voltage?	Battery voltage	Go to step 6	Go to step 4
4	Contact point on relay is sticking intermittently. After DTC is cleared does the MIL indication code reads DTC 0421 display?	—	Go to step 5	Repair/replace PCV harness or PCV relay.
5	Does DTC 0421 display even if no change from LO (0V)?	—	Replace ECM.	System OK
6	1. Remove PCV relay. 2. Measure resistance between contact point ⑤ and ①. Is resistance within value?	10MΩ or more	Go to step 7	Replace PCV relay
7	Possible cause that the cable (Battery → R/L → PCV) on the side of PCV power supply short circuit to B+. 1. Key switch "OFF". 2. Disconnect PCV harness from PCV, PCV relay and ECM. 3. Measure voltage between pin number 1 at PCV relay side of PCV harness and pin number 82 (P–GND) at ECM side of PCV harness. (Measuring method 5) Is voltage within value?	Less than 1V	Go to step 8	Repair/replace PCV harness. Then go to step 8
8	Clear all DTCs. Does DTC 0421 display?	—	Go back to step 3	System OK

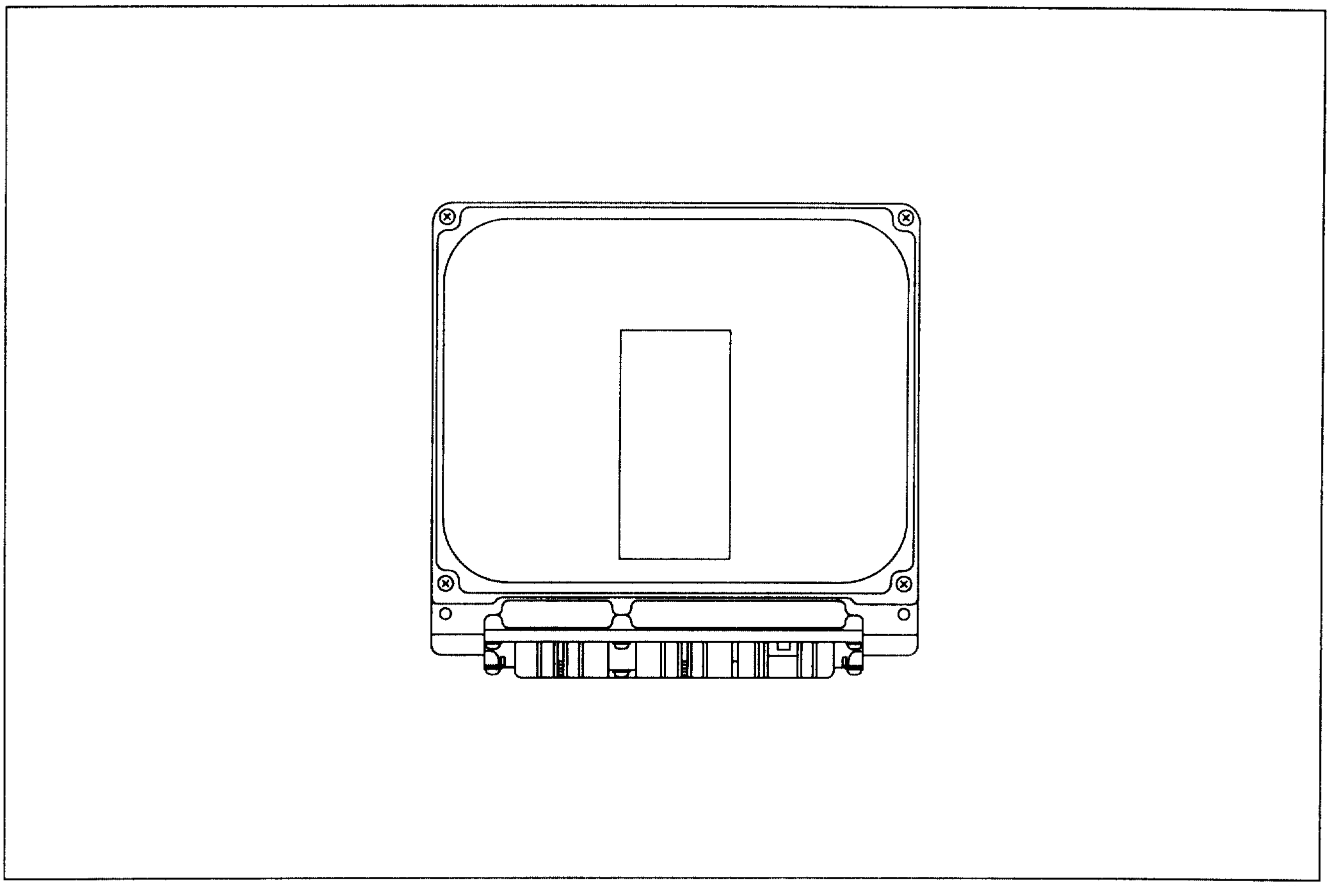
IMPORTANT:* *The replacement ECM must be restored the capture fuel rate data by Tech 2. Refer to "Capture and Restore Fuel Rate Data" of "Tech 2 Scan Tool" in this manual.

DTC 0421 PCV1, 2 Relay (R/L) System Error (short circuit)





DTC 0543 Over Speed Condition (Not turn on MIL)



Circuit Description

If the ECM detects over speed condition, then fuel injection stop.

Conditions for Setting the DTC

- At 3650 rpm or higher
- Fuel injection stops.
- Fuel pressure feed stops.

Action Taken When the DTC Sets

- The ECM will illuminate the malfunction indicator lamp (MIL) the first time the fault is detected.

Conditions for Clearing the MIL/DTC

DTC 0543 can be cleared by using the "Clear Info" by scan tool or using by the Diag Clear Switch.

STEP	ACTION	VALUE	YES	NO
1	Does DTC 0543 display while key switch is "ON" or engine in operation?	—	Go to step 2	—
2	Ask driver if over speed condition was caused by gear slip-out, shift error, etc.	—	Misusage by owner or operator.	See Intermittent chart

ENGINE CONTROL MODULE (ECM) DESCRIPTION

The engine control module (ECM) is located in the compartment below the right seat. The ECM controls the following:

- Fuel system.
- Ignition timing.
- On-board diagnostics for powertrain functions.

The ECM constantly observes the information from various sensors. The ECM controls the systems that affect vehicle performance. The ECM performs the diagnostic function of the system. It can recognize operational problems, alert the driver through the MIL (Check Engine lamp), and store diagnostic trouble codes (DTCs). DTCs identify the problem areas to aid the technician in making repairs.

ECM Function

The ECM supplies either 5 or 12 volts to power various sensors or switches. The power is supplied through resistances in the ECM which are so high in value that a test light will not light when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. Therefore, a digital voltmeter with at least 10 megohms input impedance is required to ensure accurate voltage readings. Too J 39200 meets this requirement. The ECM controls output circuits such as the injectors, etc.

ECM Voltage Description

The ECM supplies a buffered voltage to various switches and sensor. It can do this because resistance in the ECM is so high in value that a test light may not illuminate when connected to the circuit. An ordinary shop voltmeter may not give an accurate reading because the voltmeter input impedance is too low. Use a 10-megohm input impedance digital voltmeter (such as J 39200) to assure accurate voltage readings.

The input/output devices in the ECM include analog-to-digital converters, signal buffers, counters, and special drivers. The ECM controls most components with electronic switches which complete a ground circuit when turned "ON".

ECM Service Precautions

The ECM is designed to withstand normal current draws associated with vehicle operation. Avoid overloading any circuit. When testing for opens and shorts, do not ground or apply voltage to any of the ECM's circuits unless instructed to do so. These circuits should only be tested using digital voltmeter J 39200. The ECM should remain connected to the ECM or to a recommended breakout box.

Aftermarket Electrical Equipment

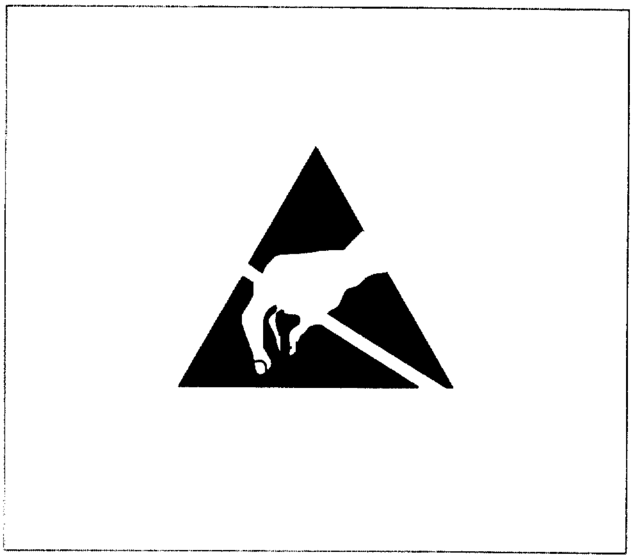
Aftermarket (add-on) electrical equipment is defined as any equipment which connects to the vehicle's electrical systems that is installed on a vehicle after it leaves the factory. No allowances have been made in the vehicle design for this type of equipment.

NOTE: Add-on electrical equipment must only be connected to the vehicle's electrical system at the battery (power and ground).

Add-on electrical equipment, even when installed to these guidelines, may still cause the powertrain system to malfunction. This may also include equipment not connected to the vehicle electrical system such as portable telephones and radios. Therefore, the first step in diagnosing any powertrain problem is to eliminate all aftermarket electrical equipment from the vehicle. After this is done, if the problem still exists, it may be diagnosed in the normal manner.

Electrostatic Discharge Damage

Electronic components used in the ECM are often designed to carry very low voltage. Electronic components are susceptible to damage caused by electrostatic discharge. Less than 100 volts of static electricity can cause damage to some electronic components. By comparison, it takes as mush as 4000 volts for a person to feel even the zap of a static discharge.



There are several ways for a person to become statically charged. The most common methods of charging are by friction and induction.

- An example of charging by friction is a person sliding across a vehicle seat.
- Charge by induction occurs when a person with well insulated shoes stands near a highly charged object and momentary touches ground. Charges of the same polarity are drained off leaving the person highly charged with the opposite polarity. Static charges can cause damage, therefore it is important to use care when handling and testing electronic components.

NOTE: To prevent possible electrostatic discharge damage, follow these guidelines:

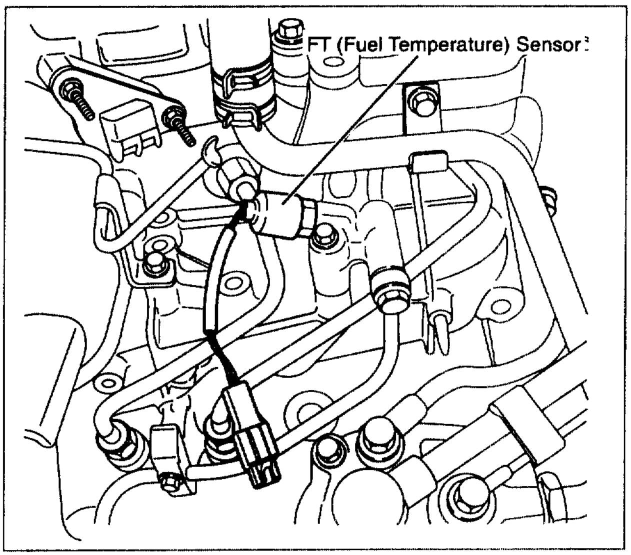
- **Do not touch the ECM connector pins or soldered components on the ECM circuit board.**
- **Do not open the replacement part package until the part is ready to be installed.**
- **Before removing the part from the package, ground the package to a known good ground on the vehicle.**
- **If the part has been handled while sliding across the seat, while sitting down from a standing position, or while walking a distance, touch a known good ground before installing the part.**

ON-VEHICLE SERVICE

Fuel Temperature (THF) Sensor

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the clip from resonator.
3. Remove the resonator.
4. Disconnect the electrical connector to the Fuel Temp. Sensor.



080MX075

5. Loosen the Fuel Temp. retaining bolt.
6. Remove the Fuel Temp. sensor.

Inspection Procedure

1. Inspect the sensor for worn or damage.
2. Replace the sensor if it is worn or damaged.
3. Inspect the packing for cracks or leaks.
4. Replace the packing if it is worn or damaged.

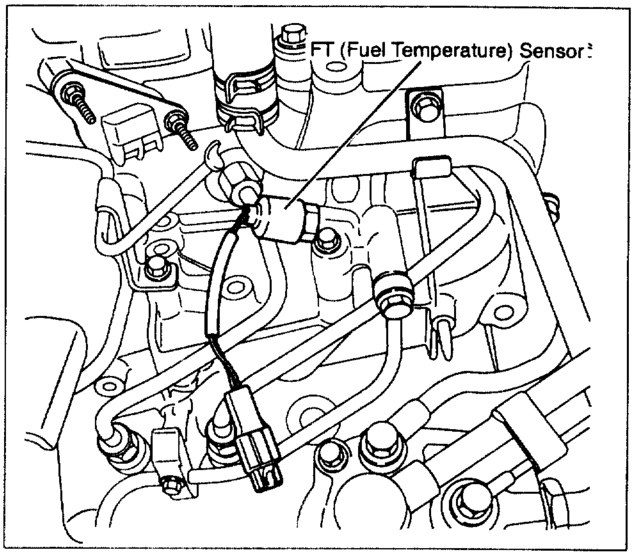
Installation Procedure

1. Install the Fuel Temp. sensor.
2. Install the Fuel Temp. sensor retaining bolt.

Tighten

- Tighten the retaining bolt to 19.6 N·m (173 lb·in)

3. Connect the electrical connector to the Fuel Temp. sensor.



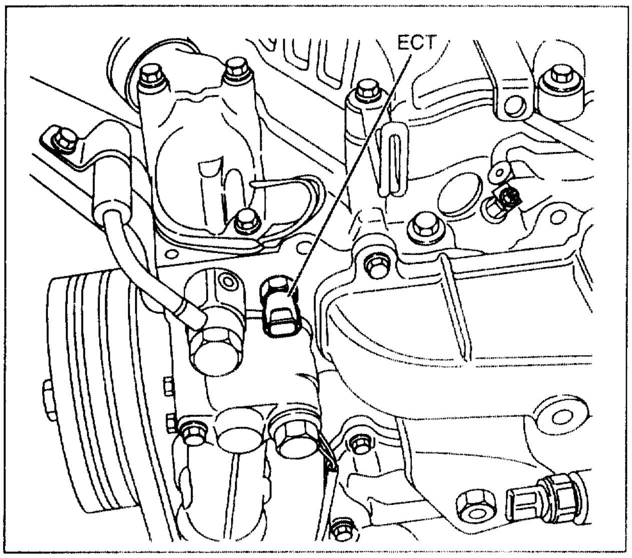
080MX075

4. Install the resonator.
5. Install the clip to the resonator.
6. Connect the negative battery cable.

ECT Sensor

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector to the ECT sensor.

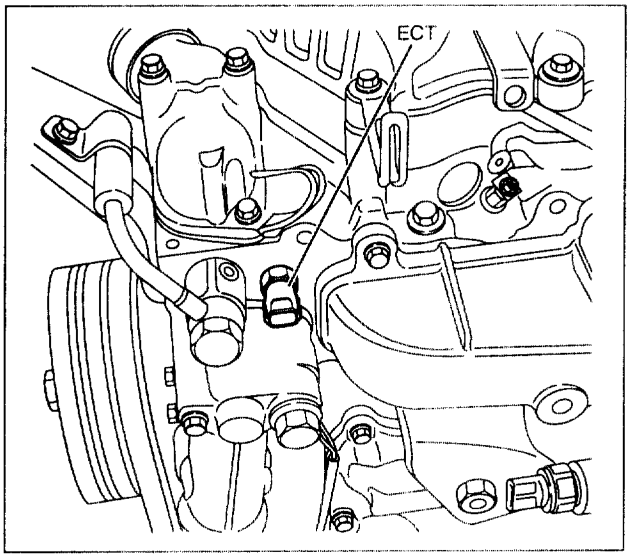


3. Loosen the ECT retaining bolt.
4. Remove the ECT sensor.

Installation Procedure

1. Install the ECT sensor.
2. Install the ECT sensor retaining bolt.

Tighten



- Tighten the retaining bolt to 19.6 N·m (173 lb·in)

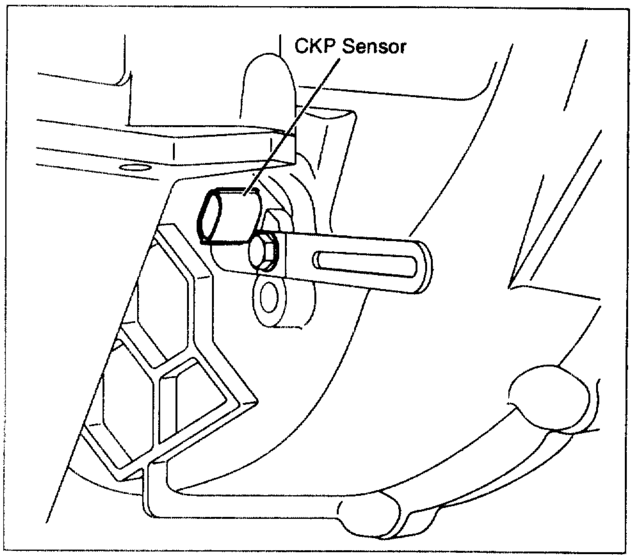
3. Connect the electrical connector to the ECT sensor.
4. Connect the negative battery cable.

CKP (Crank Position) Sensor

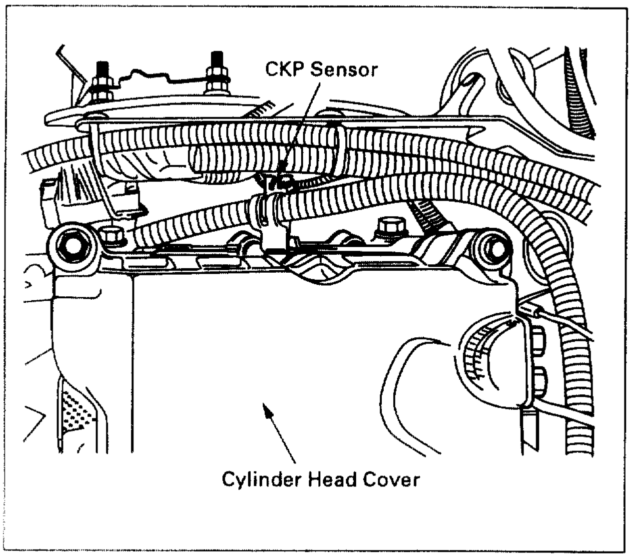
Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector to the CKP sensor.
3. Loosen the CKP retaining bolt.

Transmission Type : M/T



Transmission Type : A/T



4. Remove the CKP sensor with clip.

Inspection Procedure

1. Inspect the sensor for worn or damage.
2. Replace the sensor if it is worn or damaged.

Installation Procedure

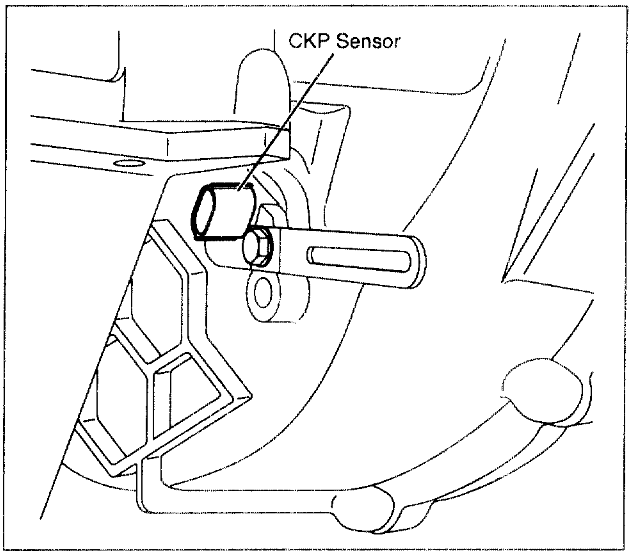
1. Install the CKP sensor.
2. Install the CKP sensor retaining bolt.

Tighten

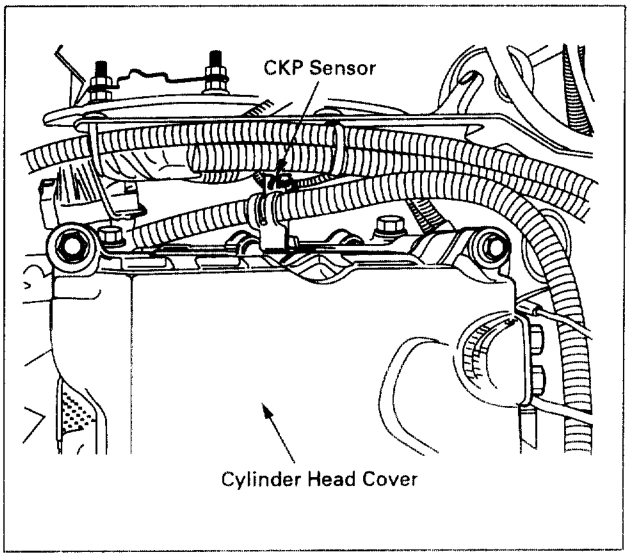
- Tighten the retaining bolt to 5.9 N·m (52 lb·in)

3. Connect the electrical connector to the CKP sensor.

Transmission Type : M/T



Transmission Type : A/T

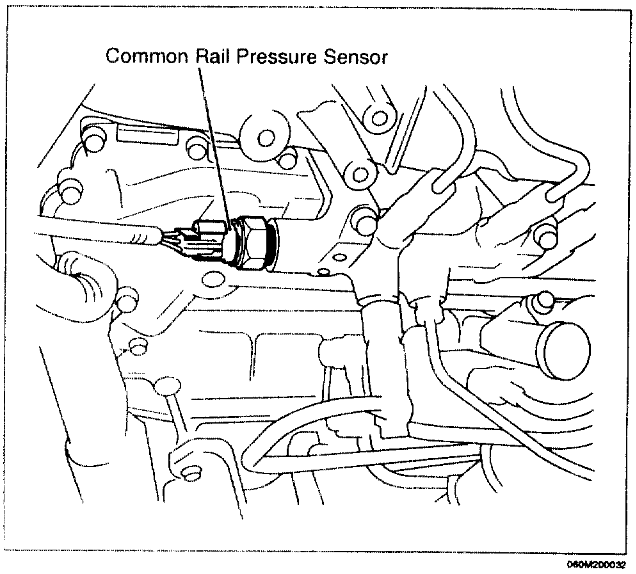


4. Connect the negative battery cable.

Common Rail Pressure Sensor

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the electrical connector to the Common Rail Pressure Sensor.



3. Common Rail Pressure Sensor.

Common Rail Pressure Sensor only type
Remove the Common Rail Pressure Sensor.

Common Rail Pressure Sensor with Gasket type
Remove the Common Rail Pressure Sensor with Gasket.

NOTE

- **A sheet side is not damaged when taking out a gasket.**
- **After removing a common rail pressure sensor, a sensor attachment part is turned downward and a common rail is cleaned.**

Installation Procedure

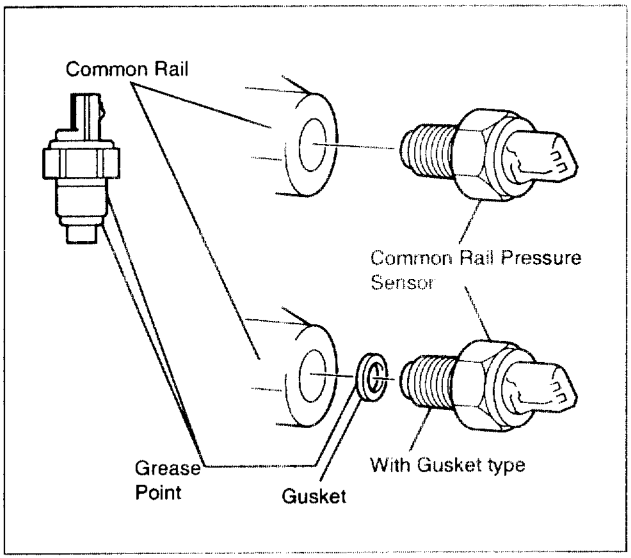
1. Common Rail Pressure Sensor.

Common Rail Pressure Sensor only type
Install the New Common Rail Pressure Sensor.

Common Rail Pressure Sensor with Gasket type
Install the New Common Rail Pressure Sensor with new gasket.

2. Apply grease to the Common Rail Pressure Sensor.

Tighten



Common Rail Pressure Sensor only type

- Tighten the retaining bolt to 98 N·m (72lb·ft)

Common Rail Pressure Sensor with Gasket type

- Tighten the retaining bolt to 83 N·m (61lb·ft)

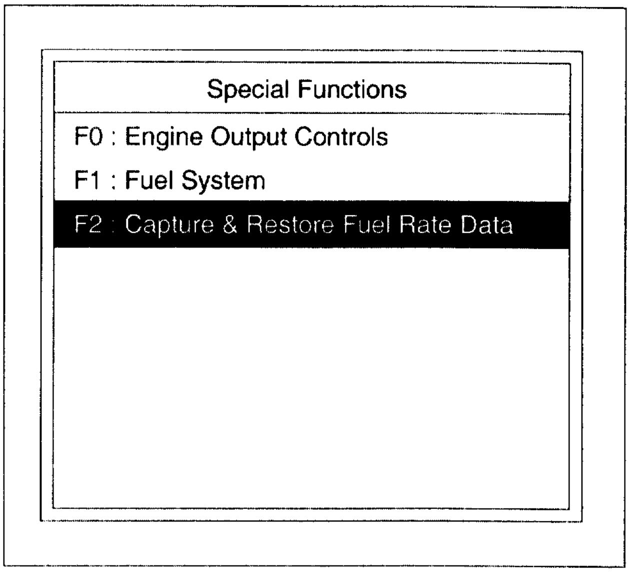
3. Connect the electrical connector to the Common Rail Pressure Sensor.
4. Connect the negative battery cable.

ECM

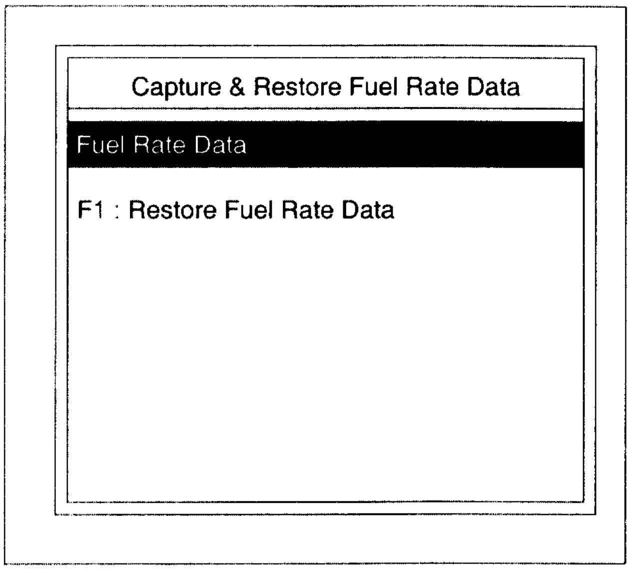
IMPORTANT; The replacement ECM must be stored the capture fuel rate data by scan tool.

FRR ECM Replace procedure

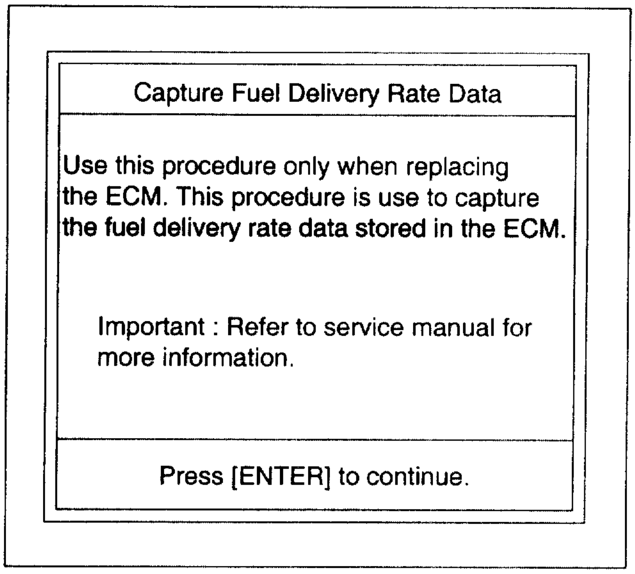
1. Ignition "ON", Engine "OFF".
2. Tech2 "ON".
3. Push "ENTER" key, when the "Tech2" appeared display screen.
4. Operate "△" or "▽" key, put on the hi-light bar to the "F0: Diagnostic".
5. Operate "△" or "▽" key, put on the hi-light bar to the "Model Year(s)", and push "ENTER" key.
6. Select "ISUZU", and push "ENTER".
7. Select "F0: Power Train" and push "ENTER".
8. Select "7.6L L6 LG4" by operating "△" or "▽" key.
9. Select "Automatic".
10. Select "F2: Special Functions" by operating "△" or "▽" key, and push "ENTER" key.
11. Select "F2: Capture & Restore . . . . ." by operating "△" or "▽" key, and push "ENTER" key.



12. Select "F0: Capture Fuel Rate . . . . ." by operating "△" or "▽" key, and push "ENTER" key.



13. The message will be appeared on the Display Screen, and push "ENTER" key few times.
    When the Up Load was successfully, the message "Fuel Delivery rate data capture complete.



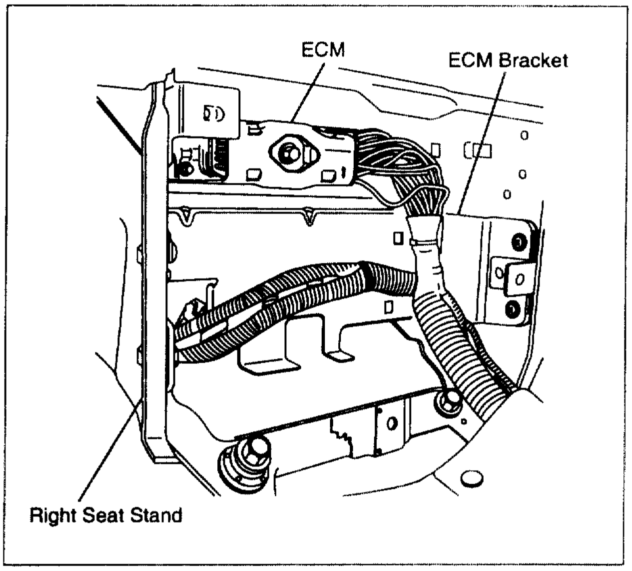
Capture Fuel Delivery Rate Data

Use this procedure only when replacing the ECM. This procedure is use to capture the fuel delivery rate data stored in the ECM.

Important : Refer to service manual for more information.

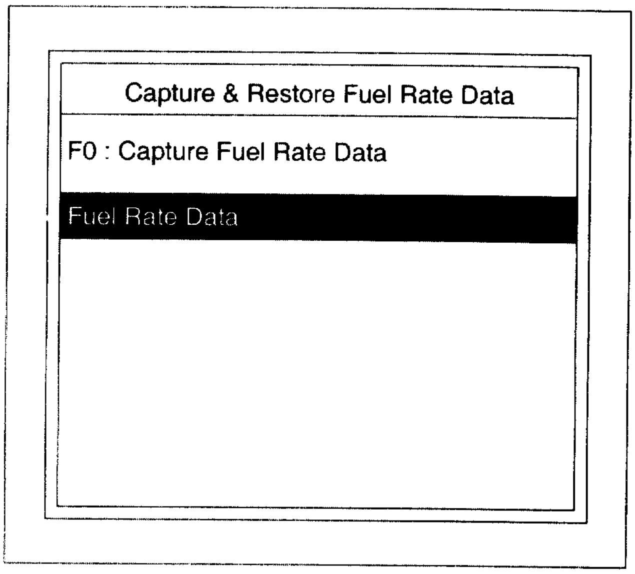
Press [ENTER] to continue.

14. Tech2 "OFF" after this message appeared.
15. Ignition "OFF".
16. It replace ECM to a new on.
    - Push the seat to behind.
    - Remove the four screws from Right seat stand.
    - Pull the ECM straight out with bracket.
    - Loosen the bracket retaining screws at the ECM.
    - Remove the bracket from ECM.
    - Loosen the electrical connector retaining bolt.
    - Disconnect the electrical connector from the ECM.



- Connect the electrical connector at the new ECM.
- Tighten the electrical connector retaining bolt to 2 N·m (17 lb in)
- Install the bracket at the new ECM.
- Install the new ECM.
- Reconnect the electrical connector at the new ECM.
- Tighten the electrical connector retaining bolt to 2 N·m (17 lb in)
- Install the ECM panel the new ECM.
- Install the new ECM.
  Down the cushion of the passenger seat.

17. Ignition "ON", Tech2 "ON".
18. Repeat from Item 3 to 11 (This procedure).
19. Select "F1: Restore Fuel Rate . . . . ." by operating "△" or "▽" key, and push "ENTER" key, and push "ENTER" key.

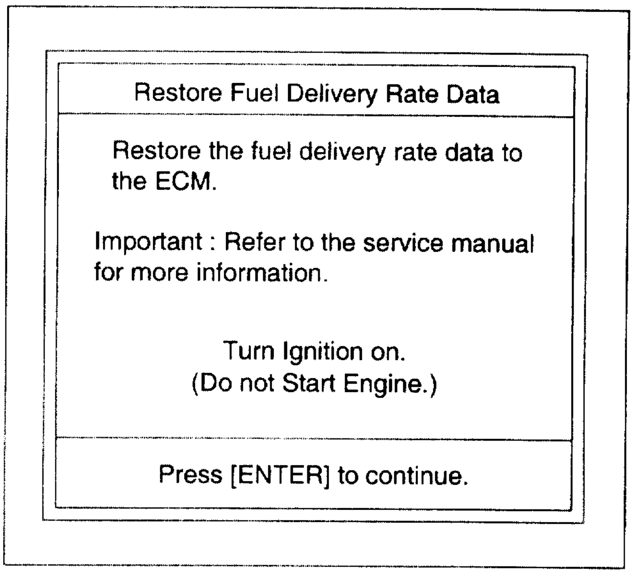


Capture & Restore Fuel Rate Data

F0 : Capture Fuel Rate Data

Fuel Rate Data

20. Push "ENTER" key following message few times, when some message will be appeared.



Restore Fuel Delivery Rate Data

Restore the fuel delivery rate data to the ECM.

Important : Refer to the service manual for more information.

Turn Ignition on.
(Do not Start Engine.)

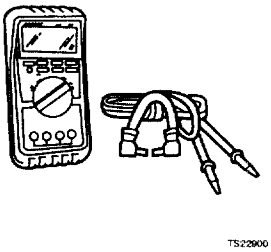
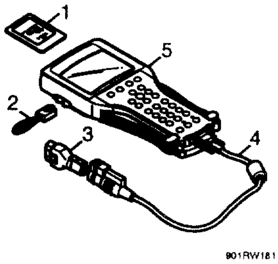
Press [ENTER] to continue.

When the "Fuel delivery rate data storage complete" was appeared, the procedure was successfully completed".

At this moment the "Self Diagnosis Lamp" will be turned off.

NOTE: Unfortunately if you have failed, return to the initial menu screen by operating the "ENTER" key and repeat again.
There is a possibility to be appeared some information in relation to failure.
Also in this case, by operating "EXIT" key, return to the initial menu screen and then repeat from first step.

SPECIAL TOOLS

ILLUSTRATION	**TOOL NO.** TOOL NAME
	**J 39200** High Impedance Multimeter (Digital Voltmeter – DVM)
	(1) PCMCIA Card (2) RS232 Loop Back Connector (3) SAE 16/19 Adapter (4) DLC Cable (5) TECH-2

SECTION 7

TRANSMISSION AND CLUTCH

CONTENTS

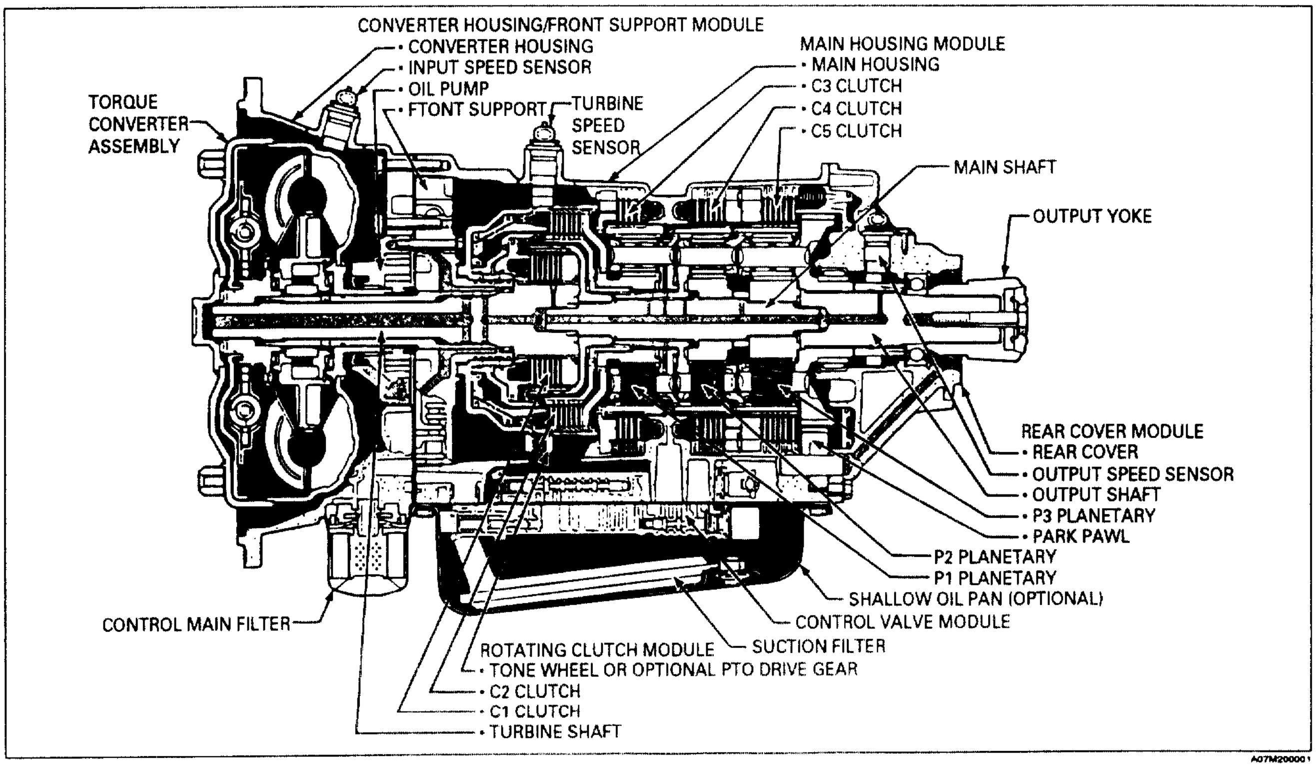
MEMO

SECTION 7A

AUTOMATIC TRANSMISSION (S1000 TRANSMISSION)

CONTENTS

For major repair of the Automatic transmission, refer to the applicable "Allison Transmission Manual."



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DESCRIPTION

The S1000 transmissions are fully automatic, torque-converter driven, electronically controlled transmissions best suited for light-medium duty, on-highway applications.

The S1000 transmissions have park pawls.

A provision to mount a Power Takeoff (PTO) is available on all models. The PTO drive gear is optional.

The S1000 transmissions have up to five forward ranges and one reverse. All clutches are hydraulically-actuated, spring-released, and have automatic compensation for wear. Gearing is helical type, arranged in planetary sets. Electronic controls provide automatic gear selection in each drive range and automatic engagement of the torque converter (lockup) clutch.

ELECTRONIC CONTROL SYSTEM

The 1000 Series control system consists of five major components connected by customer-furnished wiring harnesses — Transmission Control Module (TCM), engine throttle position direct electronic communication, three speed sensors, NSBU switch, and control valve module (which contains solenoid valves and a pressure switch module). The throttle position engine-to-transmission communication link, speed sensors, pressure switch module, and NSBU switch transmit information to the TCM. The TCM processes this information and then sends signals to actuate specific solenoids located on the control valve module in the transmission. These solenoids control both oncoming and offgoing clutch pressures to provide closed-loop shift control by matching rpm during a shift to a previously established desired profile that is programmed into the TCM.

The S1000 electronic control system has the "adaptive shifting" feature. Adaptive shifting helps optimize shift quality by monitoring critical characteristics of clutch engagement and making on-going adjustments to improve subsequent shifts. The transmission shift calibration is based on several different types of shifts, e.g., full throttle, part throttle, closed throttle — upshifts, downshifts, etc. Each shift is associated with specific speed and throttle position parameters. In order to optimize each type of shift for normal driving, shift controls must experience operation and shifting in a wide variety of operating conditions.

A "drive in" period under varied conditions is required before the Adaptive Controls can be expected to optimize each and every shift. In general, shift quality will begin to converge to their "adapted" level after five typical shifts of a particular shift type.

TORQUE CONVERTER

The torque converter consists of three elements — pump, turbine, and stator. The pump is the input element and is driven directly by the engine. The turbine is the output element and is hydraulically driven by the pump. The stator is the reaction (torque multiplying) element. When the pump turns faster than the turbine, the torque converter is multiplying torque. When the turbine approaches, the speed of the pump, the stator starts to rotate with the pump and turbine. When this occurs, torque multiplication stops and the torque converter functions as a fluid coupling.

All 1000 Series torque converters contain a torque converter (lockup) clutch. When engaged, this clutch causes the torque converter pump and turbine to be locked together, thus enabling them to rotate in unison at engine speed. This condition, commonly referred to as "torque converter clutch operation," thus provides direct drive through the transmission. This type of operation maximizes engine braking and enhances fuel economy. The torque converter (lockup) clutch is regulated by the shift controls to engage automatically. The torque converter clutch releases at lower speeds or when the TCM detects conditions requiring it to be released. The torque converter clutch contains a damping mechanism which reduces the transmittal of engine-induced torsional vibrations into and beyond the transmission.

PLANETARY GEARS AND CLUTCHES

A series of three helical planetary gear sets and shafts provides the mechanical gear ratios and direction of travel for the vehicle. The planetary gear sets are controlled by five multiplate clutches that work in pairs to produce up to five forward speeds and one reverse speed. The clutches are applied and released hydraulically in response to electronic signals from the TCM to the appropriate solenoids.

COOLER CIRCUIT

The transmission fluid is cooled by a remote-mounted oil cooler. The bottom of the transmission torque converter housing provides for the direct mounting of a control main filter and includes two ports to facilitate the attachment of the oil cooler lines.

LUBRICATION DETAILS

For information on lubrication intervals and type of lubricant used in automatic transmission, refer to MAINTENANCE AND LUBRICATION (SEC. 0B).

INSPECTION

Clean and inspect the exterior of the transmission at regular intervals. Severity of service and operating conditions determine the frequency of these inspections. Inspect the transmission for:

- loose bolts — transmission and mounting components
- fluid leaks — repair immediately
- loose, dirty, or improperly adjusted throttle sensor or shift selector linkage
- damaged or loose hoses
- worn, frayed, or improperly routed electrical harnesses
- worn or frayed electrical connections
- worn or out-of-phase driveline U-joints and slip fittings
- clogged or dirty oil vent (breather)

Vehicle Inspection

Check the vehicle cooling system occasionally for evidence of transmission fluid which would indicate a faulty oil cooler.

TRANSMISSION FLUID

Before diagnosis of any transmission complaint is attempted, there must be understanding of fluid checking procedures and what appearance the fluid should have. Many times a transmission malfunction can be traced to low fluid level or improper reading of the dipstick. Due to the transmission fluid that is now being used it may appear to be darker and have a stronger odor. This is normal, and not a positive sign of required maintenance or transmission failure.

1. **Air Bubbles**
   When the dipstick is removed, it should be noted whether the fluid is free of air bubbles or not. Fluid with air bubbles gives an indication of an air leak in the suction lines, which can cause inconsistent operation and slipping.
2. **Engine Coolant Leakage**
   If engine coolant leaks into the transmission, the fluid will be a milky pink color, and can cause swelling of nylon parts. The transmission must be completely disassembled, inspect and cleaned. All traces of engine coolant, and varnish deposits resulting from engine coolant contamination must be removed.
3. **Metal Particles**
   Metal particles in the fluid indicates damage has occurred in the transmission. When these particles are found in the oil pan, the transmission must be disassembled and closely inspected to find the source. Also clean all internal and external fluid circuits where particles could lodge.

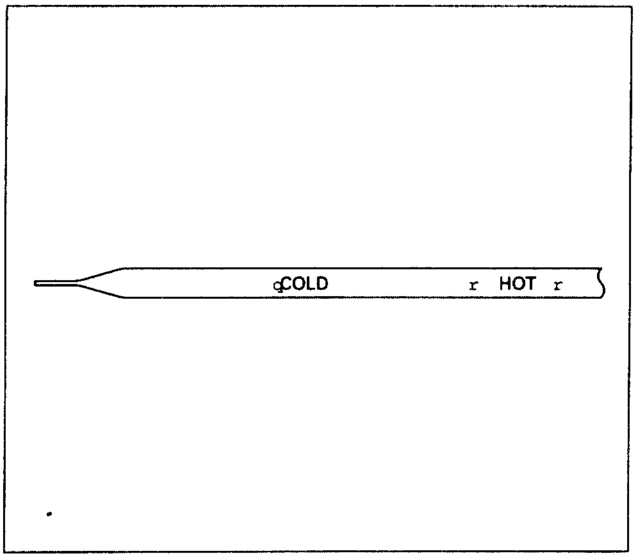
FLUID LEVEL

Transmission fluid cools, lubricates, and transmits hydraulic power. Always maintain proper fluid level. If fluid level is too low, the torque converter and clutches do not receive an adequate supply of fluid and the transmission overheats. If the level is too high, the fluid aerates — causing the transmission to shift erratically and overheat. Fluid may be expelled through the breather or dipstick tube when the fluid level is too high.

Hot Check

1. Operate the transmission in D (Drive) range until normal operating temperature is reached:
   - — sump temperature 71°C - 93°C (160°F - 200°F)
   - — converter-out temperature 82°C - 104°C (180°F - 220°F)
   - — If a transmission temperature gauge is not present, check fluid level when the engine water temperature gauge has stabilized and the transmission has been operated under load for at least one hour.

2. Bring the vehicle to a complete stop on a level surface using the service brake.
3. Ensure that the engine is at low idle rpm.
4. Put the transmission in P (Park).
5. Engage the P (Park) range by slowly releasing the service brake.
6. Apply the emergency brake and/or parking brake, if present, and make sure it is properly engaged.
7. Chock the wheels and take any other steps necessary to keep the vehicle from moving.
8. With the engine running, remove the dipstick from the tube and wipe the dipstick clean.
9. Insert the dipstick into the tube and remove. Check fluid level reading. Repeat the check procedure to verify the reading.
10. If the fluid level is not within the "HOT RUN" band, add or drain as necessary to bring the fluid level to within the "HOT RUN" band.



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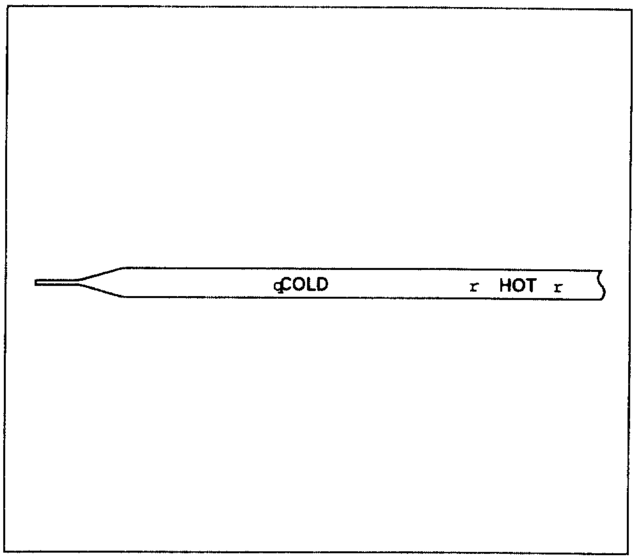
Cold Check

1. Bring the vehicle to a complete stop on a level surface using the service brake.
2. Ensure that the engine is at low idle rpm.
3. Put the transmission in P (Park).
4. Engage the P (Park) range by slowly releasing the service brake.
5. Apply the emergency brake and/or parking brake, if present, and make sure it is properly engaged.

- Chock the wheels and take any other steps necessary to keep the vehicle from moving.
- Run the engine for at least one minute. Apply the service brakes and shift to D (Drive), then to N (Neutral), and then shift to R (Reverse) to fill the hydraulic system. Finally, shift to P (Park) and allow the engine to idle (500 – 800 rpm). slowly release the service brakes.
- With the engine running, remove the dipstick from the tube and wipe the dipstick clean.
- Inspect the dipstick into the tube and remove. Check the fluid level reading. Repeat the check procedure to verify the reading.
- If the fluid level is within the "COLD" band, the transmission may be operated until the fluid is not enough to perform a "HOT" check. If the fluid level is not within the "COLD" band, add or drain as necessary to bring it to the middle of the "COLD" band.



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- Perform a hot check at the first opportunity after the normal operating sump temperature of 71°C – 93°C (160°F – 200°F) is reached.

GENERAL TROUBLESHOOTING INFORMATION

CHECK TRANS Light

The CHECK TRANS light is illuminated briefly during vehicle start-up as a bulb check.

> ***NOTE:***
> The CHECK ENGINE light may serve the CHECK TRANS function for vehicles which are compliant to industry On Board Diagnostics II (OBD-II) requirements.

When the light is "ON" shifts may be restricted by the Transmission Control Module (TCM) as follows:

> ***WARNING:***
> If ignition is turned "OFF" and then "ON" while the CHECK TRANS light is displayed, the transmission may remain in neutral until the code is cleared. Leave ignition "ON" until you are in a safe place to stop.

- When the TCM senses abnormal conditions.
- The transmission may be locked in the range it was in when the problem was detected.
- The transmission may continue to operate with inhibited shifting.
- The TCM may not respond to shift selector requests.
- Direction changes and shifts from neutral-to-range may not occur.
- Whenever the CHECK TRANS light is displayed, the TCM logs a diagnostic code in memory. These diagnostic codes can be accessed through the PC-based TransPro® diagnostic system.

> ***NOTE:***
> Diagnostic codes can be logged without illuminating the CHECK TRANS light. This occurs when the TCM senses a problem, but determines the problem won't cause immediate transmission damage or dangerous performance.

Range Inhibit Indicator

Some conditions detected by the TCM cause the transmission to be locked in one range. When this occurs, the torque converter clutch is automatically disengaged. Shifts out of N (Neutral) may be inhibited.

At the same time these events occur, RANGE INHIBITED light, is illuminated. This notifies the driver that shifting is inhibited and the shift selector may not respond to shifts requested.

Personal Computer (PC)-Based Diagnostic System (TransPro®)

Control system diagnostics are done using a "Windows" PC operating system and interface/software which is available through Allison Transmission tool sources and extension harness (J-43890). The PC is a receiver/transmitter/display medium that allows the service technician to communicate with the TCM. Typical troubleshooting activities performed are installation checkout and diagnostic code retrieval.

Consult the Users Manual which accompanies the TransPro® interface/software diagnostic tool. The users manual contains the information for performing the following:

- Display (retrieve) diagnostic trouble codes (DTCs) Transmission diagnostic codes begin with P0, P1, U1, or U2 followed immediately by three additional numbers. For a complete list of codes and more detailed information, refer to TS3192, Electronic Troubleshooting Manual.
- Clear diagnostic codes
- Obtain transmission data such as input speed or sump fluid temperature
- Do solenoid test
- Do clutch diagnostics (including torque converter clutch)

Troubleshooting When No Diagnostic Codes Are Present

- Always start with the basics:
  - — Make sure the shifter is in the appropriate range.
  - — Check the fluid level.
  - — Make sure batteries are properly connected and charged.
  - — Make sure throttle is closed and engine speed is below 900 rpm.
  - — Make sure electrical connections are properly made.
  - — Check support equipment for proper installation and operation.
- If the shifting process is rough, give the shifts time to adapt to "converged" state before assuming there is a problem.
- Refer to "General Troubleshooting of Performance Complaints."
  - — These troubleshooting charts list a variety of conditions that may or may not relate to the Electronic Control.
  - — Some conditions and suggested checks include mechanical and hydraulic items.
- If the troubleshooting charts refer you to an Electronic Control check, use the diagnostic code troubleshooting information that best applies to the situation.

Troubleshooting Intermittent Diagnostic Codes

Intermittent codes are a result of conditions which are not always present.

When conditions causing the code exist, the code is logged in memory. The code stays in memory until it is manually cleared or cycled out.

When intermittently occurring codes exist, check for the following items:

- Dirty, damaged or corroded harness connectors and terminals
- Terminals not fully seated in connectors
- Damaged harnesses (due to poor routing, chafing, excessive heat, tight bends, etc.)
- Improperly mounted electronic control components
- Poor connector seals (where applicable)
- Exposed harness wires
- EMI generating components and accessories
- Loose ground connections

To help locate intermittents, it sometimes helps to place the appropriate tester on the suspect component or circuit and simulate operating conditions — wiggle, pull, bump, and bend while watching the tester.

GENERAL TROUBLESHOOTING OF PERFORMANCE COMPLAINTS

Make the following general checks before beginning specific troubleshooting, removing the transmission, or removing attached components.

- Are wheel chocks in place?
- Are there active diagnostic codes?
- Is the lever shift selector leer in N (Neutral) to allow starting the engine?
- Is the battery properly connected and charged?
- Is the fluid level correct?
- Is voltage to the TCM correct?
- Is the engine properly tuned?
- Is fuel flow to the engine correct?
- Is air flow to the cooler and radiator unrestricted?
- Is the driveline properly connected?
- Are there signs of fluid leakage under the vehicle? What is the origination point?
- Are hydraulic connections correctly made and not leaking?
- Is vehicle acceleration from a stop changed?
- Are electrical connections correctly made?
- Are there any other obvious vehicle or transmission problems?

After making these general checks use the various sections of this manual to isolate the listed problems. The following charts address specific vehicle complaints. Some complaints involve diagnostic codes, so all troubleshooting checks should involve checking the system for diagnostic codes.

Table 6-1. Troubleshooting Performance Complaints

Problem	Possible Cause	Suggested Remedy
VEHICLE WILL NOT START (ENGINE WILL NOT CRANK)	Lever shift selector not in neutral or Park	Select N (Neutral) and restart
	Dead battery	Recharge battery
	Disconnected battery	Reconnect battery
	Faulty starter circuit	Repair vehicle starter circuit
	Faulty NSBU switch	Replace NSBU switch
	Misadjusted NSBU switch	Adjusted NSBU switch
	Faulty wiring in vehicle neutral start circuit	Repair wiring
	7-pin connector not properly seated on NSBU switch	Properly install connector
CHECK TRANS LIGHT WILL NOT GO OUT AT START-UP	TCM HAS LOGGED A DTC	INSTALL DIAGNOSTIC TOOL TO DETERMINE IF DTC IS PRESENT
A. Vehicle Drives Normally	Faulty CHECK TRANS light, relay, or circuit.	Replace relay or repair circuit
B. Vehicle Does Not Drive Normally	Inappropriate calibration in TCM	Calibrate TCM via PCCS
	Faulty harness	Repair harness (see Allison TS3192 Electronic Troubleshooting)
	Faulty TCM	Replace the TCM
CHECK TRANS LIGHT FLASHES INTERMITTENTLY	Intermittent power to TCM	Check input power to the TCM and correct if necessary
	Faulty vehicle wiring	Repair vehicle wiring
	Loose wiring to CHECK TRANS light	Repair wiring
	Faulty or incorrect ground wire attachment	Repair ground circuit
	Intermittent opening in Circuit 125	Repair Circuit 125
NO CHECK TRANS LIGHT AT IGNITION	Faulty light bulb or socket	Replace light bulb or socket
	Incorrect wiring to and from CHECK TRANS light bulb	Repair wiring (see TS3192 Electronic Troubleshooting)
	Faulty vehicle wiring	Repair vehicle wiring
	Circuit 125 open	Repair circuit 125
	Faulty TCM	Replace TCM
	TCM connected to battery power instead of ignition power	Be sure TCM power is connected to ignition sense, circuits 102 and 104

Table 6-1. Troubleshooting Performance Complaints (cont'd)

Problem	Possible Cause	Suggested Remedy
TRANS MISSION WILL NOT SHIFT TO FORWARD OR REVERSE (STAYS IN NEUTRAL)	Engine rpm too high	Reduce engine rpm (it may be necessary to reselect Neutral also, and then D or R)
	Low fluid level	Add fluid to proper level
	Faulty throttle signal from engine	Correct engine throttle signal
	Shift selector is not functioning properly	Repair shift selector
	Speed sensor(s) not function properly	Repair or replace speed sensor(s) or circuitry
	Mechanical failure to C5 clutch	Repair transmission
	Mechanical failure in transmission torque converter, shafts, or planetaries	Repair transmission
	Low pressure	Repair transmission
	Faulty wiring in TCM Input/ Output function circuits	Correct circuit wiring
TRANSMISSION WILL NOT STAY IN FORWARD OR REVERSE	Auto-neutral for PTO circuit (input function) faulty	Repair quick-to-neutral circuit
	Low fluid	Adjust fluid level
	Leaking at solenoid assembly	Rebuild solenoid assembly (see Allison transmission Service Manual)
	Low pressure	Repair transmission
	Faulty solenoid — leaking	Replace solenoid
TRANSMISSION WILL NOT MAKE A SPECIFIC SHEET	Low engine power	Correct engine problem, see Engine Service Manual
	Extreme fluid temperature	Inspect cooling system and fluid level
	Faulty speed sensor/circuit	Repair circuit or replace speed sensor(s)
	Faulty temperature sensor/circuit	Check for temperature reading which inhibits shifts
	Incorrect calibration	Install correct calibration
	Faulty or misadjusted shift selector	Repair shift selector
TRANSMISSION DOES NOT SHIFT PROPERLY (ROUGH SHIFTS, SHIFTS OCCURRING AT TOO LOW OR TOO HIGH SPEED)	Engine idle speed too fast (neutral to range shift)	Adjust engine idle speed (refer to Vehicle Service Manual)
	Faulty throttle sensor/circuit	Refer to Allison TS3192 Electronic Troubleshooting
	Faulty or sticking bleed ball in C1 position housing	Replace C1 piston housing
	Excessive clutch running clearance	Rebuild transmission and adjust clearances
	Incorrect shift calibration for vehicle	Install correct calibration

Table 6-1. Troubleshooting Performance Complaints (cont'd)

Problem	Possible Cause	Suggested Remedy
TRANSMISSION DOES NOT SHIFT PROPERLY (ROUGH SHIFTS, SHIFTS OCCURRING AT TOO LOW OR TOO HIGH SPEED) (cont'd)	Instrument panel tachometer incorrect	Repair or replace tachometer
	Incorrect calibrated electronic speedometer	Calibrate electronic speedometer
	Faulty speed sensor/circuit	Repair circuit or replace speed sensor
	Degraded fluid	Change transmission fluid and filter
	Loose speed sensor	Tighten speed sensor retaining bracket bolt
	Incorrect fluid level	Correct fluid level
	Shift adaptives not converged	Drive vehicle until shift adaptives are converged
	Low main pressure	Repair transmission
	Intermittent problems	Check wiring harnesses and connectors (see Allison TS3192 Electronic Troubleshooting)
	Loose or damaged speed gear	Tighten output flange bolt or replace speed gear
	Sticking valves in control valve body	Overhaul control valve body assembly
	Leaking trim solenoids	Repair or replace trim solenoids
	Incorrect calibration	Install correct calibration
ABNORMAL ACTIVITIES OR RESPONSES		
A. Excessive Creep in First and Reverse Gears	Engine idle speed too high	Adjust to correct idle speed
B. Vehicle Moves Forward in Neutral	C1 clutch failed or not released	Rebuild C1 clutch (refer to Allison transmission Service Manual)
C. Vehicle Moves Backward in Neutral	C3 clutch failed or not released	Rebuild C3 clutch (refer to Allison transmission Service Manual)
EXCESSIVE FLARE — ENGINE OVERSPEED ON FULL-THROTTLE UPSHIFTS	Incorrect calibration	Install correct calibration
	Incorrect fluid level	Add fluid to proper level
	Sticking valves in control valve body assembly	Rebuild control valve body assembly
	Low main pressure	See Low Pressure section
	Leaking trim solenoid	Repair or replace trim solenoids
	Erratic speed sensor signal	See speed sensor DTCs
	Piston seals leaking or clutch plates slipping in range involved	Overhaul transmission (refer to Allison transmission Service Manual)

Table 6-1. Troubleshooting Performance Complaints (cont'd)

Problem	Possible Cause	Suggested Remedy
	RANGE CLUTCH TROUBLESHOOTING SECTION	
EXCESSIVE SLIPPAGE AND CLUTCH CHARTER	Incorrect calibration	Install correct calibration
	Incorrect speed sensor readings	See speed sensor DTCs
	Incorrect fluid level	Correct fluid level
	Main pressure low	Refer to Allison Service Manual
	TCC clutch not applied	Inspect torque converter clutch system wiring, pressure, and controls; repair as necessary (refer to Allison transmission Service Manual)
A. Ranges 1, 2, 3, 4 Only	C1 clutch slipping, leaks at splitline gasket, leaks at rotating clutch seals, leaks at piston seals, C1 clutch plates worn	Inspect control module gasket, C1 clutch plates, and piston and rotating seals; replace/rebuild as necessary (refer to Allison transmission Service Manual)
B. Ranges 4, 5 Only	C2 clutch slipping, leaks at splitline gasket, leaks at rotating clutch seals, leaks at piston seals, C2 clutch plates worn	Inspect control module gasket, C2 clutch plates, and piston and rotating seals; replace/rebuild as necessary (refer to Allison transmission Service Manual)
C. Ranges 3, 5, R Only	C3 clutch slipping, leaks at piston seals, C3 clutch plates worn	Inspect C3 clutch plates and piston seals; replace/rebuild as necessary (refer to Allison transmission Service Manual)
D. Range 2 Only	C4 clutch slipping, leaks at piston seals, C4 clutch plates worn	Inspect C4 clutch plates and piston seals; replace/rebuild as necessary (refer to Allison transmission Service Manual)
E. Ranges 1, R Only	C5 clutch slipping, leaks at piston seals, C5 clutch plates worn	Inspect C5 clutch plates and piston seals; replace/rebuild as necessary (refer to Allison transmission Service Manual)
	LOW PRESSURE SECTION	
A. Low Main Pressure in All Ranges	Incorrect fluid level	Correct fluid level
	Plugged or faulty suction filter	Clean or replace oil suction filter element
	Main pressure regulator valve sticking	Overhaul control module assembly (refer to Allison transmission Service Manual)
	Leaking solenoids in control valve body assembly	Repair or replace solenoids
	Main pressure regulator valve spring weak, broken, or missing	Check spring and replace if necessary (refer to Allison transmission Service Manual)

Table 6-1. Troubleshooting Performance Complaints (cont'd)

Problem	Possible Cause	Suggested Remedy
	LOW PRESSURE SECTION	
A. Low Main Pressure in All Ranges (cont'd)	Control module body leakage (separator plate not flat, separator plate gasket leakage, loose control valve body bolts)	Replace or rebuild control module assembly. Care should be taken when removing and labeling shift springs (refer to Allison transmission Service Manual)
	Faulty or incorrect fluid pressure gauge	Repair or replace gauge
	Oil pump worn or damaged	Replace or rebuild oil pump (refer to Allison transmission Service Manual)
	Leak in suction circuit	Check suction circuit for leaking seal, gasket, or mating surface
B. Main Pressure Low in Specific Ranges, Normal Pressure in Other Ranges	Seal leak	See Service Manual for procedure to replace seals that are causing low pressure in a particular range
C. Low Lubrication Pressure	Incorrect fluid level	Correct fluid level
	Plugged suction filter	Change filter
	Plugged cooler circuit filter	Change filter
	Excessive internal fluid leakage	Check other pressure (above items); also check control module mounting bolts; lubrication valve and spring (refer to Allison transmission Service Manual); converter housing to separator plate gasket
	Cooler lines restricted or leaking	Check for kinks, leakage; reroute or replace lines as necessary
	Lubrication regulator valve sticking	Clean or replace regulator valve
	Converter relief valve sticking	Clean or replace converter relief valve
	Cooler plugged	Clean or replace cooler
	Faulty gauge	Repair or replace gauge
ABNORMAL STALL SPEEDS (Stall In First Range — Fifth Range)		
A. High Stall Speeds	Not in gear	Select D (Drive)
	Low fluid level, aerated fluid	Add fluid to proper level
	Faulty torque converter	Replace torque converter
	Incorrect torque converter	Replace torque converter (refer to Allison transmission Service Manual)

Table 6-1. Troubleshooting Performance Complaints (cont'd)

Problem	Possible Cause	Suggested Remedy
ABNORMAL STALL SPEEDS (Stall In First Range — Fifth Range)		
A. High Stall Speeds (cont'd)	Clutch pressure low (see Paragraph 6-5)	Refer to Allison TS3192 Electronic Troubleshooting
	C1 or C5 clutch slipping. **Note**: Use the diagnostic tool to check turbine speed	Rebuild C1 or C5 clutch (refer to Allison transmission Service Manual)
	Higher power engine	Confirm proper engine match
B. Low Stall Speeds	Engine not performing efficiently (may be due to plugged or restricted injectors, high altitude conditions, dirty air filters, out of time, throttle linkage, electronic engine controls problem)	Refer to Engine Section in this manual
	Stall speeds of 33 percent of normal implies freewheeling stator	Replace converter assembly (refer to Allison transmission Service Manual)
	Engine smoke controls	Compare lugback vs. static stall speed
	Incorrect torque converter	Install correct torque converter (refer to Allison transmission Service Manual)
OVERHEATING IN ALL RANGES	Aerated fluid — incorrect fluid level	Adjust fluid to proper level, check for defective pump
	Air flow to cooler obstructed	Remove air flow obstruction
	Engine overheat	Correct overheat situation
	Inaccurate temperature gauge or sending unit	Replace gauge and/or sending unit
	Inaccurate sump temperature sensor	Replace Pressure Switch Manifold (PSM) or internal harness
	Excessive cooler circuit pressure drop	Check for plugged cooler, collapsed hose
	Transmission cooler lines reversed	Connect cooler lines properly (oil and water should flow in opposite directions)
	Fluid cooler lines restricted	Remove restrictions, clean or replace lines
	Torque converter (wrong converter, no torque converter clutch, stuck stator, or slipping stator)	Replace or repair converter assembly (refer to Allison transmission Service Manual) **Note**: Stuck stator will not allow cool down in neutral
	Cooler flow loss due to internal transmission leakage	Overhaul transmission (refer to Allison transmission Service Manual)

Table 6-1. Troubleshooting Performance Complaints (cont'd)

Problem	Possible Cause	Suggested Remedy
FLUID COMES OUT OF THE FLUID FILL TUBE AND/OR BREATHER	Dipstick loose	Tighten cap, replace if necessary
	Fluid level too high	Drain to proper level
	Fluid level too low	Add fluid to proper level
	Breather stopped up — clogged	Clean or replace breather (refer to Allison transmission Service Manual)
	Fluid contaminated with foreign liquid	Drain and replace fluid. Locate and fix source of additional fluid
	Dipstick or fill tube seal worn	Replace seals or dipstick
	Incorrect dipstick marking	Calibrate dipstick (refer to Allison transmission Service Manual)
NOISE OCCURRING INTERMITTENTLY (BUZZING)	Low fluid level	Add fluid to proper level
	Air leak in oil suction screen canister	Replace oil suction screen canister (refer to Allison transmission Service Manual)
	Clogged suction filter	Replace filter
	Aerated fluid causes noisy pump	Correct fluid level
	Low main pressure causes main regulator valve to oscillate	See Service Manual
LEAKING FLUID (TRANSMISSION OUTPUT)	Faulty or missing seal at output flange	Install new lip-type seal in rear of transmission housing (refer to Allison transmission Service Manual)
	Machine lead on output flange seal surface	Replace flange
	Rear cover porosity	Repair or replace cover
	Flange worn at seal surface	Replace flange
	Insufficient sealant around seal OD	Replacing seal
	Damaged or missing output bolt washer seal	Replace output bolt sealing washer
	Damaged, missing, or loose output flange bolt	Replace and/or torque output flange bolts
	Front seal leaks	Replace front seal
TRANSMISSION INPUT	Manifold gasket leaks	Replace manifold gasket
	Front support bolt seals leaking	Replace bolt seals
	Converter leaks	Check converter seals, cracked converter pump tangs, converter cover, or converter housing porosity; replace parts as required (refer to Allison transmission Service Manual)
	Spin-on filter leaking	Replace filter

Table 6-1. Troubleshooting Performance Complaints (cont'd)

Problem	Possible Cause	Suggested Remedy
TRANSMISSION INPUT (cont'd)	Main pressure plug leak	Replace or torque main pressure plug
	Pump bushing shows excessive wear	Rebuild and repair pump
DIRTY FLUID	Failure to change fluid and filters	Change fluid and install new filters
	Excessive heat	Check cooling system for restrictions and proper capacity
	Substandard fluid	Use recommended fluid
	Clutch/transmission failure	Overhaul transmission (refer to Allison transmission Service Manual)

ON-VEHICLE SERVICE

DRAIN AND FILL

Removal

1. Disconnect the dipstick.
2. Remove the drain plug.
3. Drain transmission fluid.
    - Catch the fluid in a pan.

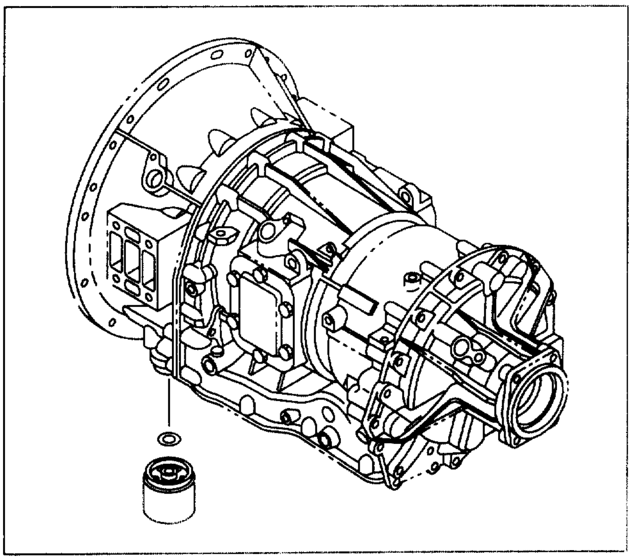
Installation

1. Install the drain plug and a new gasket.
2. Fill new transmission fluid.
    - Refer to "Lubrication" in this section for the proper amount.
3. Insert the dipstick.
    - Check the fluid level. Refer to "Fluid Level" in this section.

FILTER

Removal

1. Remove the control-main filter by rotating it in the counterclockwise direction. Use a standard strap-type filter wrench.
2. Remove the magnet from the filter attachment tube or from the top of the filter element.
    - Refer to "Lubrication" in this section for the proper amount.



Clean

Clean any metal debris from the magnet. Report any metal pieces larger than dust to your maintenance personnel.

Installation

1. Reinstall the magnet onto the filter attachment tube.
2. Lubricate the gasket on the control-main filter with transmission fluid.
3. Install, by hand, the control-main filter until the gasket on the control-main filter touches the converter housing or cooler manifold.

CAUTION:

Turning the control-main filter more than ONE FULL TURN after gasket contact will damage the filter.

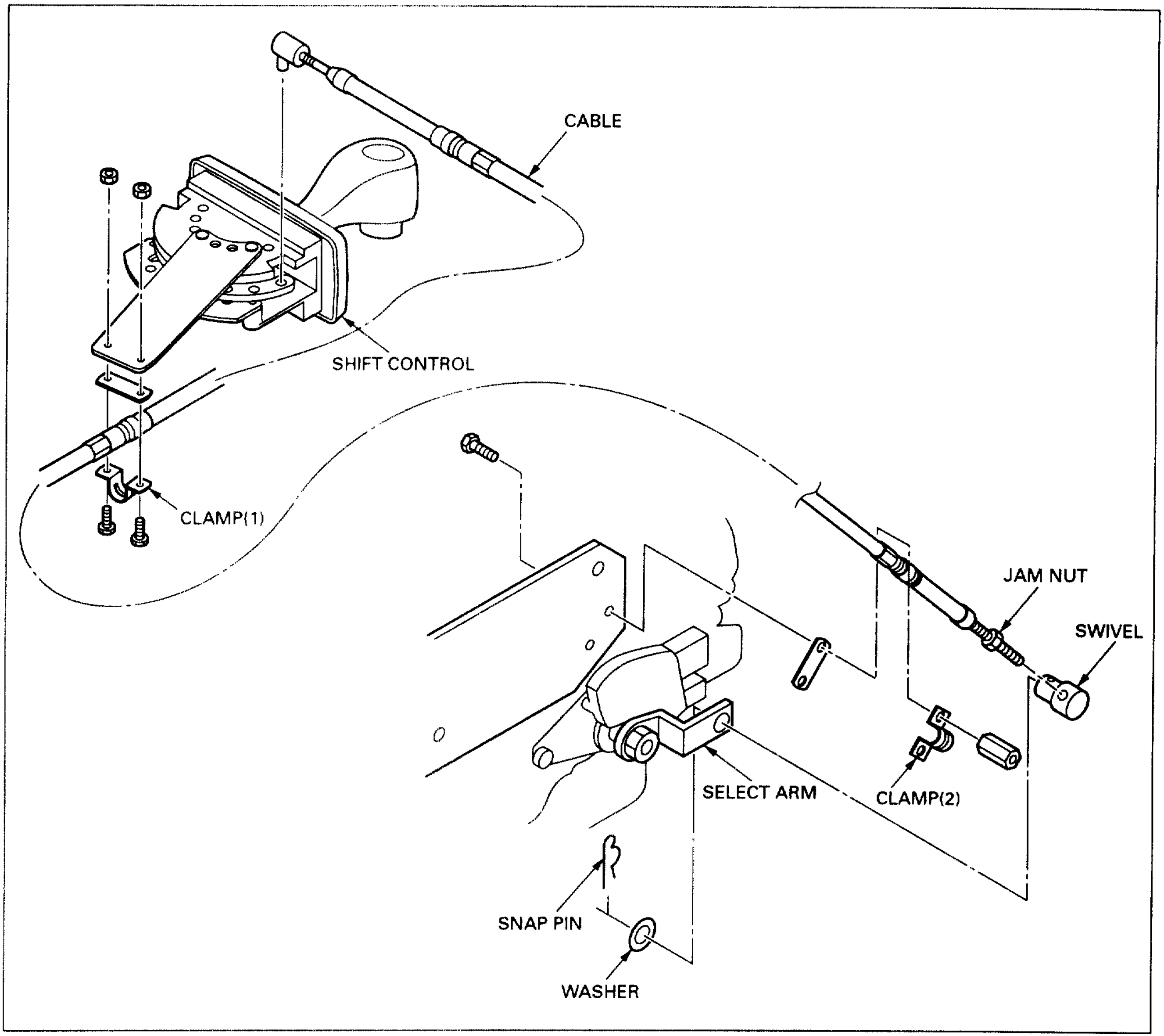
4. Turn the filter ONE FULL TURN ONLY after gasket contact.

Refill Transmission

The amount of refill fluid is less than the amount used for the initial fill. Fluid remains in the external circuits and transmission cavities after draining the transmission.

After refill, check the fluid level using the FLUID LEVEL section of this Manual.

SHIFT CABLE



Removal

1. Remove the clamp (1) from the shift control.
2. Disconnect the cable from the shift control.
3. Remove the clamp (2) from the bracket.
4. Disconnect the snap pin, washer and the cable with the swivel from the select arm.
5. Remove the swivel from the cable.

Clean

- Clean all metal parts using solvent.
- Clean the cable using a water dampened cloth.

Inspect

- Check all parts for wear and damage.
- Check the cable for kinks and stripped threads.
- Check the cable for smooth operation.

Installation

1. Connect the cable into the shift control.
   - Place the shift lever in the neutral position before installing the cable.
2. Install the clamp (1) and cable.
   Tighten the nuts to the specified torque.

   Torque: 7.0N·m (61 lb·in)
3. Install the cable and clamp (2).
   Tighten the nuts to the specified torque.

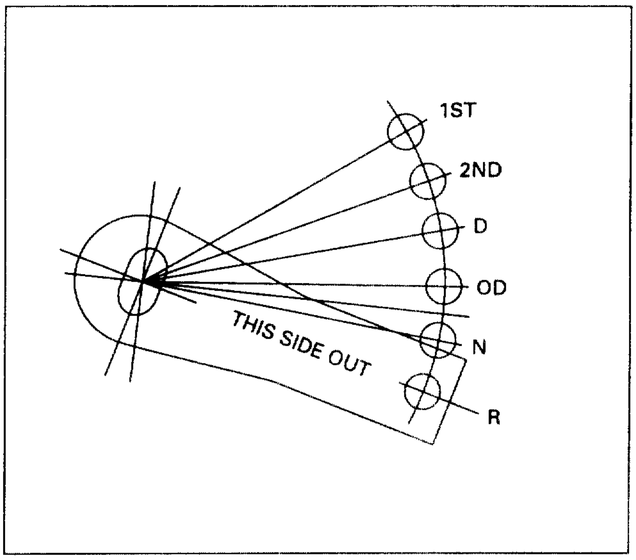
   Torque: 8N·m (69 lb·in)
4. Install the swivel onto the cable.
   - Place the shift lever in the neutral position.
   - Place the select arm in the neutral position.

5. Connect the cable with swivel into the select arm and install the washer and snap pin.

Adjust

1. Remove the swivel from the select arm.
2. Place the shift lever and the select arm in the neutral positions.
3. Turn and move the swivel up or down the cable as needed until the swivel fits into the select arm without moving the cable. Tighten the jam nut.

   Torque: 9N·m (78 lb·in)
4. Install snap pin and washer into the swivel.



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FLUSHING THE TRANSMISSION COOLER AND LINES

The oil cooler and lines must be flushed following a transmission breakdown. This will help prevent more trouble after the transmission is repaired.

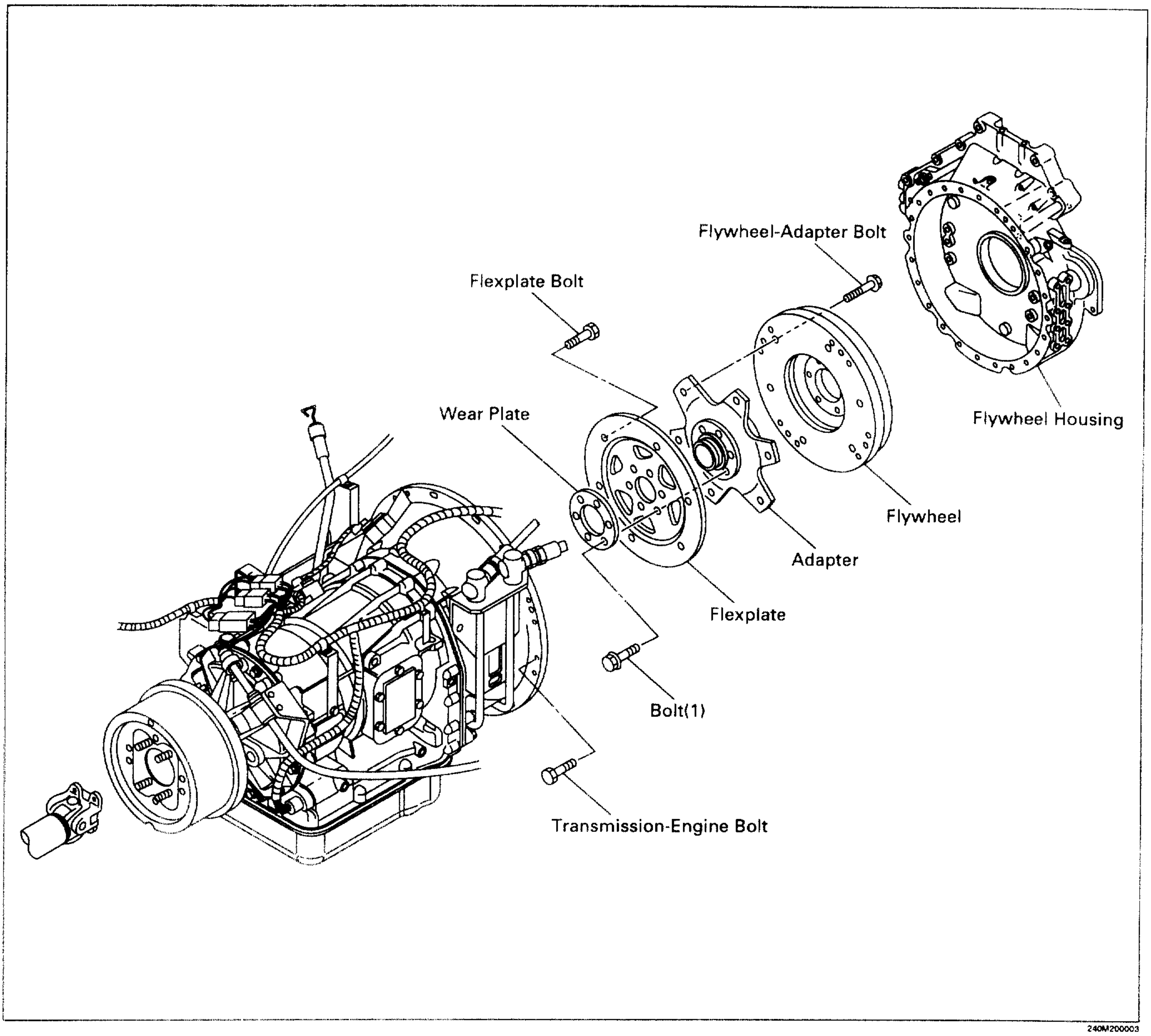
1. Disconnect oil cooler lines at the transmission case.
2. Back-flush the oil cooler and lines using clean solvent and compressed air.

Important:

- DO NOT exceed 689 kPa (100 psi) air pressure or damage may result to oil cooler.

3. Remove all remaining cleaning solvent from the system with compressed air.
4. Flush the cooling system again with transmission fluid. After the final flush, test the oil cooler for free flow of oil. If the flow is restricted, the cooler assembly must be replaced.

TRANSMISSION REPLACEMENT



Removal

1. **DRAINING TRANSMISSION**

   Drain the transmission fluid before removing the transmission from the vehicle. The transmission should be warm and the fluid allowed to drain completely.

   - Block the vehicle wheels.
   - Disconnect the battery ground cable.
   - Remove the drain plug from the oil pan. Examine the drained fluid for evidence of contamination – refer to "TRANSMISSION FLUID". Reinstall the drain plug.
   - Remove transmission fill tube if it interferes with transmission removal.

   NOTE:

   A significant amount of fluid may drain from the hydraulic lines when they are disconnected from the transmission.

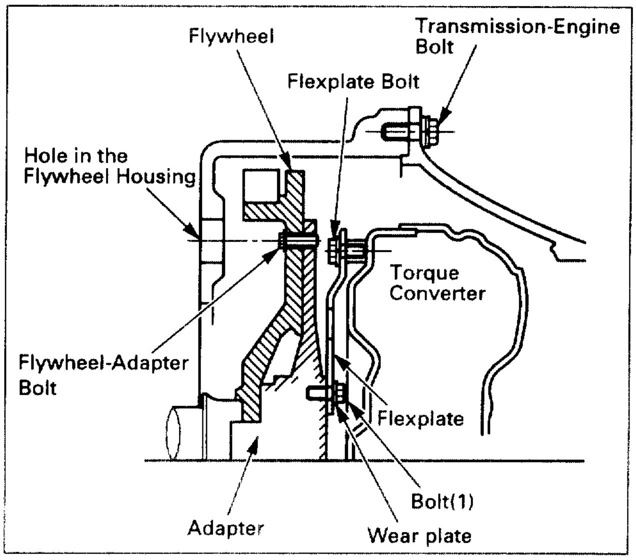
   - Disconnect the oil cooler flexible hoses from the transmission. Remove the lines from the vehicle if they interfere with transmission removal. Plug all openings to keep dirt from entering the hydraulic system.

2. **DISCONNECTING CONTROLS**

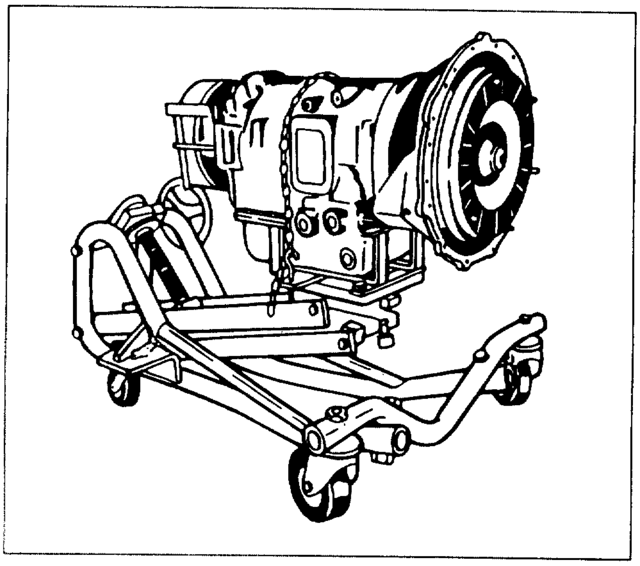
   - Disconnect or completely remove controls. If controls are not removed from the transmission, position them so that they do not interfere with transmission removal.

- Disconnect the external wiring harness and clips at the harness connector, the engine and turbine speed sensor connectors, and the output speed sensor connector. Prevent dirt or moisture from entering a disconnected connector. Position the wiring harness so it does not interfere with transmission removal.
- Remove the shift cable from the transmission. Refer to "SHIFT CABLE".

3. **STARTER**
   - Disconnect the battery cable for the starter and clips.
   - Remove the starter from the flywheel housing.
4. **PROPELLER SHAFT**
   - Remove the propeller shaft. Refer to "PROPELLER SHAFT".
5. **PARKING BRAKE CABLE**
   - Remove the parking brake cable at the end of the transmission. Refer to "PARKING BRAKE".



6. **FLYWHEEL-ADAPTER BOLT**
   - Align the hole in the flywheel housing with one of the flywheel-adapter bolts by rotating the flywheel through the starter installing hole.
   - Remove six (6) flywheel-adapter bolts through the hole in the flywheel housing.
7. **REMOVING THE TRANSMISSION**
   - Securely support the transmission with a hoist, jack, or other suitable removal equipment.



   - Remove twelve (12) bolts that attach the transmission to the engine. Do not tilt the transmission toward engine side as the torque converter may slide out from the transmission.
   - Move the transmission away from the engine, until it is completely clear of the engine.
   - Raise or lower the transmission as necessary to remove it from the vehicle.
8. Remove the six (6) flexplate bolts.
9. Remove the bolts (1).
   - Wear plate.
   - Flex plate.
   - Adapter.

Inspection and Repair

a. **Bolt Holes.** Check all bolt holes on the front of the flywheel/converter cover/flexplate adapter. The threads must be undamaged and the holes free of chips or foreign material.

b. **Pilot Boss.** Check the pilot boss (at the center of the adapter) for damage or raised metal that prevents free entry into the adapter.

c. **Starter Ring Gear.** Check the starter ring gear for excessive wear or damage.

d. **Adapter.** Check the adapter boss for damage that prevents free entry into the flywheel.

e. **Transmission-to-Engine Mounting Flange.** Inspect the transmission-to-engine mounting flange for raised metal, burrs. Remove any of these defects. Inspect the threaded holes for damaged threads.

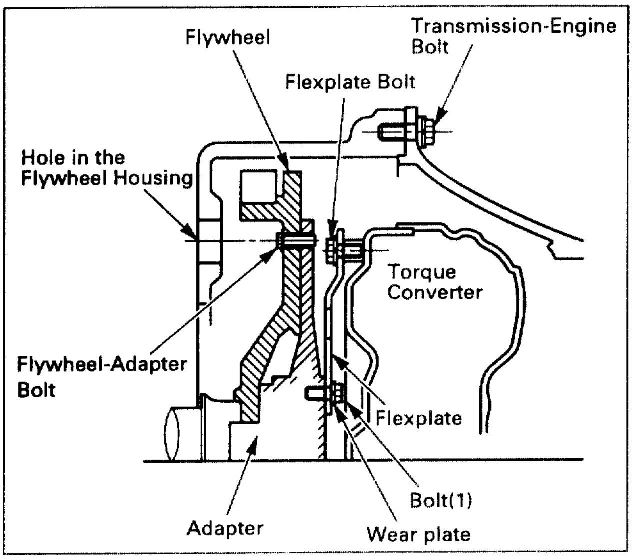
Installation

1. **HANDLING**

a. **Preventing Damage.** Carefully handle the transmission to prevent damage to components in the installation path.

b. **Control of Transmission Movements.** Use a hoist or transmission jack that allows precise control of transmission movements during installation.

2. **MOUNTING TO ENGINE**



Use the following procedure to mount the transmission to the engine:

- Assemble the adapter and flexplate with the wear plate and bolts (1).

Note that there is a different pitch hole having a mark.

Tighten the bolts (1) to the specified torque.

Torque: 157N·m (116 lb·in)

- Install the above assembly on the torque converter.

Tighten twice the flexplate bolts to the specified torque.

Torque: 56N·m (41 lb·in)

- Align one of the flywheel-adapter bolt holes in the flywheel with the hole in the flywheel housing.
- Lubricate the center pilot boss with molybdenum disulfide grease (Molycote G, or equivalent).
- Insert a headless guide bolt into one of the flywheel-adapter bolt holes. Align the guide bolt with the adapter hole at the hole in the flywheel housing.
- Push the transmission toward the engine while guiding the pilot boss on the adapter into the flywheel assembly, and the guide bolt into the bolt hole in the adapter.
- Seat the transmission squarely against the engine flywheel housing – no force is required. If interference is encountered, move the transmission away from the engine and investigate the cause.
- Align the bolts holes in the converter housing with those in the engine flywheel housing.
- Install all transmission-to-engine bolts finger tight.

CAUTION:

The entire converter housing circumference must be flush against the engine flywheel housing before tightening any bolts. DO NOT use the bolts to seat the housing.

- Tighten four bolts at 90 degree interval around the converter housing bolt circle.

Torque: 44N·m (33 lb·in)

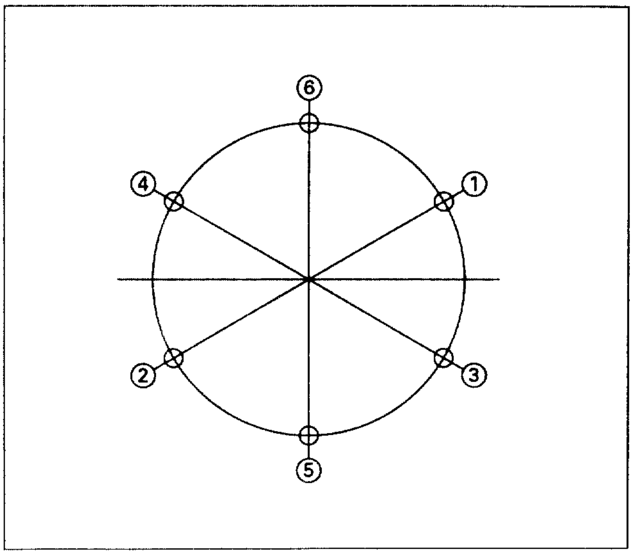
- Remove the guide bolt through the engine flywheel housing hole.
  Replace it with a bolt. Tighten the bolt finger tight.

NOTE:

DO NOT Tighten any flywheel-adapter bolts until all of the bolts have been installed and tightened finger tight.

- Rotate the engine crankshaft to install the remaining bolts into the adapter.
  After all bolts have been tightened finger tight, tighten them to the specified torque, according to the sequence showing the illustration.

Torque: 56N·m (41 lb·in)



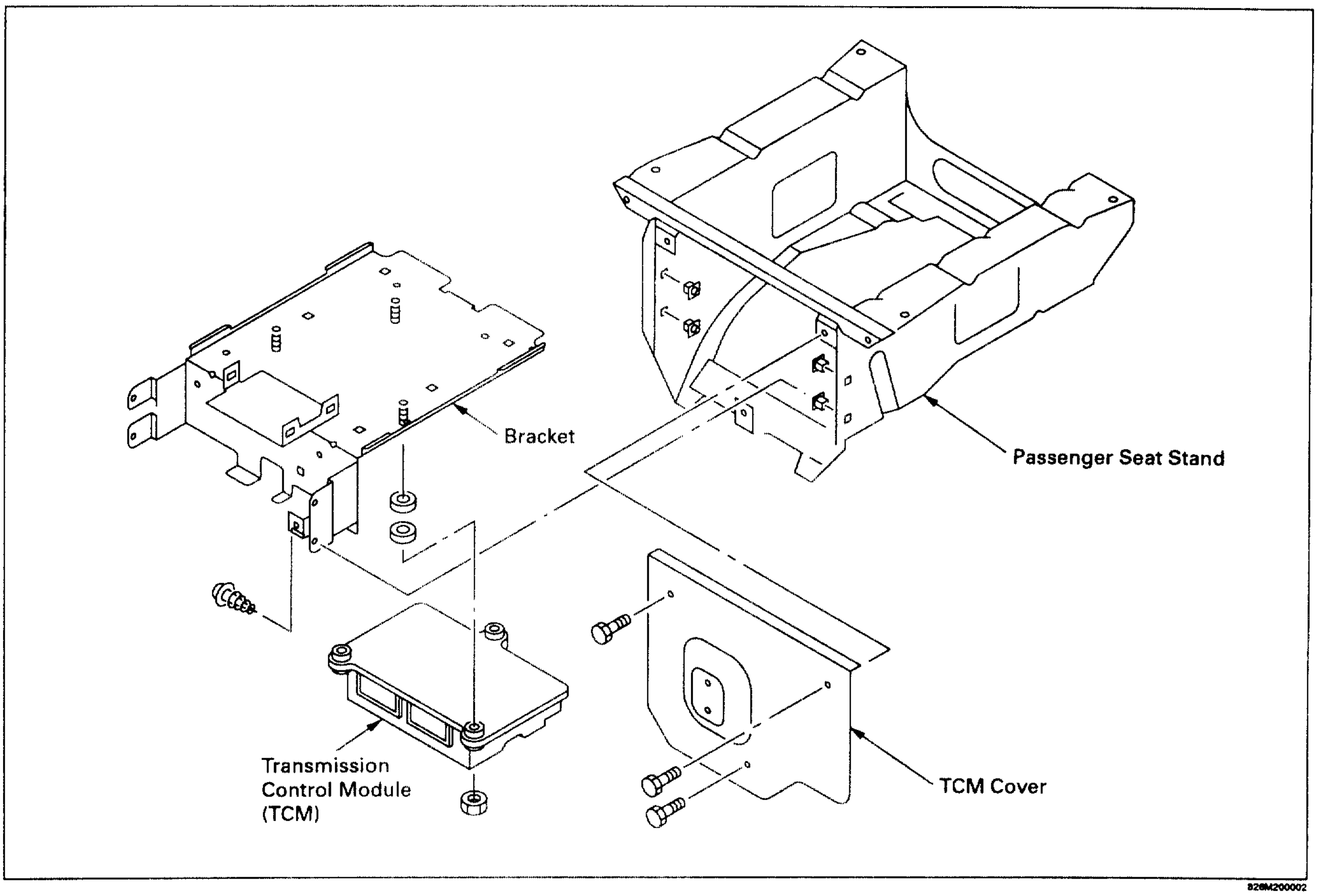
3. **COUPLING TO DRIVELINE**
   - Install the propeller shaft. Refer to "PROPELLER SHAFT".
4. **STARTER**
   - Install the starter to the flywheel housing.
   - Connect the battery cable for starter and clips.
5. **CONNECTING COOLER**

   Connect the oil cooler flexible hoses to the transmission.
6. **PARKING BRAKE CABLE**

   Install the parking brake cable. Refer to "PARKING BRAKE".
7. **CONNECTING CONTROLS**
   - Install the shift cable to the transmission.

     Refer to "SHIFT CABLE".
   - Connect the transmission external wiring harness. Keep dirt and debris out of the connector.
   - Ensure the speed sensors, and all other connectors are securely seated and latched. A connector can be heard or felt to latch, but confirm the latching by pulling on the connector – NOT THE WIRES.
8. **FILLING HYDRAULIC SYSTEM**
   - Select a transmission fluid.
   - Fill the transmission with the required amount of fluid.
   - Connect the battery ground cable.
   - Run the engine for about one minute and check the fluid level.

TRANSMISSION CONTROL MODULE (TCM)



Removal

1. Disconnect the battery ground cable.
2. Remove the TCM cover.
3. Disconnect the TCM connectors.
4. Remove the bracket with the TCM.
5. Remove the TCM.

Installation

1. Install the TCM on the bracket.
2. Install the bracket with the TCM.
3. Connect the TCM connectors.
4. Install the TCM cover.
5. Connect the battery ground cable.

SPECIFICATIONS

FASTENER TORQUE

	N·m	Ft. Lbs.
Plug, Drain	35	26
Cooler Lines	61	45
Select Arm	24	17
Flex Plate – Adapter	157	116
Flex Plate – Torque Converter	56	41
Adapter – Flywheel	56	41
Transmission-Flywheel Housing	44	33

LUBRICATION

Capacity	S1000
Fluid and Filter Change	7L (7.4 Quarts)
Type Recommended	DEXRON®-III Automatic Transmission Fluid

MEMO

SECTION 8

CAB AND CHASSIS ELECTRICAL

CAUTION:

When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength for (stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound, will be called out. The correct torque values must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

MEMO

MAIN DATA AND SPECIFICATIONS

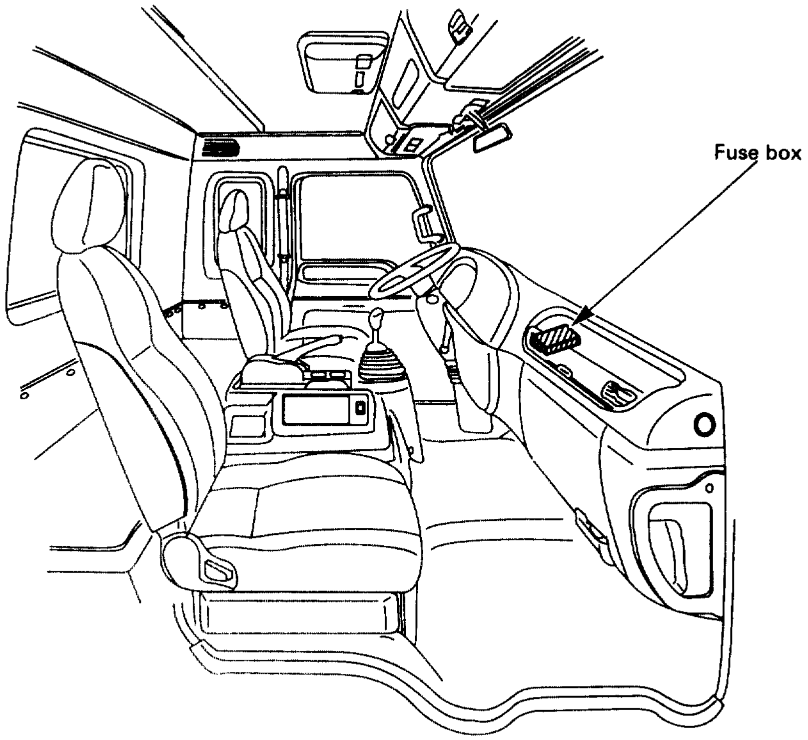
BULB SPECIFICATIONS

Light Name		Rated Power	No. of Bulb	Lens Color	Remarks
Headlight assembly	Outside	40/60W	2	White	–
	Inside	50W	2		
Front turn signal light		23W	2	Amber	–
Rear turn signal light		27W	2	Amber	–
Front side marker light		3.8W	2	Amber	–
Roof marker light		5W	5	Amber	–
Rear combination light	Turn signal light	27W	2	Amber	–
	Stop light/Taillight	27/8W	2	Red	–
	Backup light	27W	2	White	–
License plate light		8W	1	White	–
Dome light		10W	2	White	–

Light Name		Rated Power	No. of Bulb	Lens Color	Remarks
Indicator/ Warning Light	Charge	2W	1	Red	Incorporated in the meter assembly
	ABS	2W	1	Green	
		2W	1	Amber	
	High beam	2W	1	Blue	
	Seat belt	2W	1	Red	
	Oil filter	2W	1	Red	
	Air pressure	2W	1	Red	
	Parking brake	2W	1	Red	
	Service engine soon	2W	1	Amber	
	A/T oil pressure	2W	1	Red	
	DRL	2W	1	Green	
	Turn signal (LH)	2W	1	Green	
	Turn signal (RH)	2W	1	Green	
	PTO	2W	1	Red	
	Diff lock	2W	1	Amber	
	Exhaust brake	2W	1	Green	
	Brake fluid level	2W	1	Red	
Illumination Light	Illumination light for meter assembly	3.8W	5		
	Cigarette lighter	1.4W	1		

CIRCUIT BREAKER AND SLOW BLOW FUSE LOCATION

CIRCUIT BREAKER



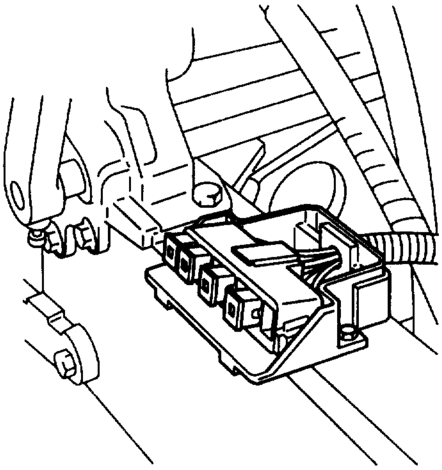
Circuit Breaker Layout

① 15A	⑥ 15A	⑪ 15A
② 15A	⑦ 15A	⑫ 15A
③ 15A	⑧ 20A	⑬ 15A
④ 15A	⑨ 15A	
⑤ 15A	⑩ 15A	

⑭ 15A	⑲ 25A	㉔ 25A
⑮ 15A	⑳ 25A	㉕ 20A
⑯ 15A	㉑ 20A	㉖ 20A
⑰ 15A	㉒ 15A	
⑱ 15A	㉓ 15A	

SLOW BLOW FUSE

Slow blow fuse box



No.	Capacity	Wire color
①	40A	W
②	40A	R
③	40A	WR
④	40A	L
⑤	40A	RY
⑥	40A	G

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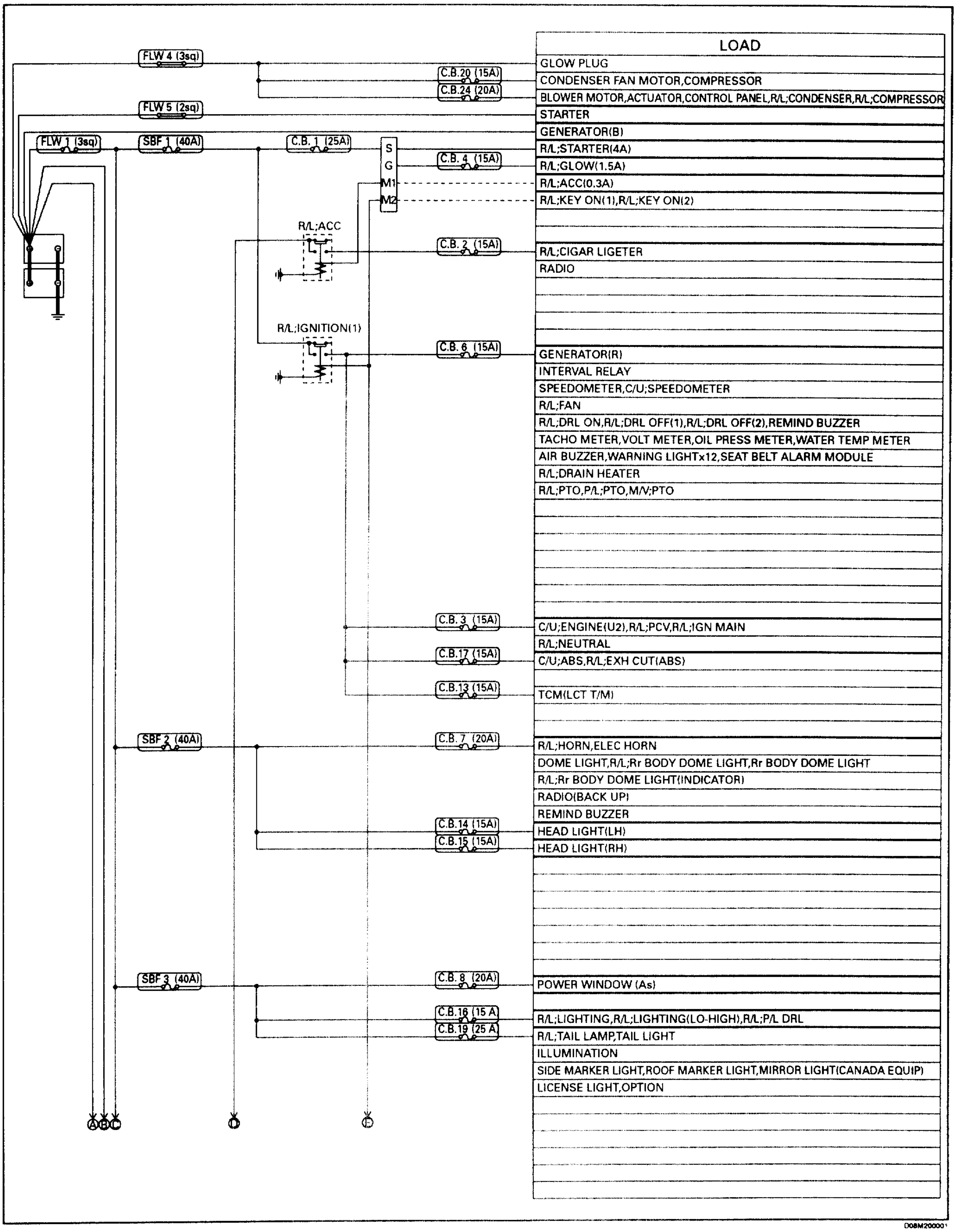
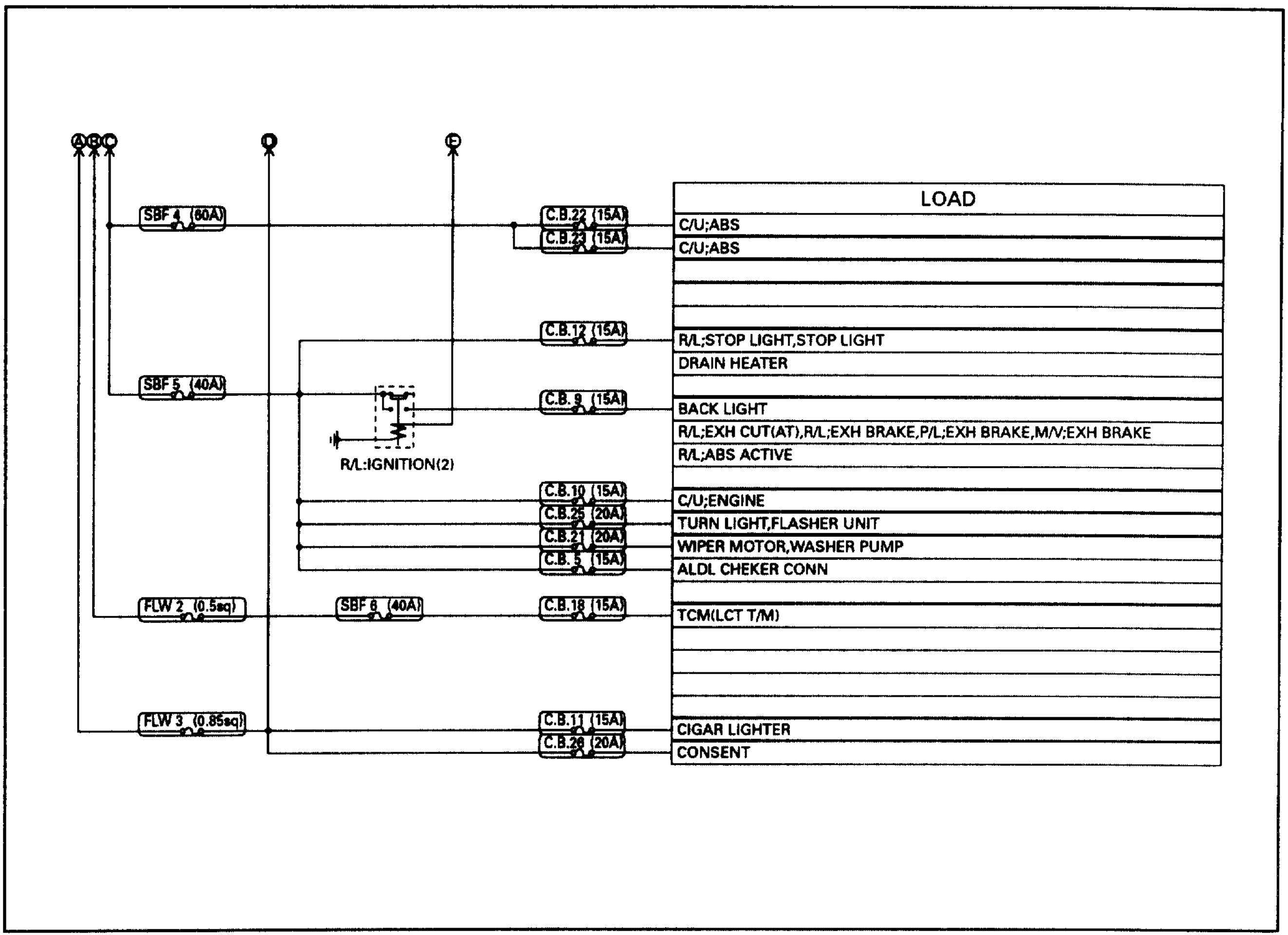
FUSE BLOCK CIRCUIT




A
B
C
D
E
SBF 4 (60A)
SBF 5 (40A)
FLW 2 (0.5sq)
SBF 6 (40A)
FLW 3 (0.85sq)
R/L:IGNITION(2)
C.B.22 (15A)
C.B.23 (15A)
C.B.12 (15A)
C.B. 9 (15A)
C.B.10 (15A)
C.B.25 (20A)
C.B.21 (20A)
C.B. 5 (15A)
C.B.18 (15A)
C.B.11 (15A)
C.B.26 (20A)
LOAD
C/U;ABS
C/U;ABS
R/L;STOP LIGHT,STOP LIGHT
DRAIN HEATER
BACK LIGHT
R/L;EXH CUT(AT),R/L;EXH BRAKE,P/L;EXH BRAKE,M/V;EXH BRAKE
R/L;ABS ACTIVE
C/U;ENGINE
TURN LIGHT,FLASHER UNIT
WIPER MOTOR,WASHER PUMP
ALDL CHEKER CONN
TCM(LCT T/M)
CIGAR LIGHTER
CONSENT

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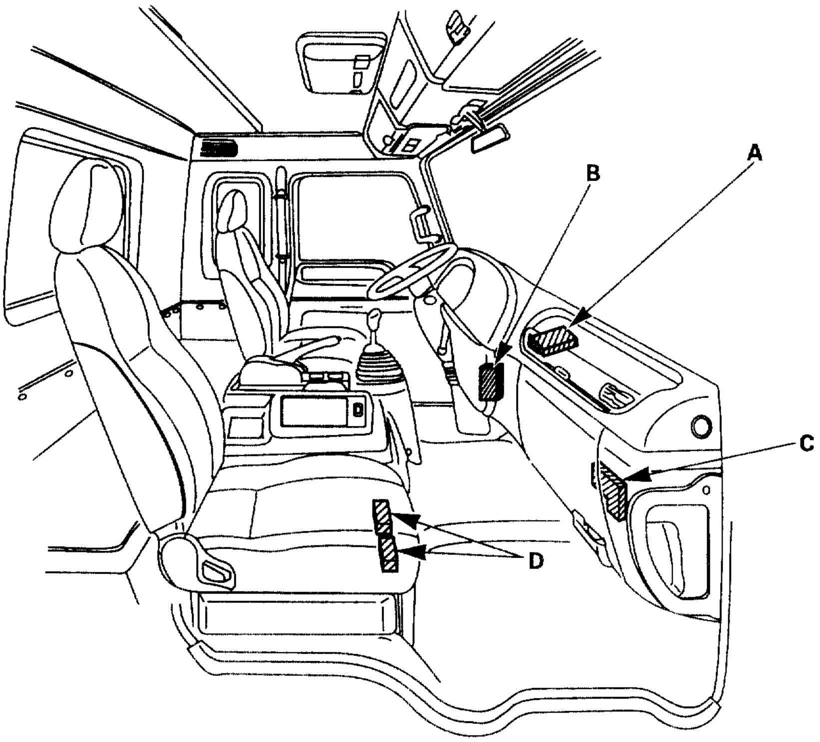
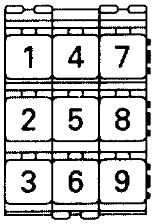
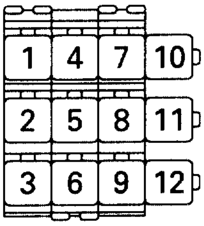
REFERENCE TABLE OF CIRCUIT BREAKER

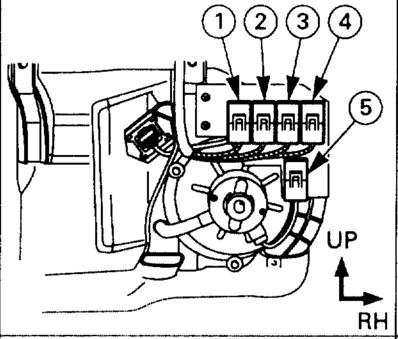
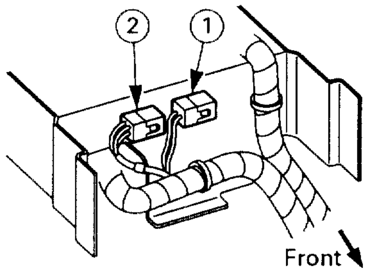
No.	Capacity	Indication on label	Main parts (Load)
①	15A	Ignition switch	Starter relay
②	15A	Cigar/L RLY Radio	Cigar lighter relay, Radio
③	15A	Engine ECU	ECM, Pressure control valve relay, Ignition main relay, ECM neutral relay, Auto trans modulator, Auto trans modulator relay
④	15A	Glow relay	Glow relay, Control resistor
⑤	15A	ALDL conn.	ALDL connector
⑥	15A	Meter Warning lamp	Interval relay, Doow SW module (Drive side), Fan relay, Speedometer ECU, Speedometer, Remind buzzer, DRL on relay, DRL off relay (1), DRL off relay (2), Meter gauges, Warning lamp (Meter), Air buzzer, PTO relay (Clutch), Drain heater relay, Power window
⑦	15A	Room lamp Horn	Horn relay, Room lamp, Rear body room lamp Radio (Backup)
⑧	20A	Power Window	Door SW module (Passenger side)
⑨	15A	Exh BRK Back lamp	Backup lamp, ECM, Exhaust brake M/V
⑩	15A	Engine ECU	ECM, ECM stop relay, Pressure control valve
⑪	15A	Cigar lighter	Cigar lighter
⑫	15A	Drain heater Auxiliary stop lamp	Stop lamp, Stop lamp relay, Drain heater
⑬	20A	T/M ECU	TCM
⑭	15A	Head lamp LH	Head lamp (LH)
⑮	15A	Head lamp RH	Head lamp (RH)
⑯	15A	Head lamp RLY DRL RLY	Lighting relay, Lighting relay (Low, High), DRL P/L relay
⑰	15A	ABS	ABS ECU
⑱	15A	T/M ECU	TCM
⑲	15A	Tail lamp, Light mirror Illumination lamp	Tail lamp, Tail lamp relay, Illumination lamp Licence lamp, ID lamp, Clearance lamp, Marker lamp
⑳	25A	Cond. fan motor Cooler compressor	Condensor fan motor, A/C compressor

No.	Capacity	Indication on label	Main parts (Load)
㉑	20A	Wiper motor Washer motor	Wiper motor, Washer motor
㉒	15A	ABS	ABS ECU
㉓	15A	ABS	ABS ECU
㉔	25A	Blower motor Aircon relay	Blower motor, A/C mode SW, A/C actuator (R/F)
㉕	20A	Turn lamp Flasher unit	Flasher unit
㉖	20A	Power post. (Consent)	Consent

RELAY LOCATION



			Name
A		1	PTO
		2	EXHAUST BRAKE CUT (ABS)
		3	NEUTRAL ECM (A/T)
		4	LIGHTING
		5	LIGHTING (LOW,HIGH)
		6	PCV (ECM)
		7	TAIL LIGHT
		8	IGNITION MAIN (ECM)
		9	CIGAR LIGHTER
B		1	CONDENSER
		2	COMPRESSOR
		3	FAN
		4	IGNITION (ACC)
		5	DRAIN HEATER
		6	IGNITION (2)
		7	ECM STOP
		8	HORN
		9	IGNITION (1)
		10	REAR BODY DOME LIGHT
		11	STOP LIGHT
		12	A/T MODULE

			Name
C		1	D.R.L ON
		2	D.R.L OFF (1)
		3	POWER WINDOW
		4	D.R.L P/L
		5	D.R.L OFF (2)
D		1	ABS ACTIVE (A/T)
		2	EXHAUST CUT (A/T)

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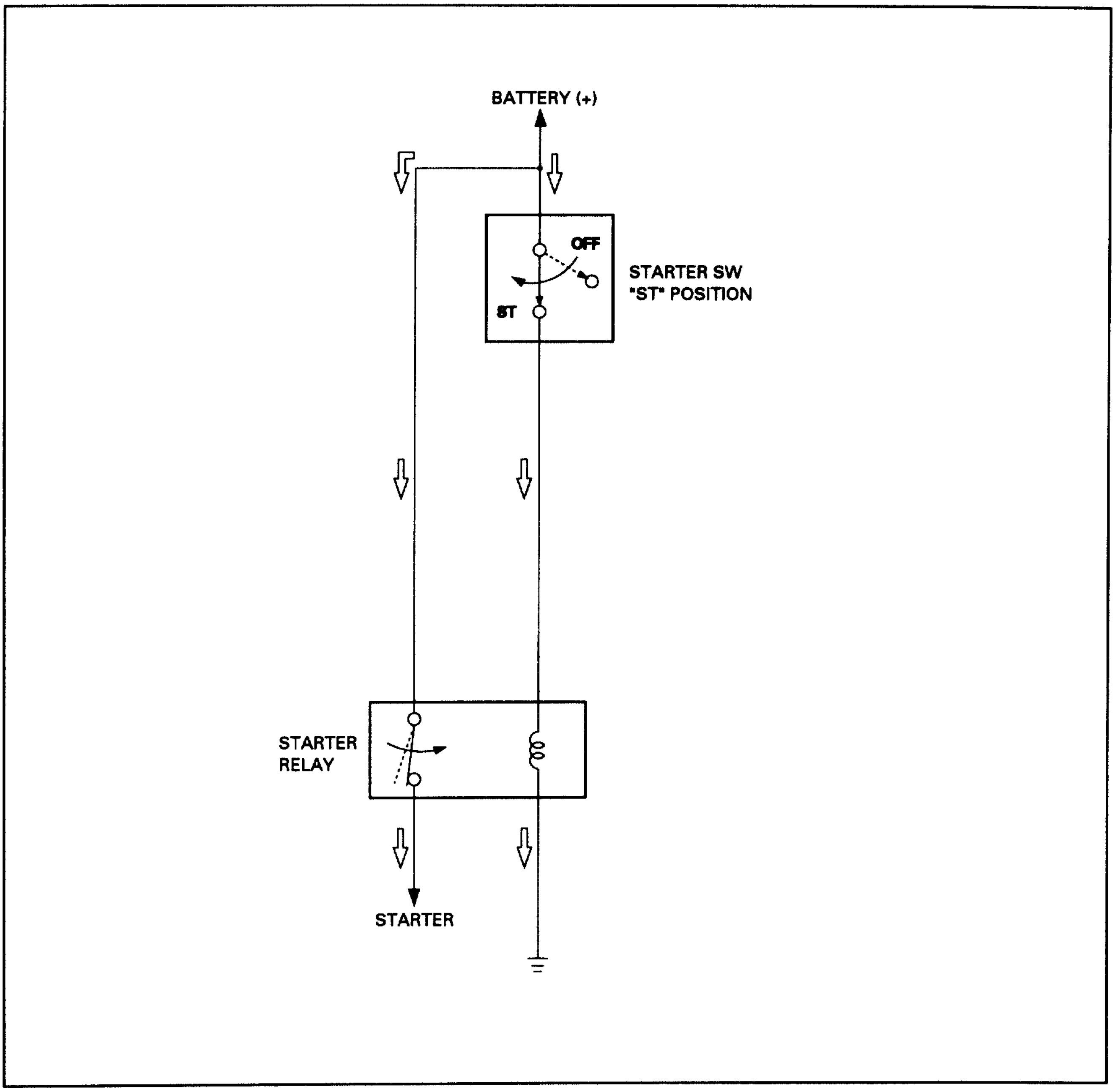
SYSTEM REPAIR

START AND CHARGING

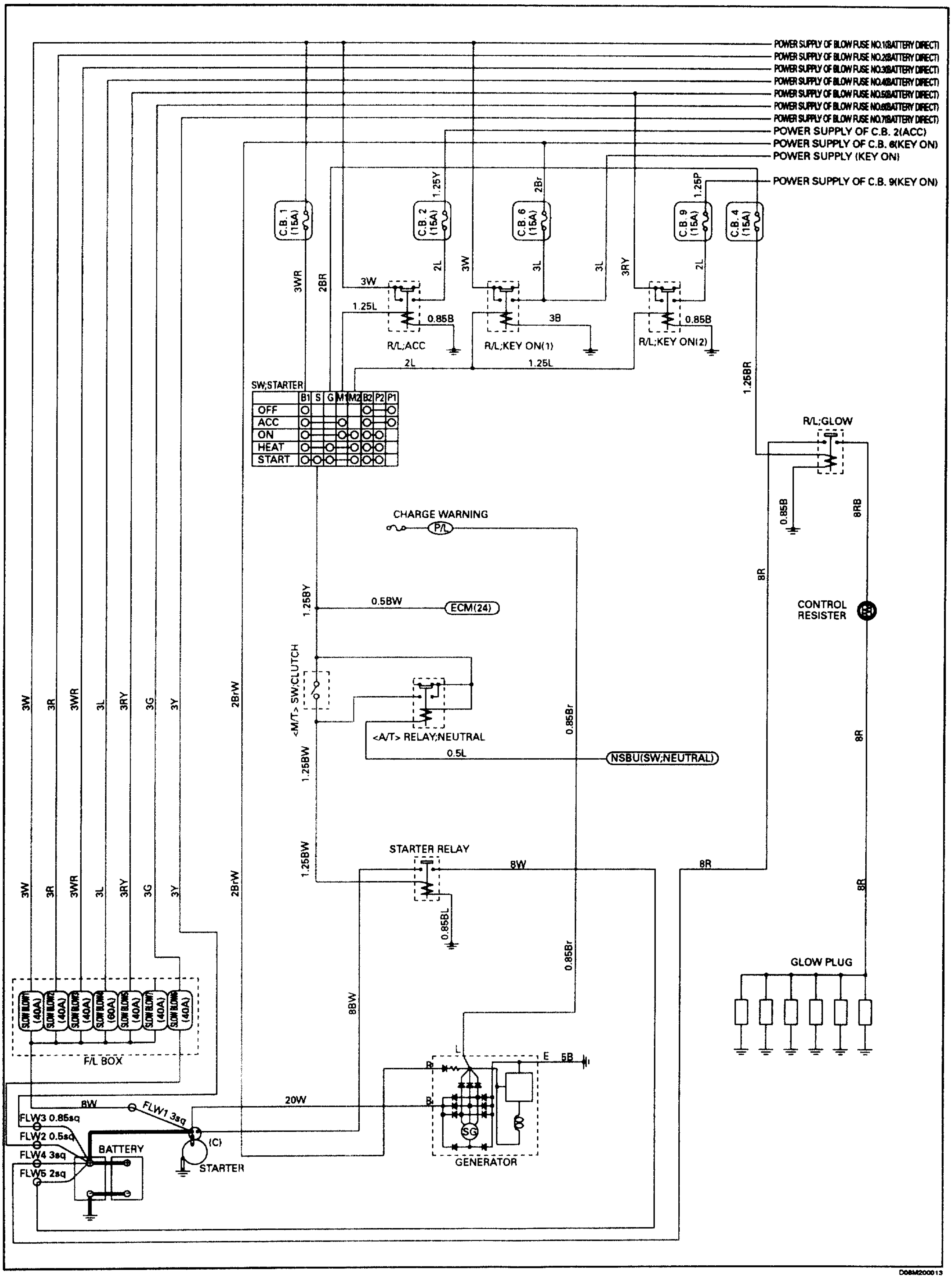
GENERAL DESCRIPTION

The system consists of the starter switch, clutch switch, starter, AC generator, starter relay, glow relay, neutral relay and neutral switch. When the starter SW is set to the "ST" position, the battery voltage is applied to the starter solenoid coil through the starter relay to start the starter.

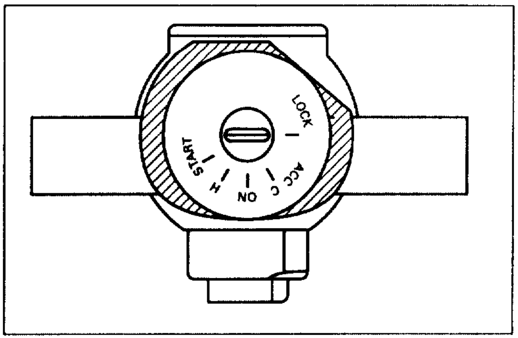
STARTING CIRCUIT



STARTING CIRCUITS



D08M200013



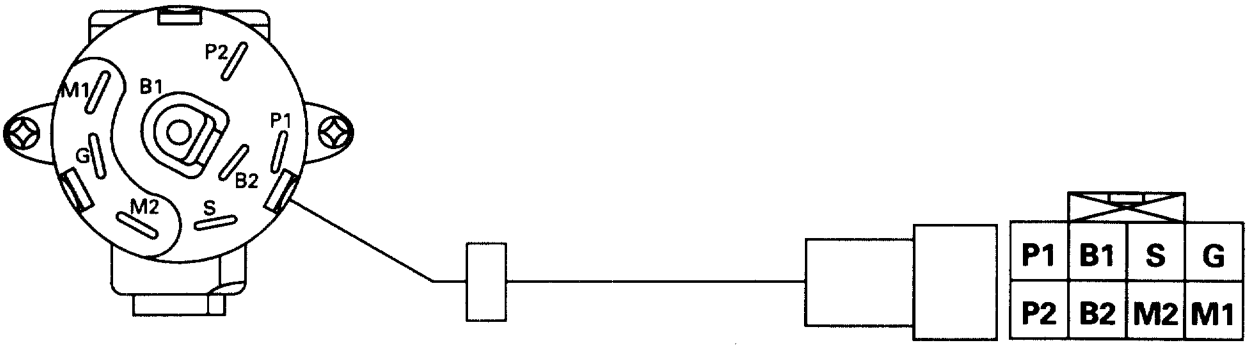
STARTER SWITCH

The starter switch positions are LOCK, ACC, ON, HEAT and START. Turning the starter key to these positions a circuit for starting the engine, the operation of accessories, or stop the engine.

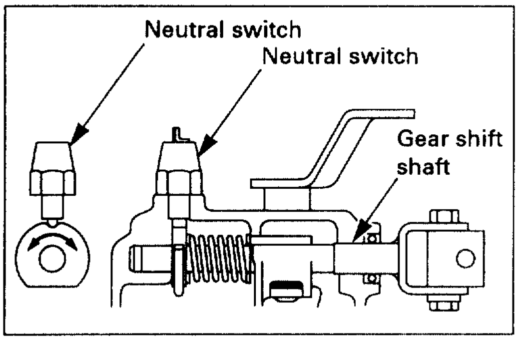
INSPECTION

Check the continuity between the starter switch connector terminals.

Repair or replace the switch when the result of inspection is found abnormal.



Starter SW key position \ Terminal No.	B1	S	G	M1	M2	B2	P2	P1
OFF	○					○	─	○
ACC	○	─	─	○		○	─	○
ON	○	─	─	○	○	○	○	
HEAT	○	─	○	─	○	○	○	
START	○	○	○	─	○	○	○	



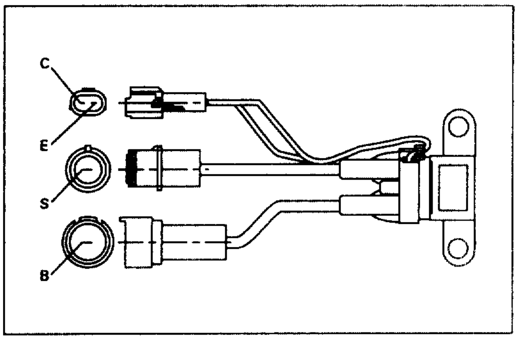
825M100013

NEUTRAL SWITCH

INSPECTION

Check to see if there is any continuity between the switch terminals.

Replace the switch when the result of inspection is found abnormal.



080MT005

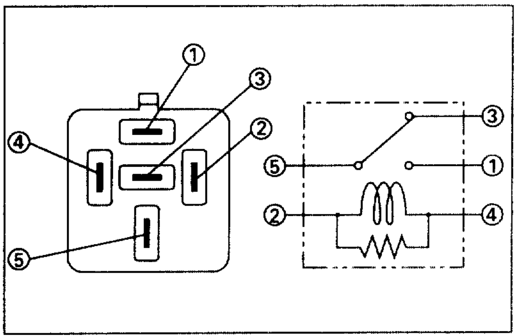
STARTER RELAY

INSPECTION

Check to see if there is any Ω (8Ω~12Ω) between the terminals C and E.

Replace the relay when the result of inspection is found abnormal.

There is continuity between terminal S and B. When the battery voltage is applied between terminal C and E.



828LX040

NEUTRAL RELAY

INSPECTION

Check continuity between the relay terminals.

① - ⑤..... No continuity

(When the battery voltage is applied between ② and ④)

① - ⑤..... Continuity

MEMO

ENGINE CONTROL MODULE (ECM)

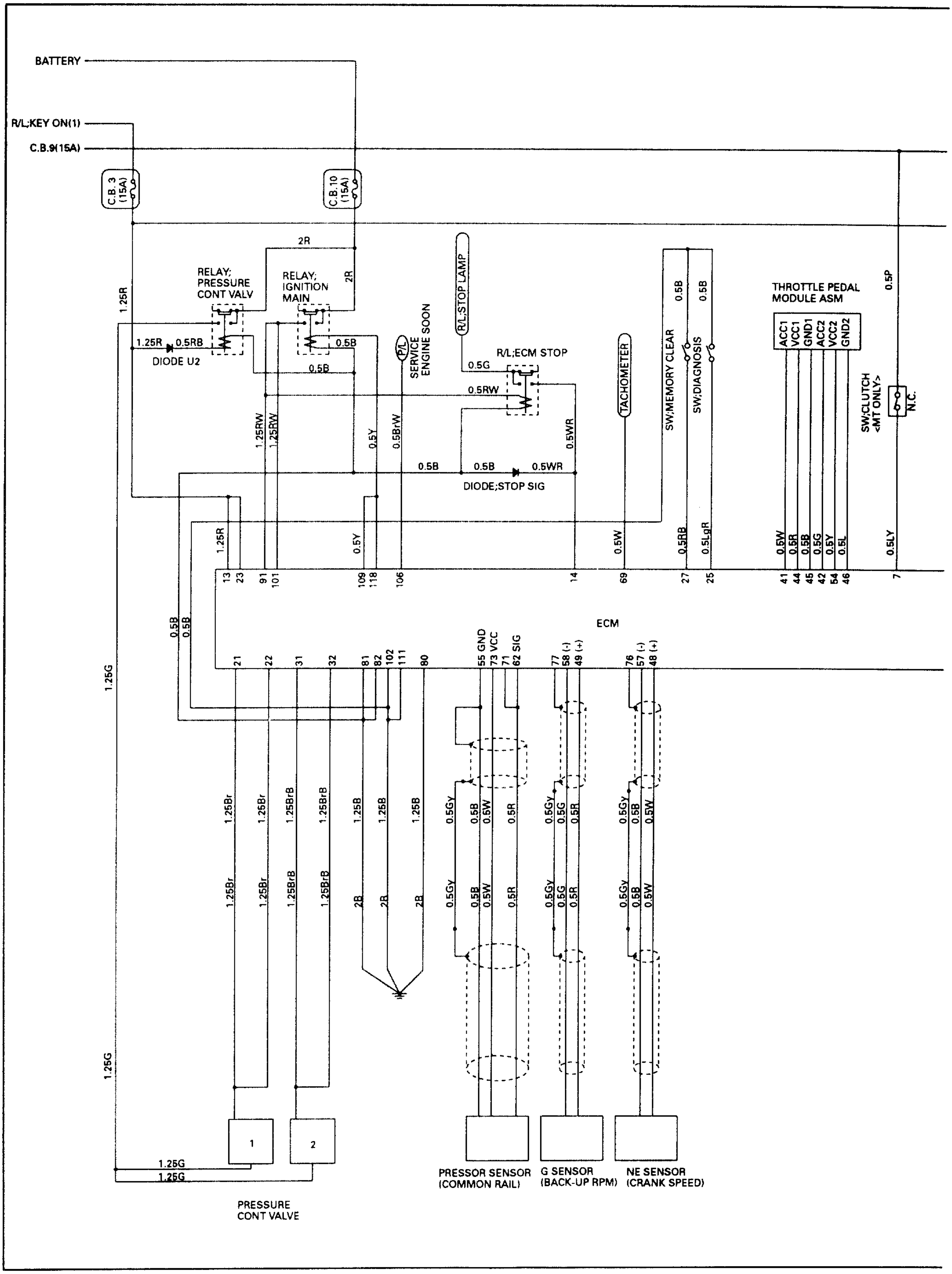
GENERAL DESCRIPTION

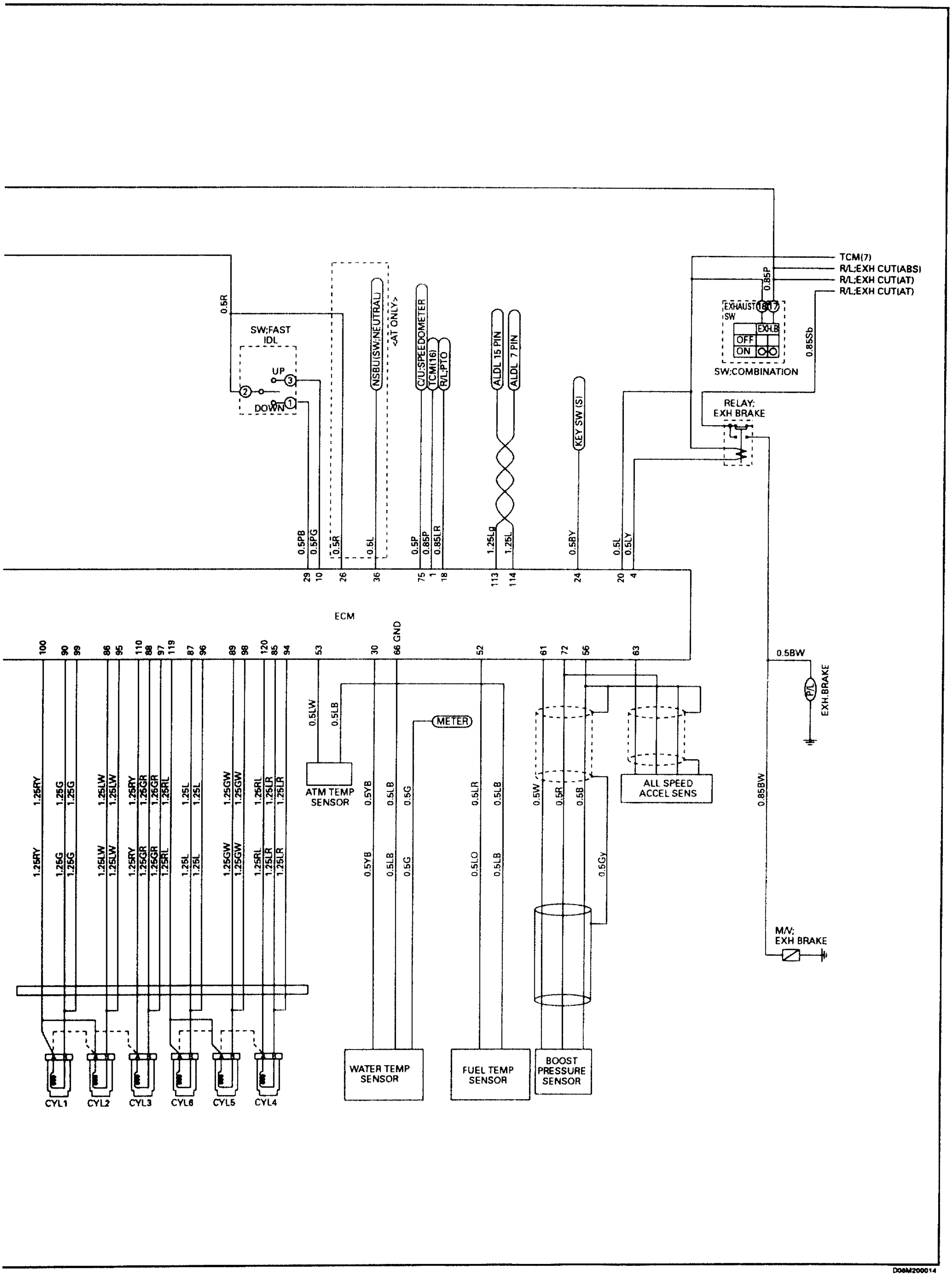
The engine control module (ECM) is located in the compartment below the right side seat. The ECM controls fuel system, Ignition timing and on-board diagnostics for powertrain functions.

The ECM constantly observes the information from various sensors. The ECM controls the systems that affect vehicle performance. The ECM performs the diagnostic function of the system. It can recognize operational problems, alert the driver through the MIL (Check engine lamp), and store diagnostic trouble codes (DTCs). DTCs identify the problem areas to aid the technician in making repairs.

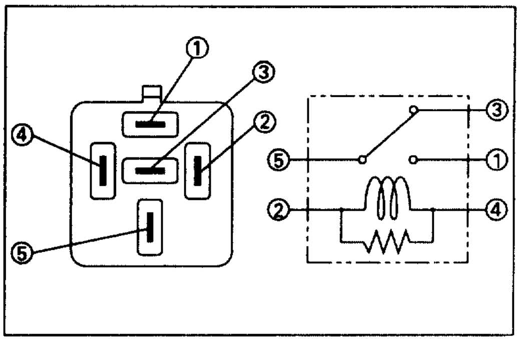
Refer to section 6E in detail.

CIRCUIT DIAGRAM




TCM(7)
R/L;EXH CUT(ABS)
R/L;EXH CUT(AT)
R/L;EXH CUT(AT)
0.85P
EXHAUST SW
18
17
EXH.B
OFF
ON
0.85Sb
SW;COMBINATION
RELAY;
EXH BRAKE
0.5R
SW;FAST
IDL
UP
DOWN
①
②
③
<AT ONLY>
NSBU(SW;NEUTRAL)
C/U;SPEEDOMETER
TCM(16)
R/L;PTO
ALDL 15 PIN
ALDL 7 PIN
KEY SW (S)
0.5PB
0.5PG
0.5R
0.5L
0.5P
0.85P
0.85LR
1.25Lg
1.25L
0.5BY
0.5L
0.5LY
29
10
26
36
75
1
18
113
114
24
20
4
ECM
100
90
99
86
95
110
88
97
119
87
96
89
98
120
85
94
53
30
66 GND
52
61
72
56
63
0.5BW
P/L
EXH.BRAKE
0.85BW
0.5LW
0.5LB
METER
ATM TEMP
SENSOR
ALL SPEED
ACCEL SENS
1.25RY
1.25G
1.25G
1.25LW
1.25LW
1.25RY
1.25GR
1.25GR
1.25RL
1.25L
1.25L
1.25GW
1.25GW
1.25RL
1.25LR
1.25LR
0.5YB
0.5LB
0.5G
0.5LR
0.5LB
0.5W
0.5R
0.5B
0.5LO
0.5Gy
M/V;
EXH BRAKE
CYL1
CYL2
CYL3
CYL6
CYL5
CYL4
WATER TEMP
SENSOR
FUEL TEMP
SENSOR
BOOST
PRESSURE
SENSOR

D08M200014



RELAY

INSPECTION

Check to see if there is any continuity between the relay terminals.

Replace the relay when the result of inspection is found abnormal.

③ – ⑤..... Continuity
① – ⑤..... No continuity

(When battery voltage is applied between ② – ④)

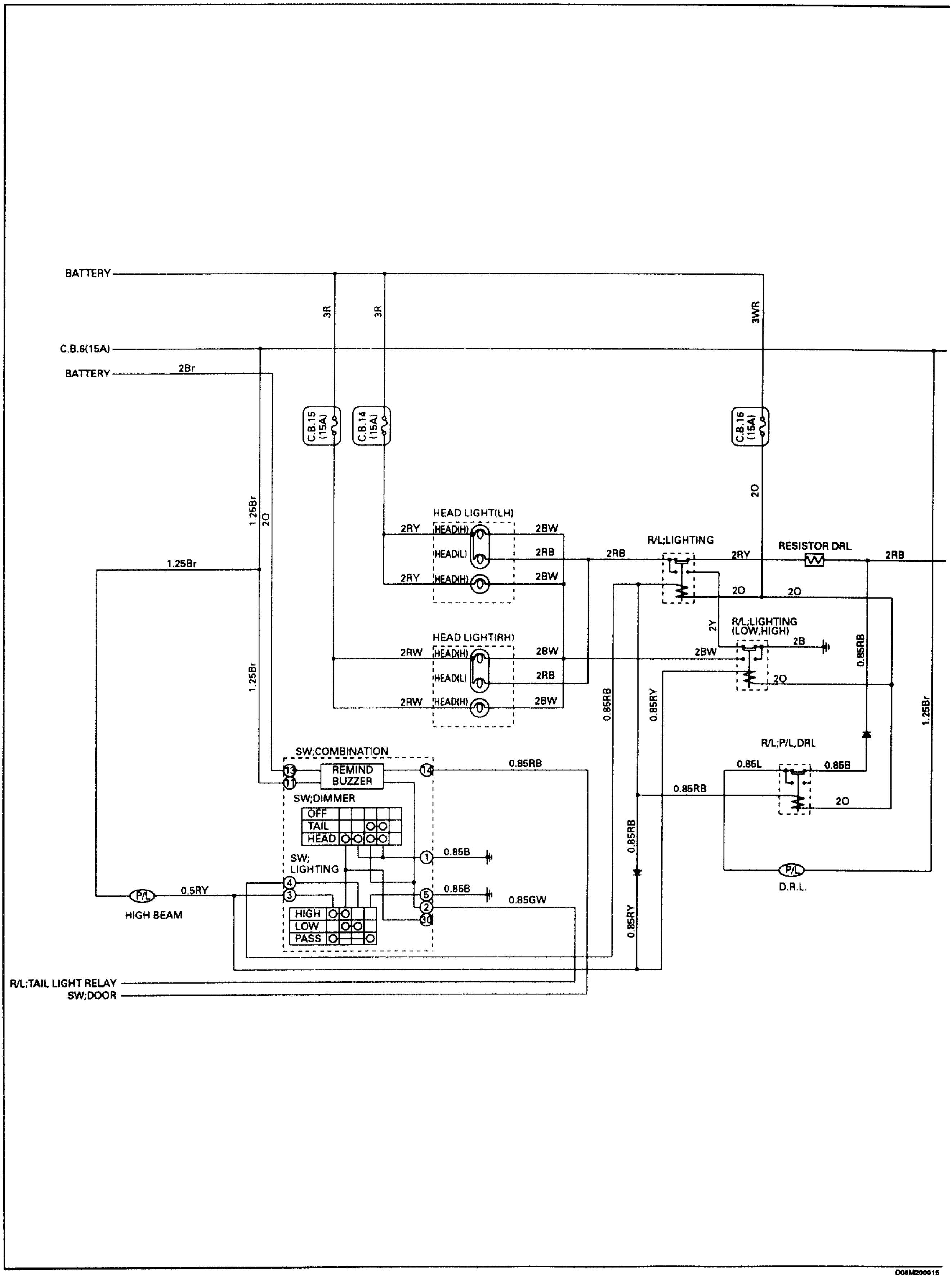
③ – ⑤..... No Continuity
① – ⑤..... Continuity

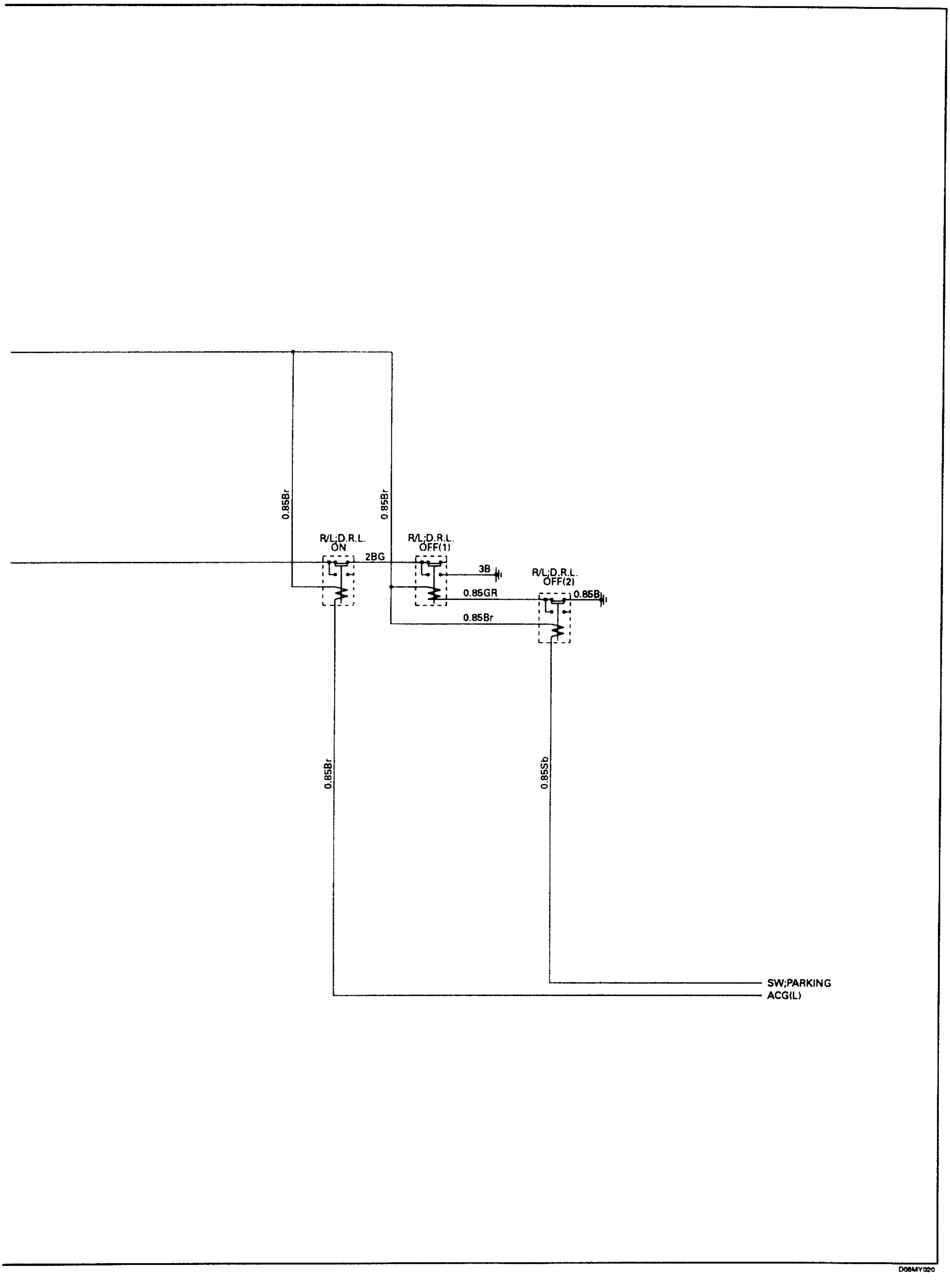
HEADLIGHT

GENERAL DESCRIPTION

The circuit consists of headlight, Combination switch (Lighting switch, dimmer·passing switch), high beam indicator light, DRL indicator light and relay.

CIRCUIT DIAGRAM

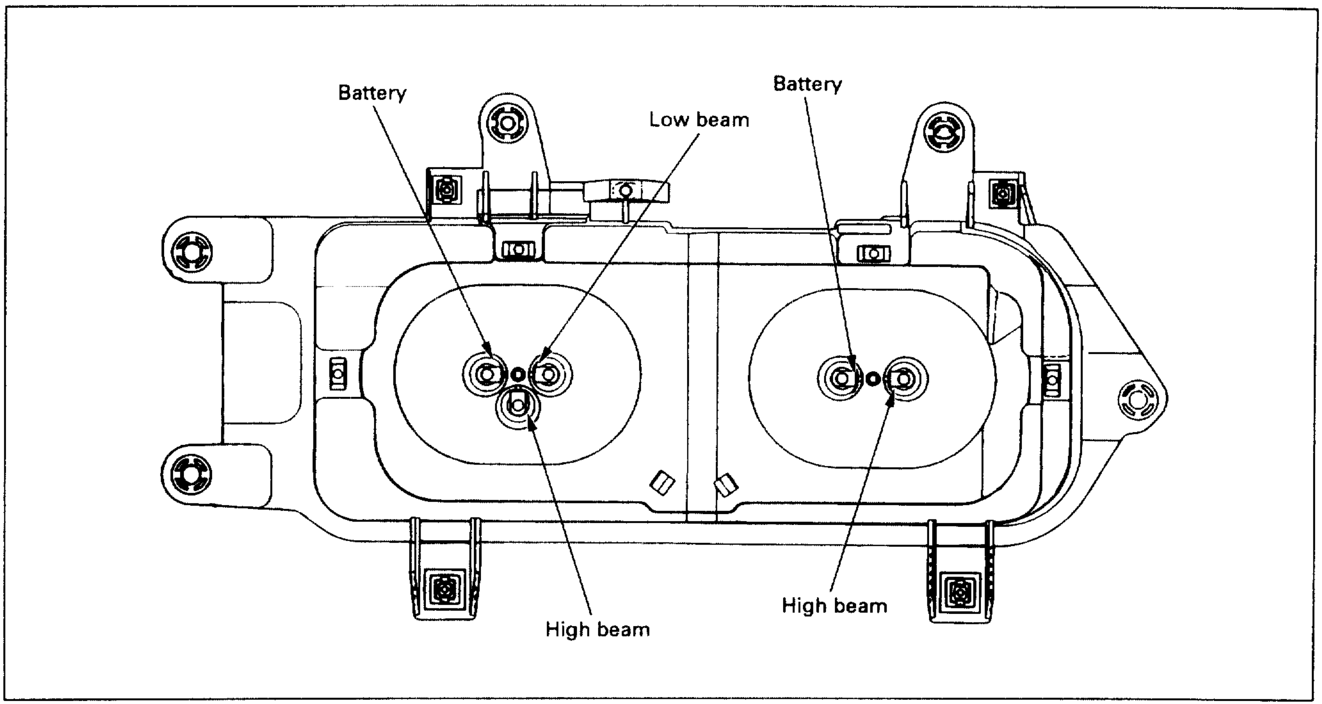



0.85Br
0.85Br
R/L;D.R.L.
ON
2BG
R/L;D.R.L.
OFF(1)
3B
R/L;D.R.L.
OFF(2)
0.85GR
0.85B
0.85Br
0.85Br
0.85Sb
SW;PARKING
ACG(L)
D08MY020

HIGH BEAM INDICATOR LIGHT

Refer to "METER AND WARNING/INDICATOR LIGHT" in this section.

HEADLIGHT



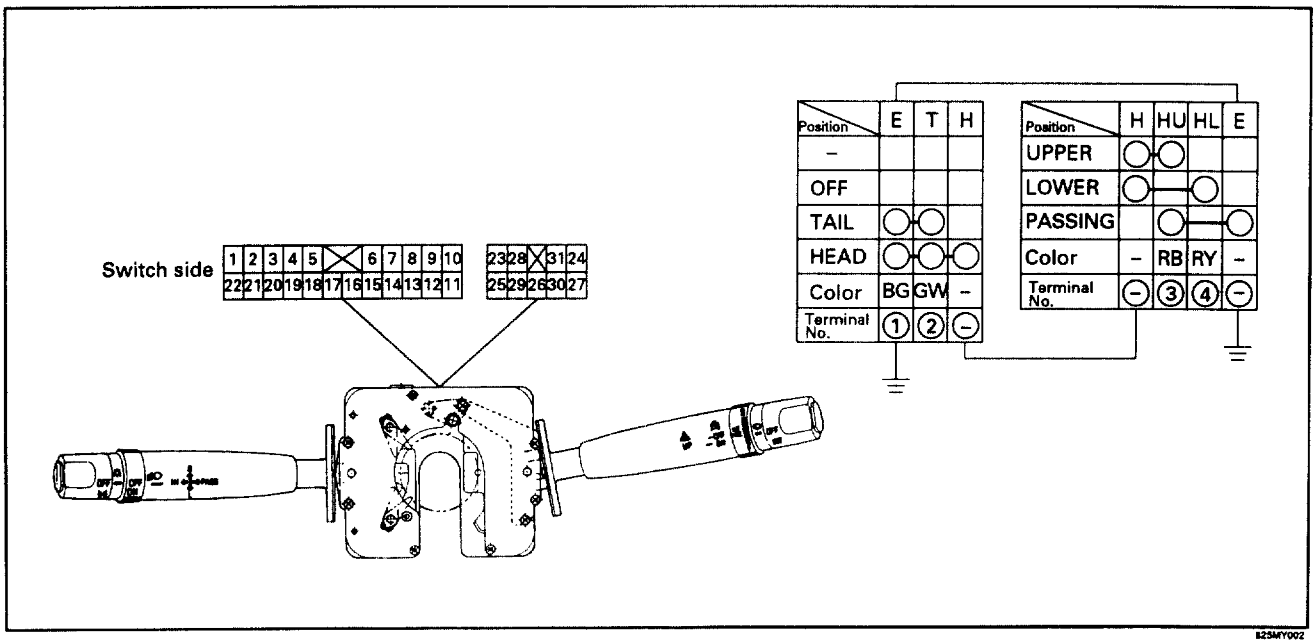
801MY001

COMBINATION SWITCH

INSPECTION

Check the continuity between the terminals of the switch.

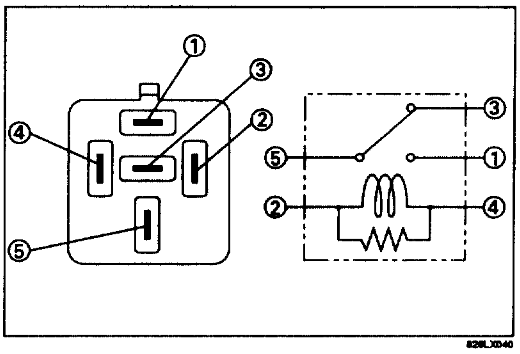
Repair or replace the switch when the result of inspection is found abnormal.



Position	E	T	H
–			
OFF			
TAIL	○—	—○	
HEAD	○—	—○—	—○
Color	BG	GW	–
Terminal No.	①	②	⊖

Position	H	HU	HL	E
UPPER	○—	—○		
LOWER	○—	——	—○	
PASSING		○—	——	—○
Color	–	RB	RY	–
Terminal No.	⊖	③	④	⊖

825MY002



RELAY

INSPECTION

Check to see if there is any continuity between the relay terminals.

Replace the relay when the result of inspection is found abnormal.

③ – ⑤..... Continuity
① – ⑤..... No continuity

(When battery voltage is applied between ② – ④)

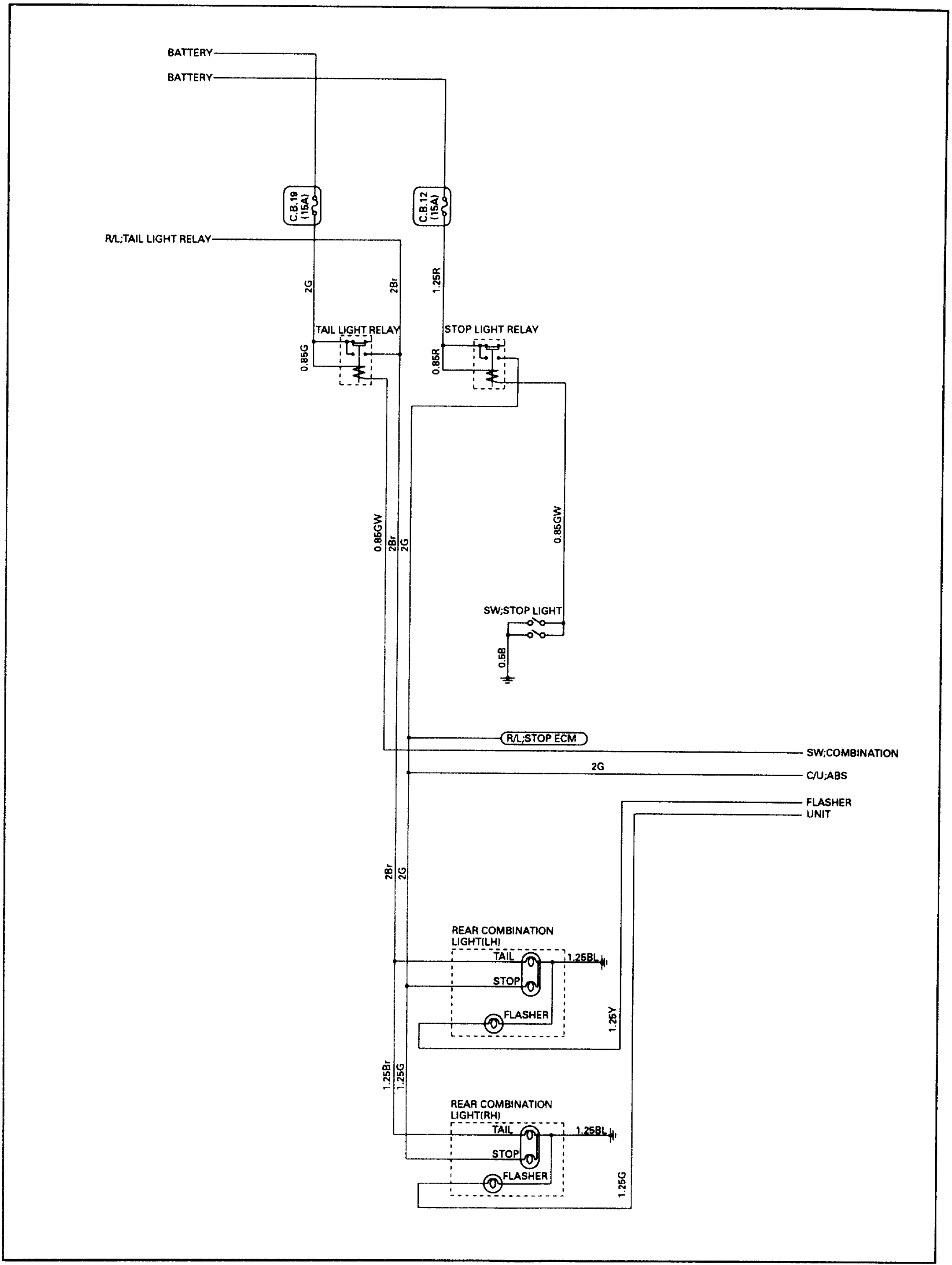
③ – ⑤..... No Continuity
① – ⑤..... Continuity

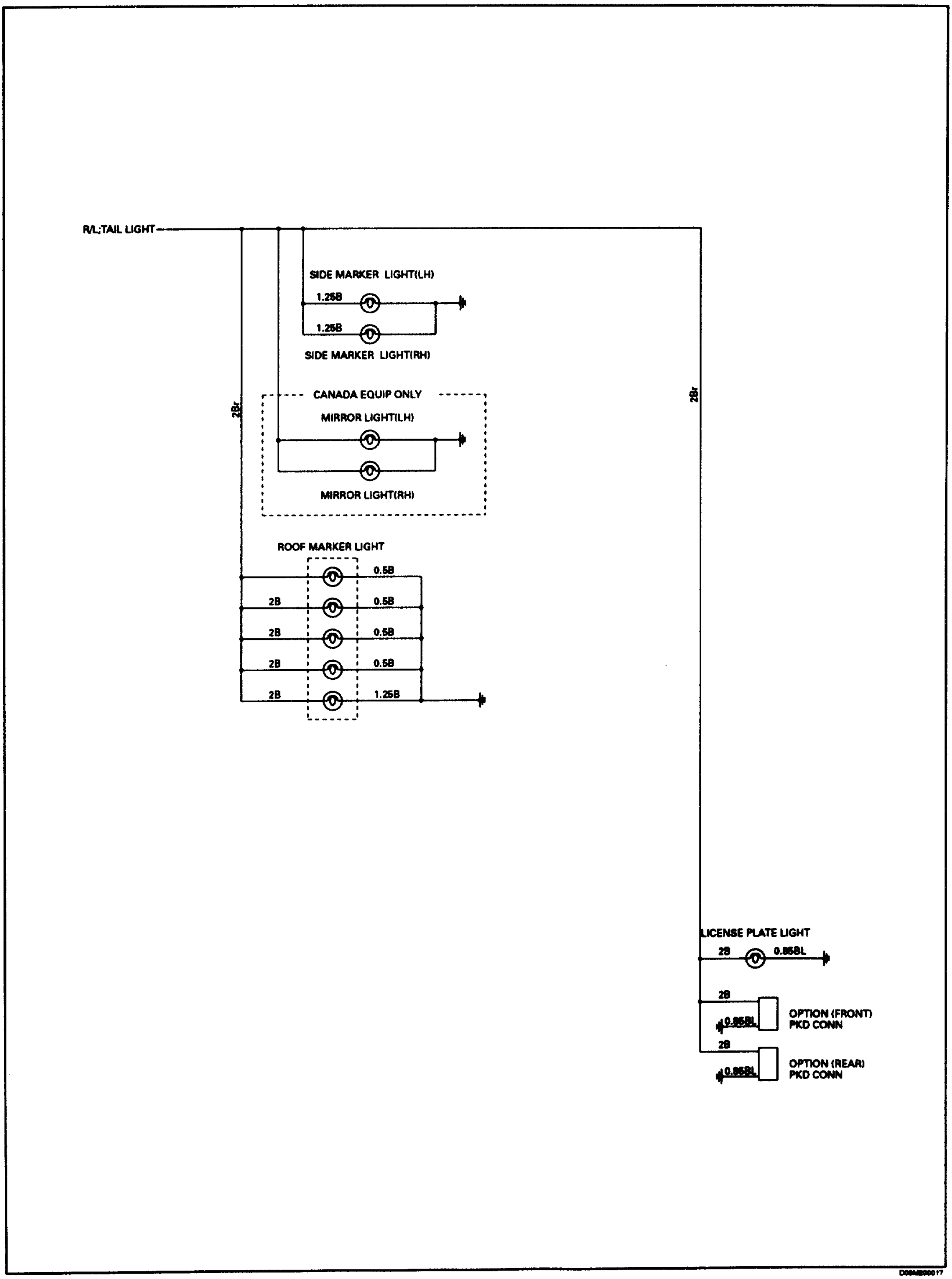
MARKER LIGHT, TAILLIGHT, LICENSE PLATE LIGHT AND STOPLIGHT

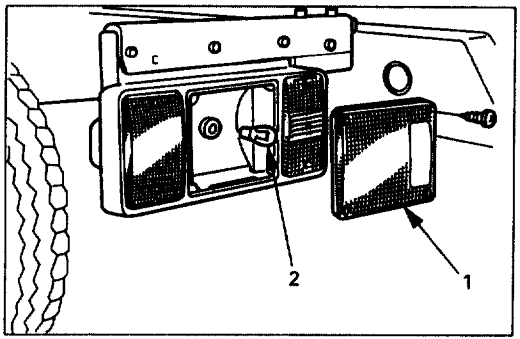
GENERAL DESCRIPTION

The circuit consists of the lighting switch, marker light, taillight, license plate light, stoplight switch, stoplight and relay. All these lights come on when the lighting switch are turned on with the switch to either clearance or headlight position. The stoplight comes on only when the brake pedal is depressed.

CIRCUIT DIAGRAM




R/L;TAIL LIGHT
SIDE MARKER LIGHT(LH)
1.25B
1.25B
SIDE MARKER LIGHT(RH)
2Br
CANADA EQUIP ONLY
MIRROR LIGHT(LH)
MIRROR LIGHT(RH)
2Br
ROOF MARKER LIGHT
0.5B
2B
0.5B
2B
0.5B
2B
0.5B
2B
1.25B
LICENSE PLATE LIGHT
2B
0.85BL
2B
0.85BL
OPTION (FRONT)
PKD CONN
2B
0.85BL
OPTION (REAR)
PKD CONN
D08MB00017



STOPLIGHT BULB
TAILLIGHT BULB

REMOVAL

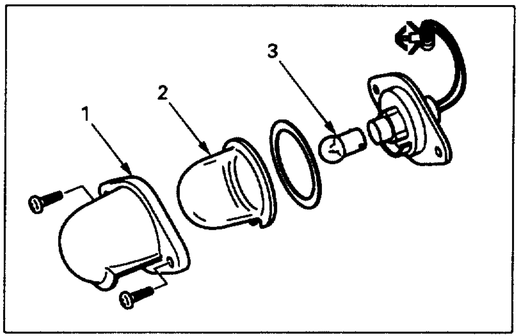
Preparation:

Disconnect the battery ground cable.

1. **Lens**
2. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.



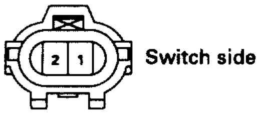
LICENSE PLATE LIGHT BULB

REMOVAL

1. **Cover**
2. **Lens**
3. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.



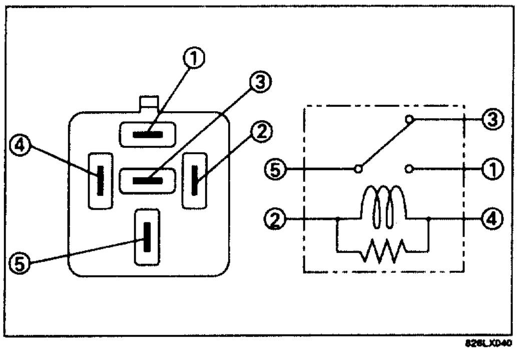
Terminal No. / SW position	1	2
Depress brake pedal (Push rod out)	○	○
Release brake pedal (Push rod in)		

STOPLIGHT SWITCH

INSPECTION

1) Check to see if stoplight switch is installed correctly to the specified position. Adjust the position when the result of the inspection is found abnormal.
2) Check to see if there is any continuity between the terminals of the stoplight switch.

   Replace the switch when the result of inspection is found abnormal.



TAIL LIGHT RELAY
STOP LIGHT RELAY

INSPECTION

Check to see if there is any continuity between the relay terminals.

Replace the relay when the result of inspection is found abnormal.

③ – ⑤ .... Continuity
① – ⑤ .... No continuity

(When battery voltage is applied between ② – ④)

③ – ⑤ .... No Continuity
① – ⑤ .... Continuity

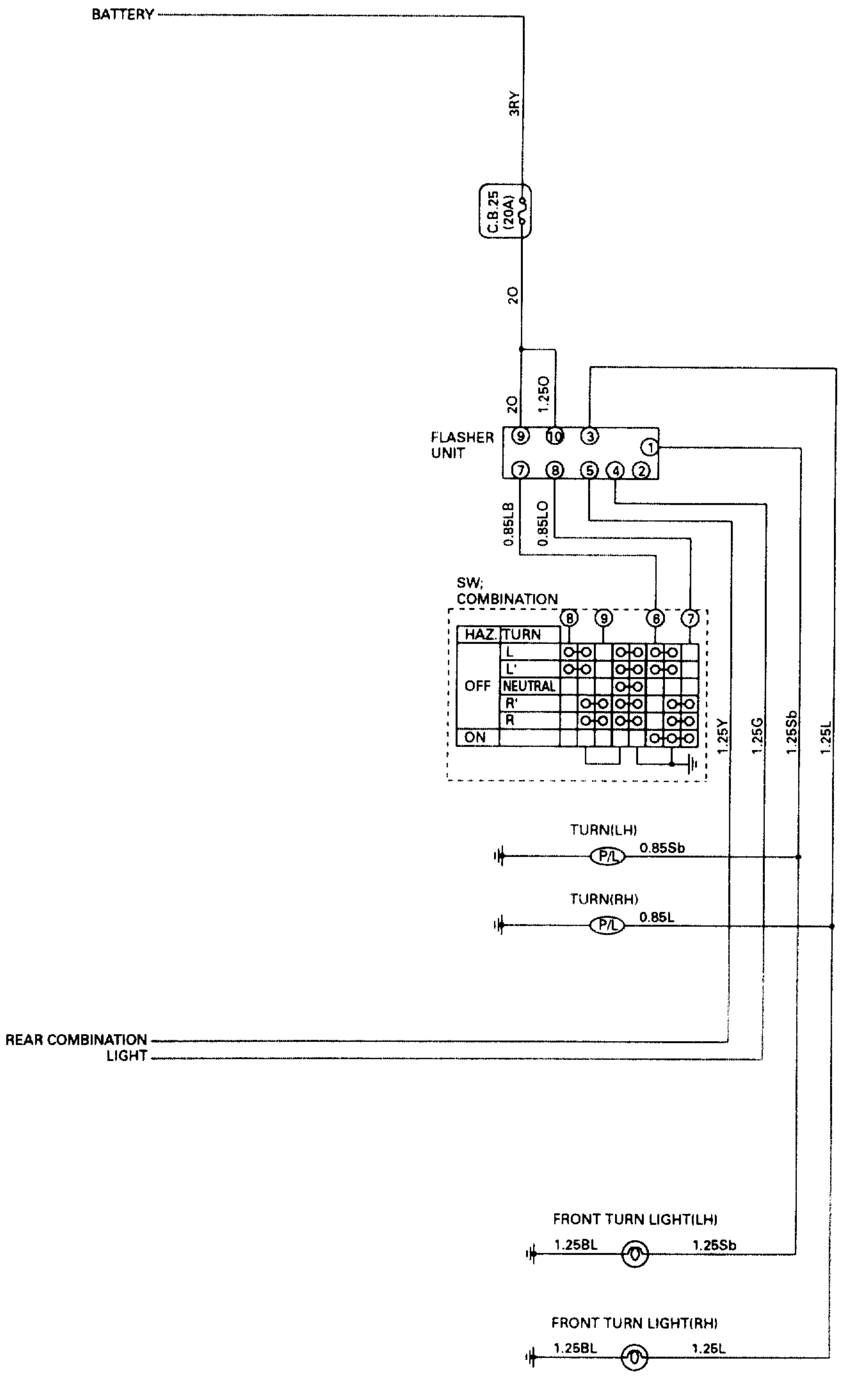
TURN SIGNAL LIGHT AND HAZARD WARNING LIGHT

GENERAL DESCRIPTION

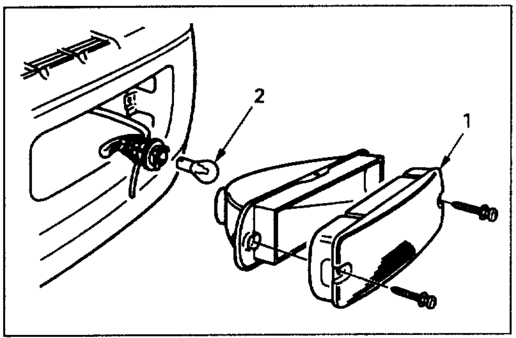
The circuit consists of turn signal light (front and rear), turn signal light switch, hazard switch and flasher unit.

When turning on the respective switches, the turn signal light will operate. When the turn signal light is flashing, the indicator light in the meter also start flashing. When the hazard warning switch is turned on, the current flows to the flasher unit through the hazard warning switch to cause the hazard warning light to flash, independent of the position of the starter switch. At the same time, the indicator lights in the meter also start flashing.

CIRCUIT DIAGRAM



D08M200018



801MT005

FRONT TURN SIGNAL LIGHT/BULB

REMOVAL

Preparation:

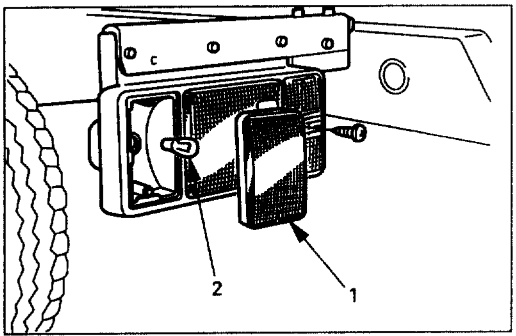
Disconnect the battery ground cable.

1. **Front Combination Light Lens**

   Remove two screws
2. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.



803HX003

REAR TURN SIGNAL LIGHT/BULB

REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Lens**
2. **Bulb**

INSTALLATION

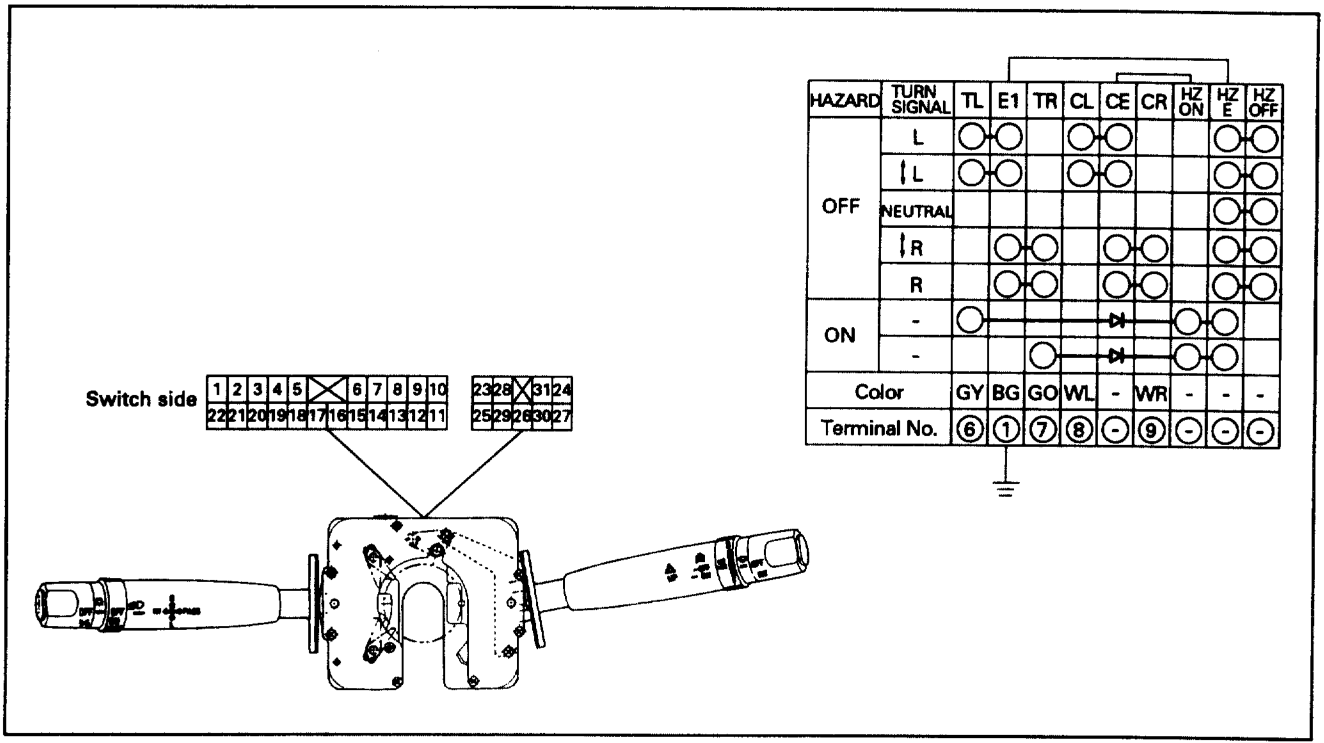
To install, follow the removal steps in the reverse order.

HAZARD SWITCH
TURN SIGNAL LIGHT SWITCH (COMBINATION SWITCH)

INSPECTION

Check the continuity between the terminals of the turn signal light switch.

Repair or replace the switch when the result of inspection is found abnormal.



HAZARD	TURN SIGNAL	TL	E1	TR	CL	CE	CR	HZ ON	HZ E	HZ OFF
OFF	L	○	○		○	○			○	○
	↕L	○	○		○	○			○	○
	NEUTRAL								○	○
	↕R		○	○		○	○		○	○
	R		○	○		○	○		○	○
ON	-	○	—	—	—	▶|	—	○	○	
	-			○	—	▶|	—	○	○	
Color		GY	BG	GO	WL	-	WR	-	-	-
Terminal No.		⑥	①	⑦	⑧	(-)	⑨	(-)	(-)	(-)

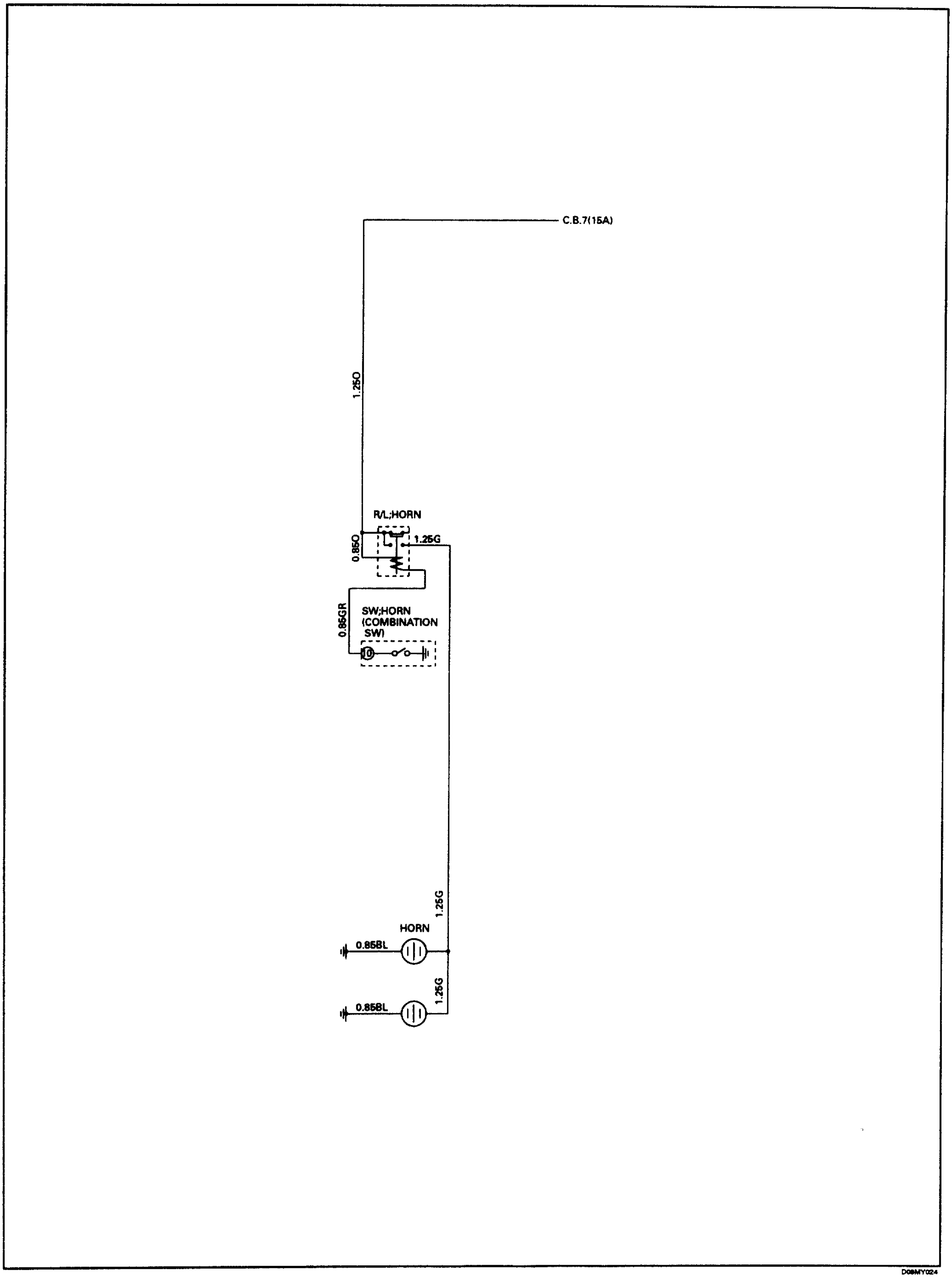
HORN AND BACKUP LIGHT

GENERAL DESCRIPTION

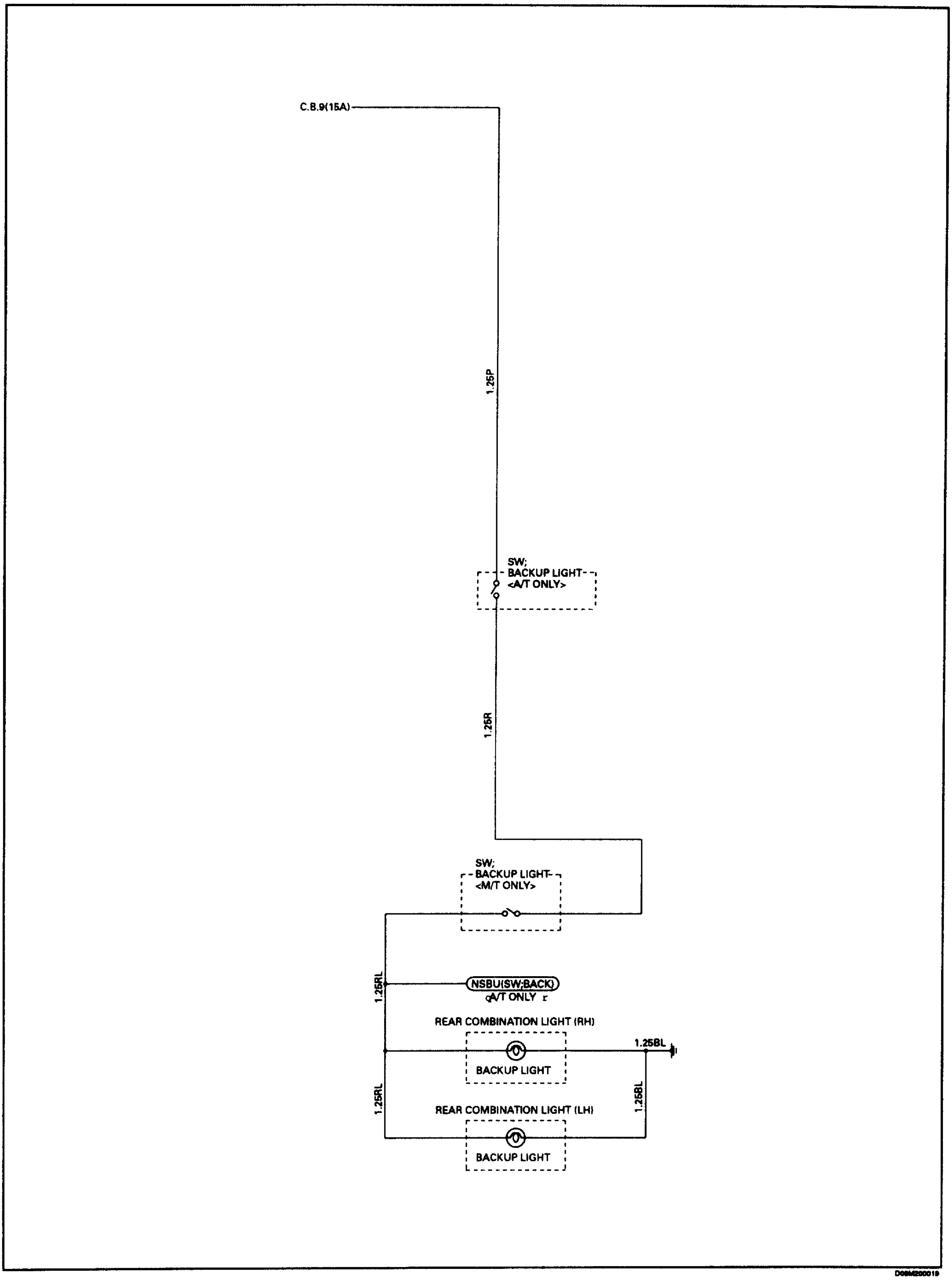
The circuit consists of the starter switch, horn, horn switch, backup light (Rear combination light), backup light switch, back buzzer and the relay.

When the horn switch is turned on independent of the position of the starter switch, the relay is activated to sound the horn. When the backup light switch turns on with the starter switch on, the backup light will operate.

CIRCUIT DIAGRAM



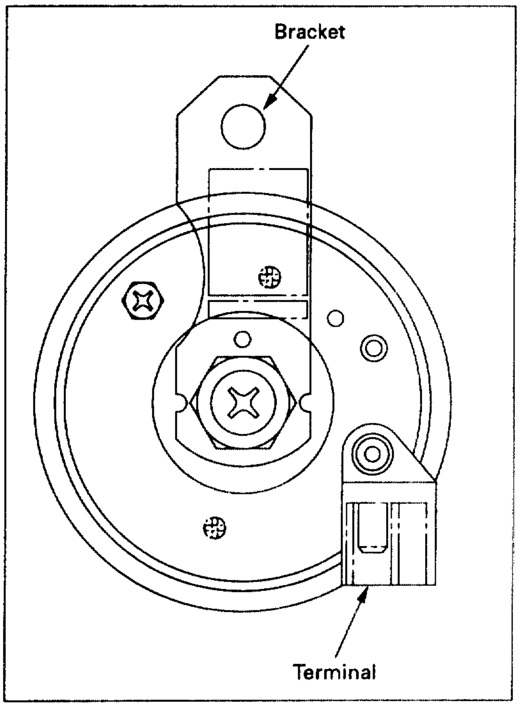
D08MY024


C.B.9(15A)
1.25P
SW;
BACKUP LIGHT
<A/T ONLY>
1.25R
SW;
BACKUP LIGHT
<M/T ONLY>
1.25RL
NSBU(SW;BACK)
<A/T ONLY>
REAR COMBINATION LIGHT (RH)
BACKUP LIGHT
1.25BL
1.25RL
REAR COMBINATION LIGHT (LH)
1.25BL
BACKUP LIGHT
D08M200019

STARTER SWITCH

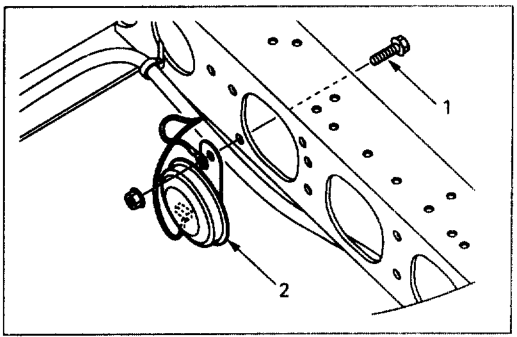
Refer to "START AND CHARGING" in this section.

ELEC. HORN



INSPECTION

Check to see if horn sound when a battery voltage is applied between horn terminal and the fixing bracket. Repair or replace the horn when the result of inspection is found abnormal.



REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Horn Assembly**

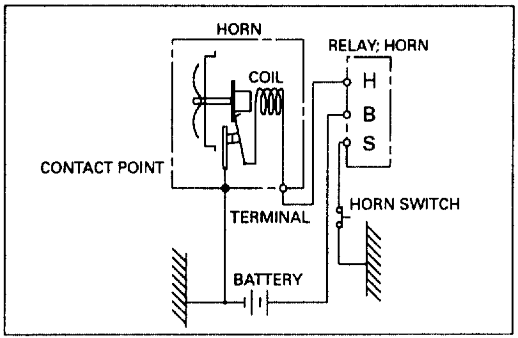
   Remove the screw.

2. **Horn**

   Disconnect the connector.

INSTALLATION

To install, follow the removal steps in the reverse order.



828MT013

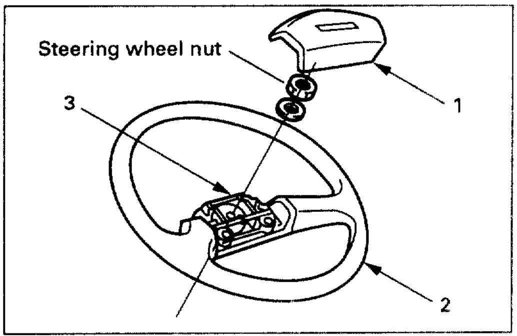
HORN SWITCH

INSPECTION

With the contact point of the horn switch pressed to the switch bracket, check the continuity between the connector terminal and the bracket of the switch.

Check the contact condition between horn contact of the combination switch and contact plate of steering wheel.

Repair or replace the switch when the result of inspection is found abnormal.



430MT001

REMOVAL

Preparation:

Disconnect the battery ground cable.

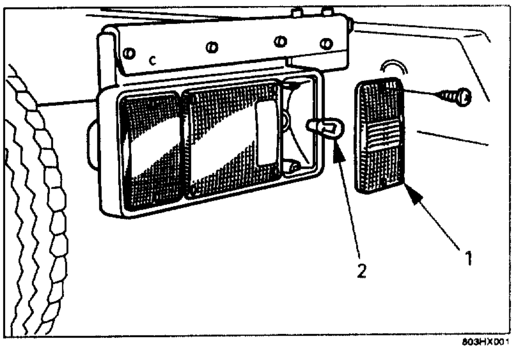
1. **Horn Pad**
   1) Hold the horn pad and pull it upward.
2. **Steering Wheel**
   1) Remove the steering wheel nut.
   2) Remove the steering wheel by using steering wheel remover.
      (Refer to Section 3B4 "STEERING COLUMN" for steering wheel removal steps.)
3. **Horn Switch**

INSTALLATION

To install, follow the removal steps in the reverse order, noting the following point.

1. **Tighten the steering shaft nut to the specified torque**

Shaft nut torque	N·m (kg·m/lb·ft)
49 (5/36)	



803HX001

BACKUP LIGHT BULB

REMOVAL

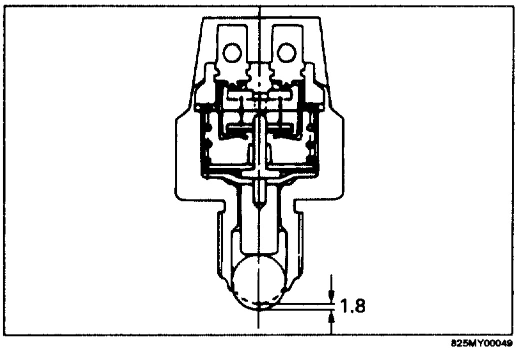
Preparation:

Disconnect the battery ground cable.

1. **Lens**
2. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.



BACKUP LIGHT SWITCH

INSPECTION

1. With the switch installed to the transmission, check the continuity between the terminals of the switch connectors.

   When the continuity is found between the terminals only with the switch shifted to the reverse position, the switch is normal.
2. When the result of the above inspection is found abnormal, remove the switch from the transmission and conduct a test on the switch alone.

   If the continuity appears between the connector terminals when the ball of the switch is released, the switch is normal. (When the ball is pushed, the continuity disappears.)
3. If there is no continuity with the switch installed to the transmission, even though the switch is found to be normal, then adjust the stroke of the switch by changing the thickness of the switch gasket.

REMOVAL

Preparation:

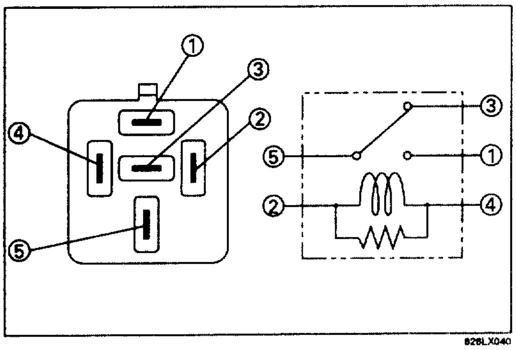
Disconnect the battery ground cable.

1. **Backup Light Switch**
   1) Disconnect the connectors.
   2) Remove the switch by turning it counterclockwise.

INSTALLATION

1. **Backup Light Switch**

   Apply liquid gasket to the screw portion of the switch to prevent oil leak.



HORN RELAY
BACKUP LIGHT RELAY

INSPECTION

Check to see if there is any continuity between the relay terminals.

Replace the relay when the result of inspection is found abnormal.

③ – ⑤ ..... Continuity
① – ⑤ ..... No continuity

(When battery voltage is applied between ② – ④)

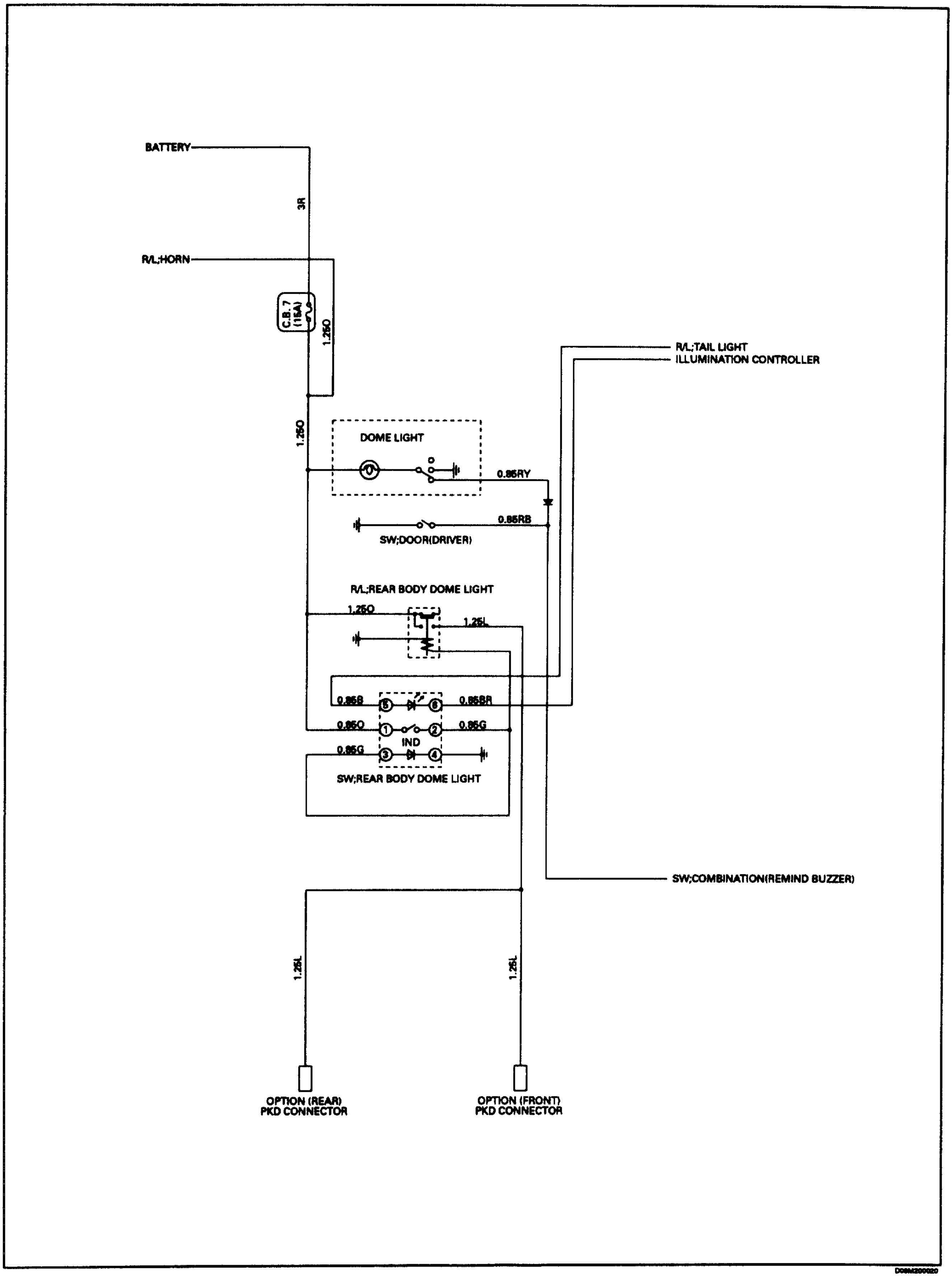
③ – ⑤ ..... No Continuity
① – ⑤ ..... Continuity

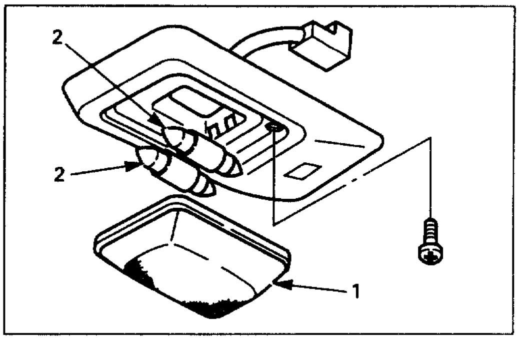
DOME LIGHT

GENERAL DESCRIPTION

The circuit consists of dome light, dome light switch and door switch.

CIRCUIT DIAGRAM





805MT001

DOME LIGHT BULB

REMOVAL

Preparation:

Disconnect the battery ground cable.

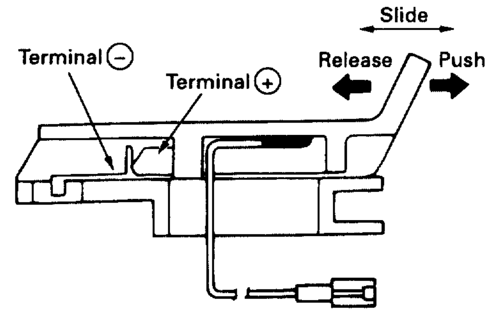
1. **Lens**

   Hold the lens and pull it downward.

2. **Bulb**

INSTALLATION

To install, follow the removal steps in the reverse order.



Terminal No. / SW operation	1	Body
Push		
Release	○	○

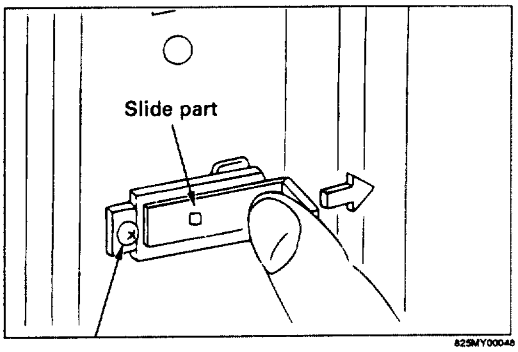
825MY00047

DOOR SWITCH

INSPECTION

Check to see if there is any continuity between the terminals and the body while operating the door switch.

Repair or replace the switch, when the result of inspection is found abnormal.



825MY00048

REMOVAL

Preparation:

Disconnect the battery ground cable.

1. **Door Switch**
   1) Remove the screw.
   2) Disconnect the connector of the switch.

INSTALLATION

To install, follow the removal steps in the reverse order.

POWER WINDOW

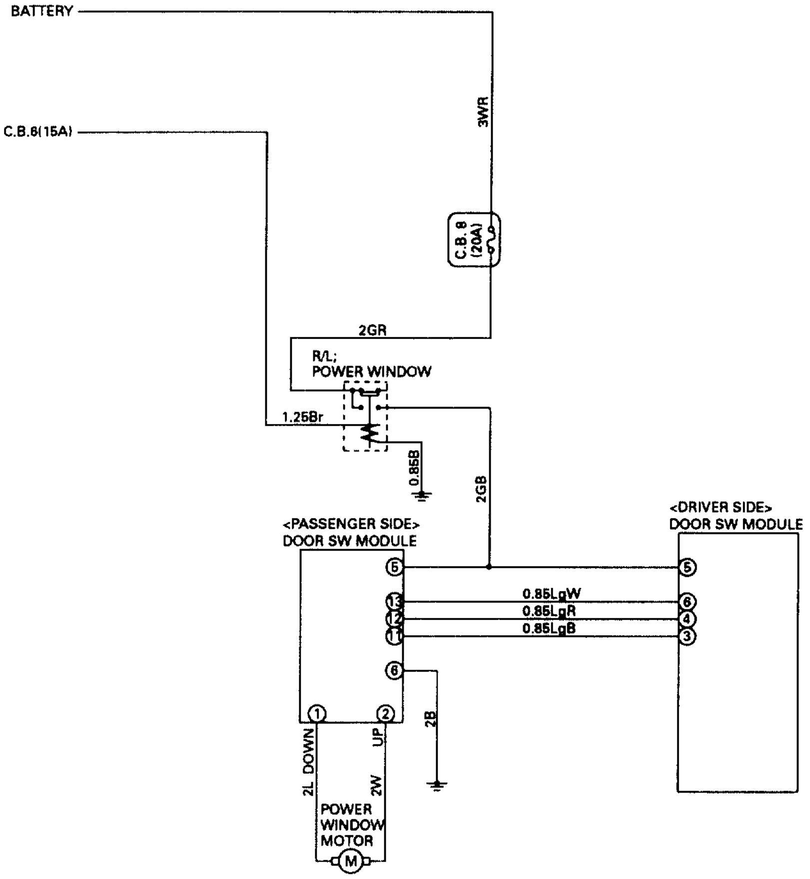
GENERAL DESCRIPTION

The circuit consists of the starter switch, door switch module and power window motor.

When the starter switch is turned on, the battery voltage is applied to each of the power window switches through the circuit breaker and the power window relay on the circuit.

To open the power window, press "DOWN" on the power window switch. To close the power "UP" on the power window switch.

CIRCUIT DIAGRAM



D08M200021

WINDSHIELD WIPER AND WASHER

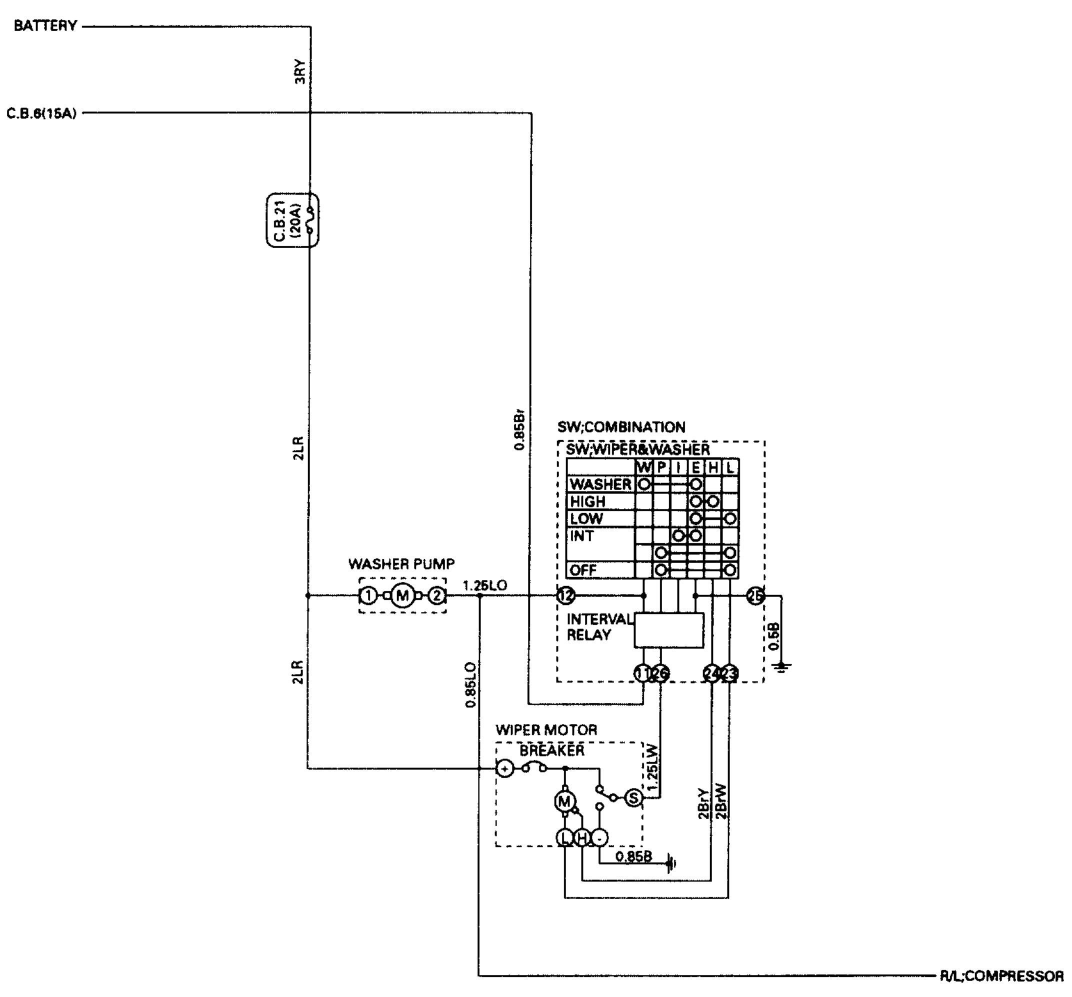
GENERAL DESCRIPTION

The circuit consists of the starter switch, windshield wiper & washer switch, wiper motor, washer motor and the interval relay.

When the wiper & washer switch is turned on with starter switch on, the battery voltage is applied to the wiper motor to activate the wiper.

The washer motor will spray washer fluid when the washer switch is pushed in. The interval relay is used to control motion of the wiper.

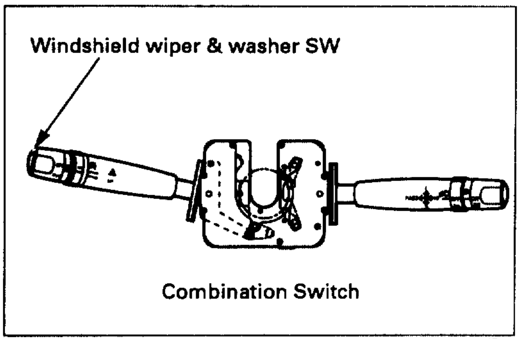
CIRCUIT DIAGRAM



D08M200022

STARTER SWITCH

Refer to "START AND CHARGING" in this section.



WINDSHIELD WIPER & WASHER SWITCH

With the starter switch on, the windshield wiper and washer switch controls the start and stop operation as well as change of operating speeds.

Both the windshield washer motor and the wiper motor jointly operate when the washer button is pushed.

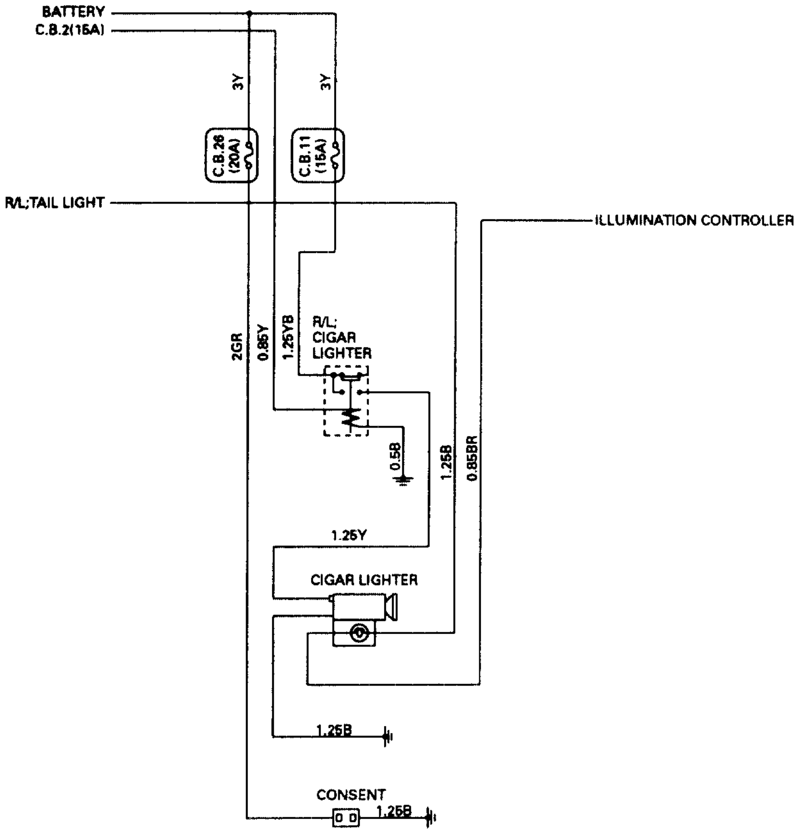
CIGARETTE LIGHTER AND CONSENT

GENERAL DESCRIPTION

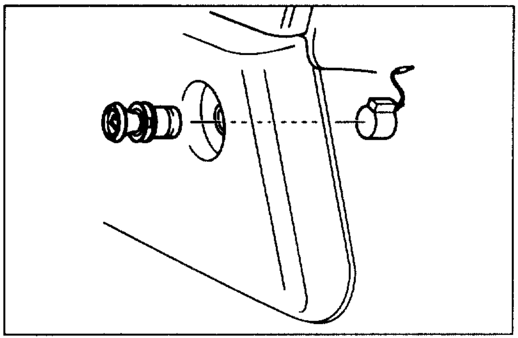
The circuit consists of the starter switch, consent, cigarette lighter and the relay.

When the cigar lighter is pushed in with the starter switch at either "ON", "HEAT" or "START" position, a circuit is formed in the cigar lighter case to heat the lighter coil. The cigar lighter springs back to its original position after the lighter coil is heated.

CIRCUIT DIAGRAM



CIGARETTE LIGHTER



REMOVAL

Preparation:

Disconnect the battery ground cable.

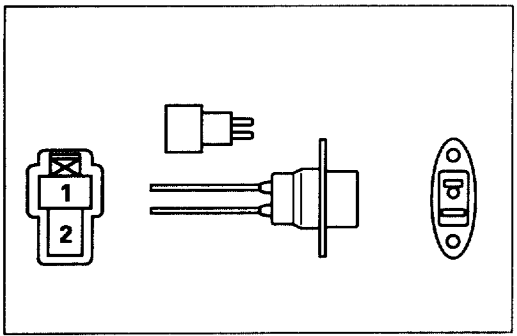
1. **Center Cluster**
2. **Cigar Lighter Assembly**

   Remove the nut, then remove cigarette lighter assembly and outer case.

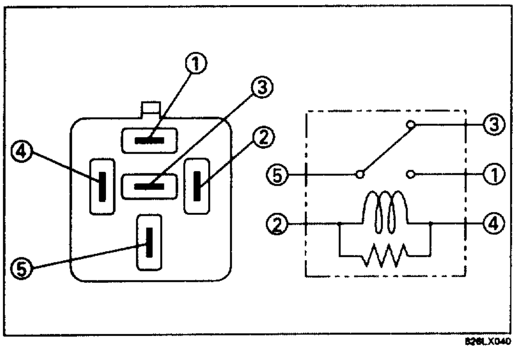
INSTALLATION

To install, follow the removal steps in the reverse order.

CONSENT



CIGARETTE LIGHTER RELAY



INSPECTION

Check to see if there is any continuity between the relay terminals.

Replace the relay when the result of inspection is found abnormal.

③ – ⑤ ..... Continuity
① – ⑤ ..... No continuity

(When battery voltage is applied between ② – ④)

③ – ⑤ ..... No Continuity
① – ⑤ ..... Continuity

METER AND WARNING/INDICATOR LIGHT

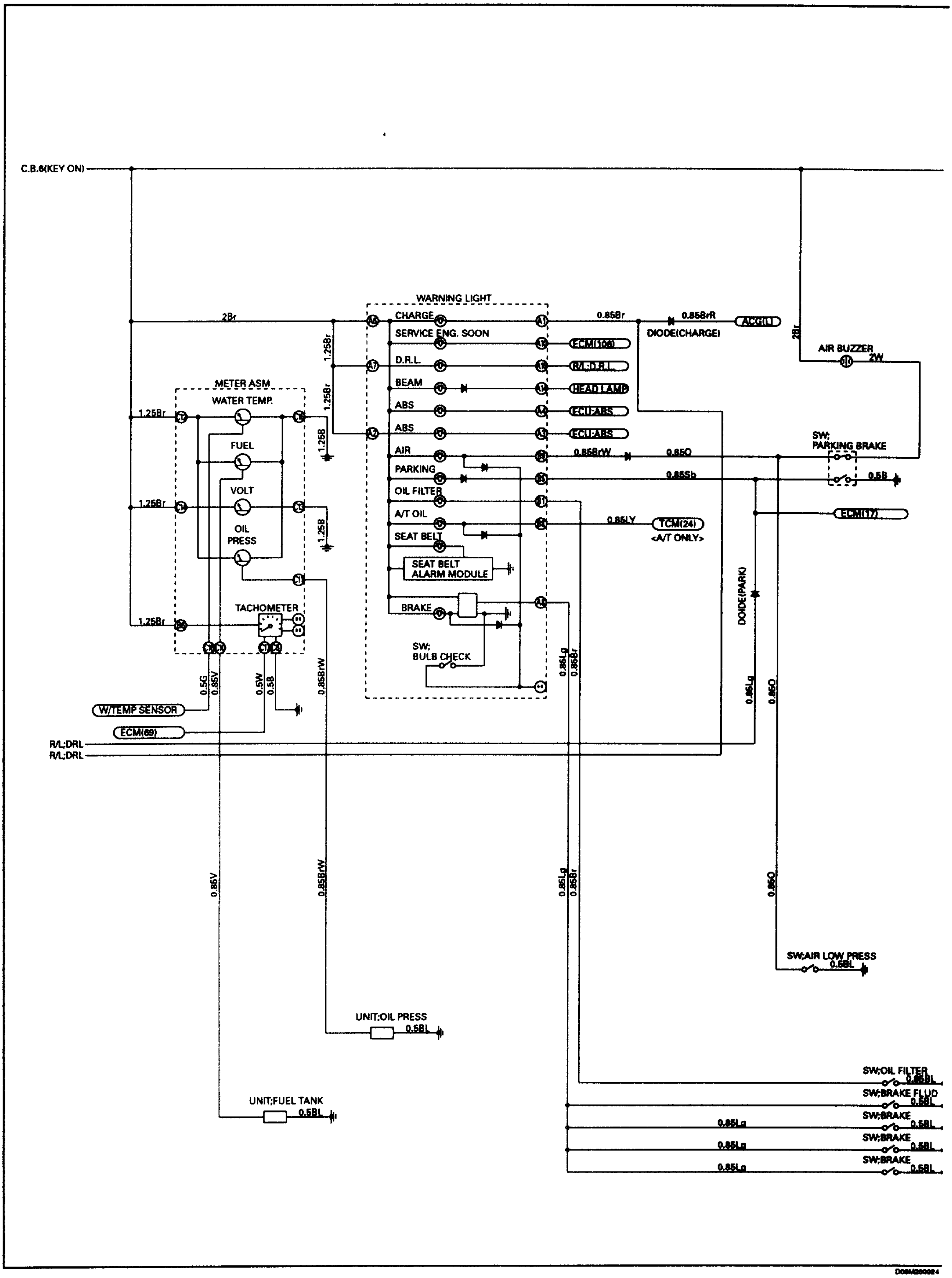
GENERAL DESCRIPTION

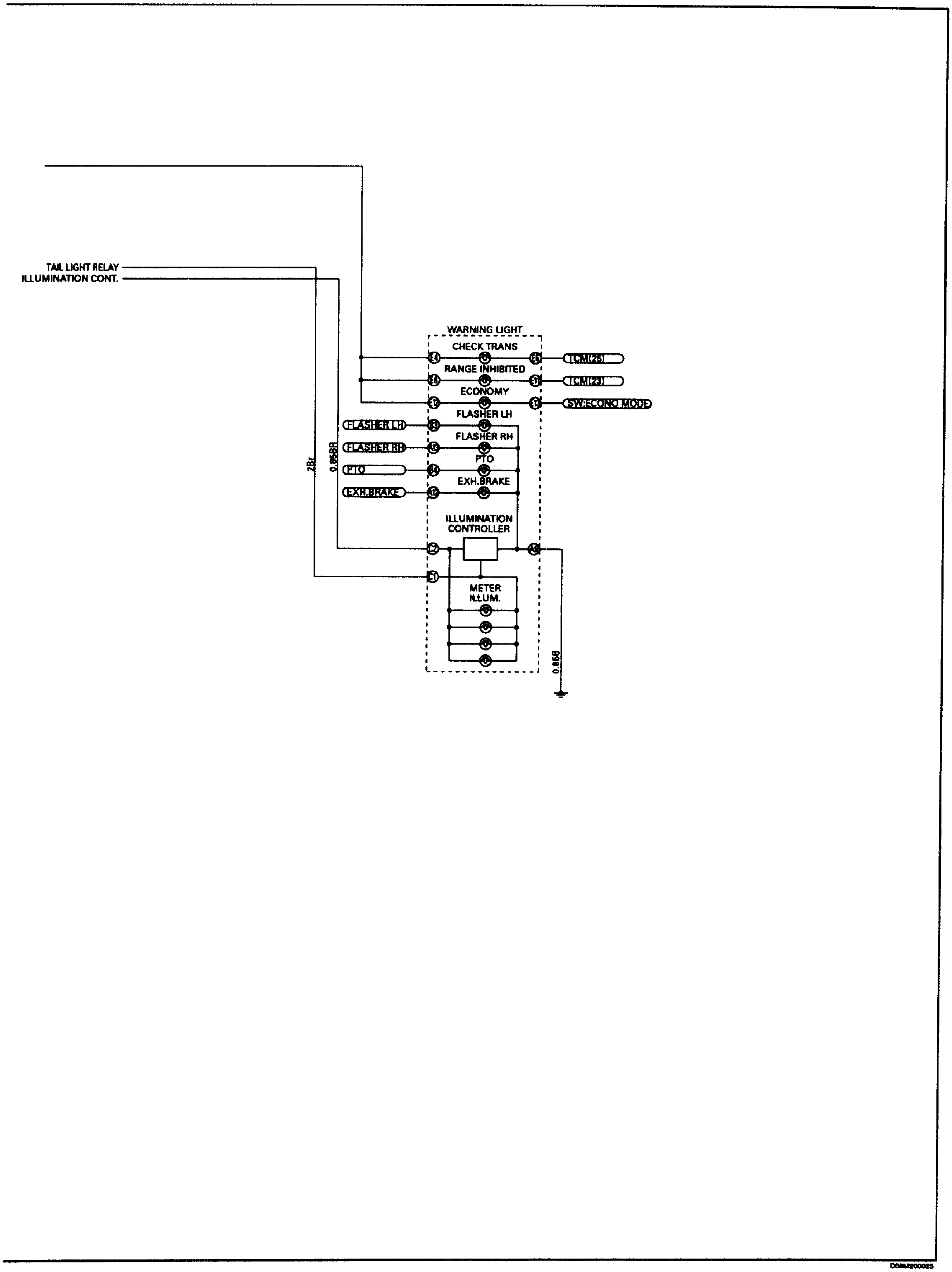
The circuit consists of the starter switch, meter assembly, the switches, the sensors and ECM.

The meter assembly contains the speedometer, tachometer, fuel gauge, water temperature gauge and the warning/indicator light.

The meter warning/indicator lights and their bulb sockets are a unit, they are installed from the back of the meter assembly.

CIRCUIT DIAGRAM

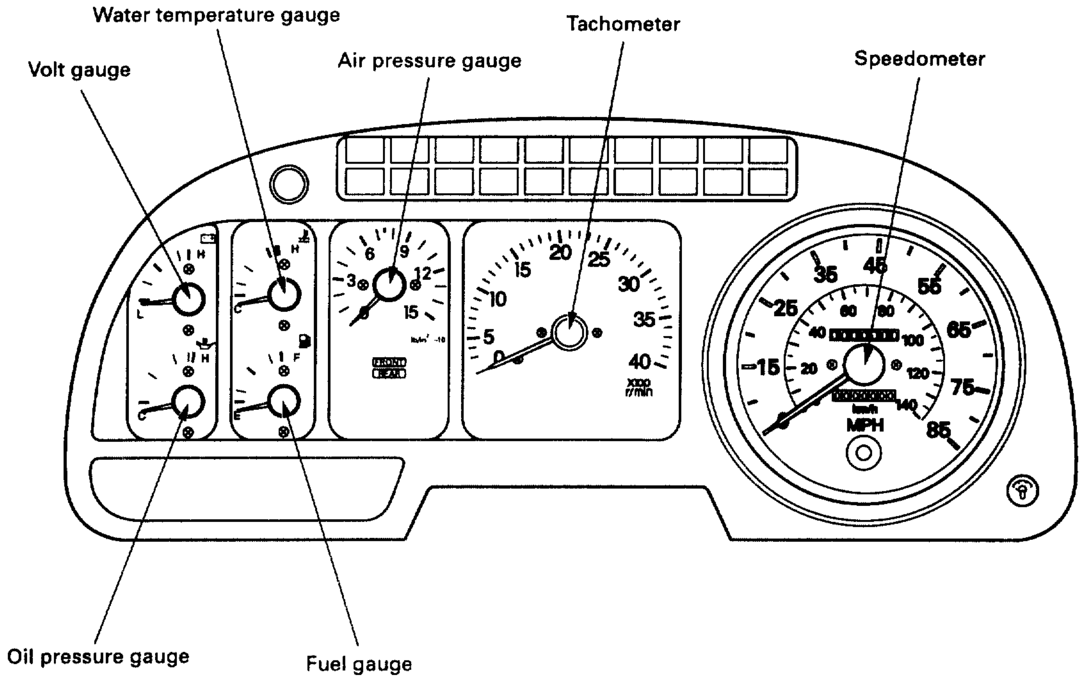



TAIL LIGHT RELAY
ILLUMINATION CONT.
2Br
0.85BR
WARNING LIGHT
CHECK TRANS
E4
E5
TCM(25)
RANGE INHIBITED
E6
TCM(23)
ECONOMY
SW:ECONO MODE
FLASHER LH
FLASHER LH
FLASHER RH
FLASHER RH
PTO
PTO
EXH.BRAKE
EXH.BRAKE
ILLUMINATION
CONTROLLER
C2
A9
E1
METER
ILLUM.
0.85B

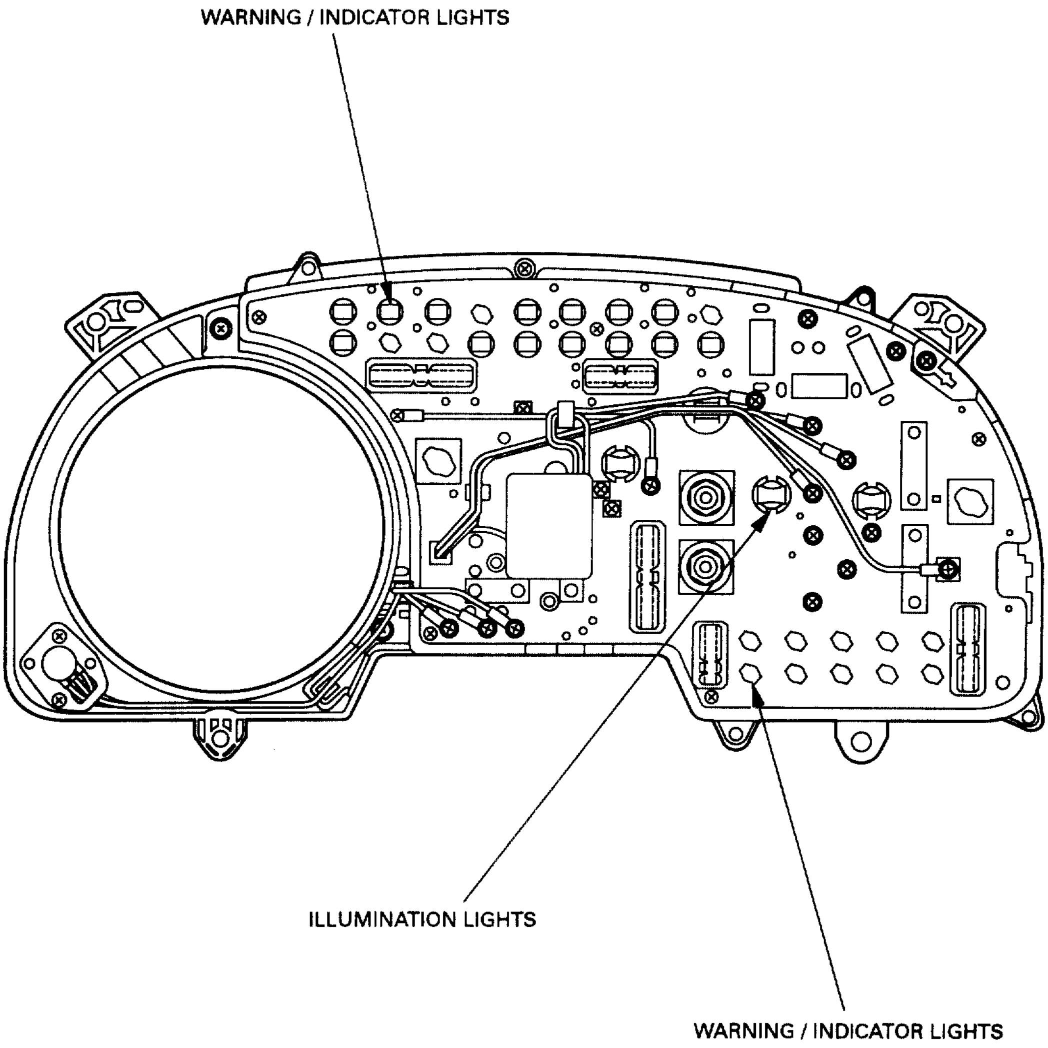
D08M200025

METER ASSEMBLY

GAUGES AND WARNING/INDICATOR LIGHTS LAYOUT

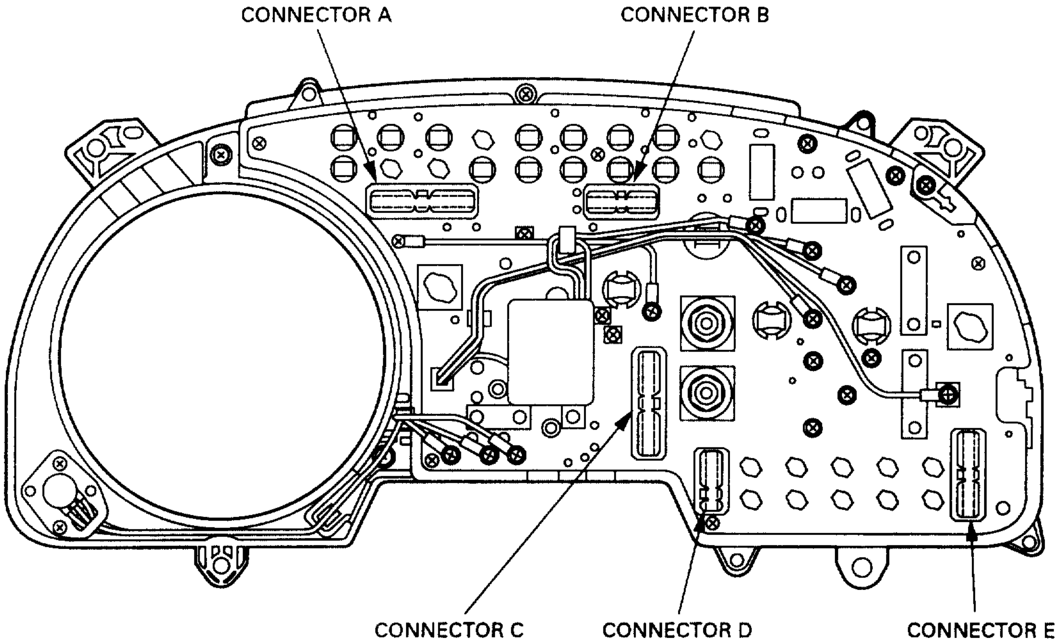


BULB LAYOUT

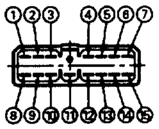


821M200003

METER CONNECTOR TERMINAL ASSIGNMENT

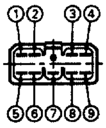


CONNECTOR A



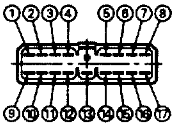
No.	Connected to
1	CHARGE
2	EXH.ABS(AMBER)
3	EXH.ABS(AMBER)
4	DO NOT SHIFT, CHECK TRANS, AIR ABS(GREEN)
5	PARK BRAKE, AIR CLEANER
6	IGN
7	DRL
8	BRAKE,AIR MASTER BRAKE OIL LEBEL
9	GROUND
10	SERVICE ENGINE SOON
11	SERVICE PARK BRAKE
12	APPLY PARK BRAKE EXH.BRAKE
13	FLASHER(RH)
14	BEAM
15	DRL

CONNECTOR B



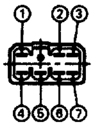
No.	Connected to
1	OIL FILTER
2	———
3	FLASHER (LH)
4	PTO,AUX BRAKE
5	LOW COOLANT PARK BRAKE
6	TACHOMETER (IGN)
7	———
8	CHECK GAGES,A/T OIL
9	PRIMARY BRAKE BRAKE AIR,TAIL STOP

CONNECTOR C



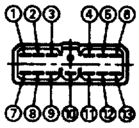
No.	Connected to
1	ILLUMI (+)
2	ILLUMI (-)
3	CHECK GAUGE OUT PUT (TEMP)
4	CHECK GAUGE OUT PUT (OIL)
5	CHECK GAUGE OUT PUT
6	TACHOMETER (GND)
7	———
8	———
9	———
10	FUEL GAUGE UNIT
11	OIL PRESSURE GAUGE
12	GAUGE UNIT (IGN)
13	VOLT GAUGE
14	VOLT GAUGE
15	GAUGE UNIT (GND)
16	WATER TEMP. GAUGE UNIT
17	TACHOMETER (PULSE)

CONNECTOR D



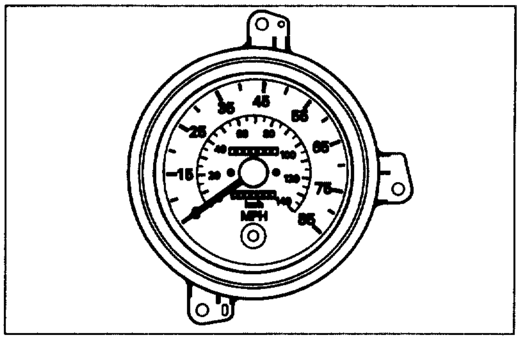
No.	Connected to
1	FAST IDLE
2	4WD
3	4WD
4	CHANGE OIL
5	CHANGE OIL
6	REDUCED ENGINE POWER
7	REDUCED ENGINE POWER

CONNECTOR E



No.	Connected to
1	INTAKE HEATER
2	RANGE INHIBITED
3	RANGE INHIBITED
4	ABS1,CHECK TRANS
5	ABS1,CHECK TRANS
6	SERVICE TRANS FILTER RANGE INHIBITED
7	AIR SUSP DUMP
8	AIR SUSP DUMP
9	FAST IDLE
10	INTAKE HEATER
11	SERVICE TRANS FILTER RANGE INHIBITED
12	ENDINE OVER-SPEED, ECONOMY
13	ENDINE OVER-SPEED, ECONOMY

821M200002



821MY007

SPEEDOMETER

The speedometer is made up of the cross coil type ammeter (movement that displays the vehicle speed) with the use of the Stepper Motor (which controls the odometer and tripmeter movement) and the Driving Circuit (that process the communication between pulse signals and current).

MP/H

Tester display speed	Meter display permissible level
20	19 – 22
40	39.7 – 42.5
60	60 – 63

ON-VEHICLE SERVICE

Check the meter display accuracy and the operation of the odometer with the speedometer tester.

NOTE:

Inappropriate tire inflation may affect the accuracy of the odometer.

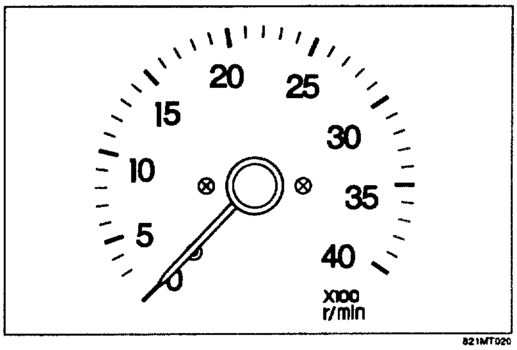
(To conduct this test, refer to the tester manufacturer's instruction manual.)

Since the meter display permissible levels above are specifications solely for the meter, they are to be used as reference values when conducting on-vehicle service.

INDIVIDUAL INSPECTION

Remove the speedometer from the meter assembly and measure the resistance and the current consumption between each terminal.

Replace the speedometer if the result of inspection is found abnormal.



821MT020

TACHOMETER

The tachometer is made up of the cross coil type ammeter (movement that displays the engine speed) and the Driving Circuit (that process the communication between pulse signals and current).

r/min

Tester display speed	Meter display permissible level
500	450 – 550
1000	900 – 1100
1500	1380 – 1620
2000	1880 – 2120
2500	2350 – 2650
3000	2850 – 3150
3500	3350 – 3650

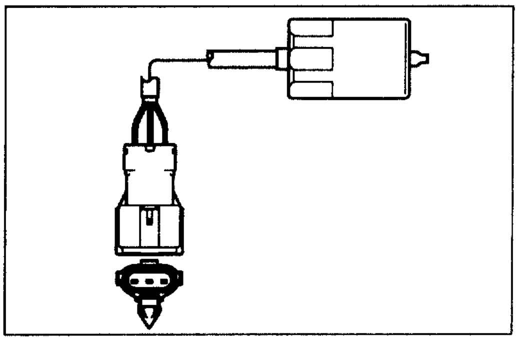
ON-VEHICLE SERVICE INSPECTION

1. Set up the tune-up tester to the engine.
2. Start the engine and compare the readings displayed by the tachometer and the tester.

   When the difference between these two readings differs largely from the specified value, replace it with a correct one.

NOTE:

Since the meter display permissible levels above are specifications solely for the meter, they are to be used as reference values when conducting on-vehicle inspection.

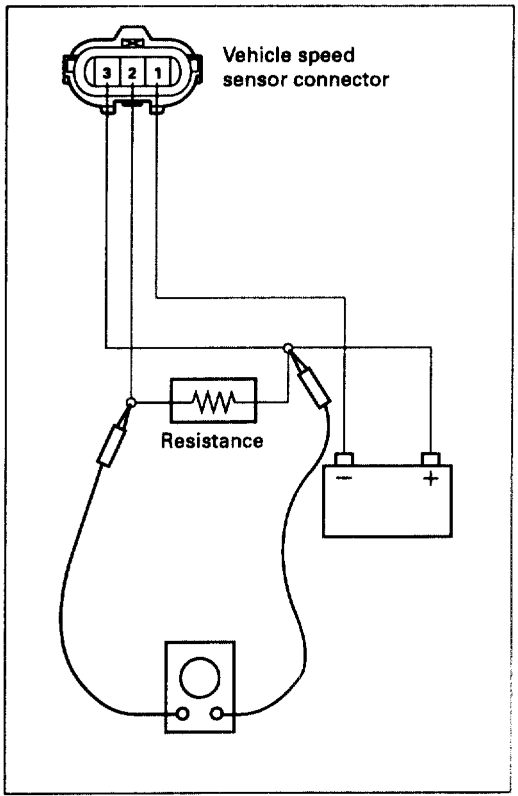


820MT001

Vehicle speed sensor (Installed on the transmission)

The vehicle speed sensor is installed on the rear portion of the transmission.

The number of pulses generated is eight pulses per one rotation of the pinion shaft.



820MT002

INSPECTION

1. Connect the vehicle speed sensor connector terminal No.3 to the battery (+) terminal and connector terminal No. 1 to the battery (–) terminal.
2. Connect a resistance of 1.3kΩ between connector terminals No. 2 and No. 3.

CAUTION: Be extremely careful not to connect the battery (+) terminal to the connector terminal No. 2. This may damage the vehicle speed sensor.

3. Rotate the shaft of the vehicle speed sensor slowly and measure the voltage at both ends with a digital tester.

The voltage, with one rotation of shaft, fluctuates eight times in the following range 20 to 28V ↔ 2V or less.

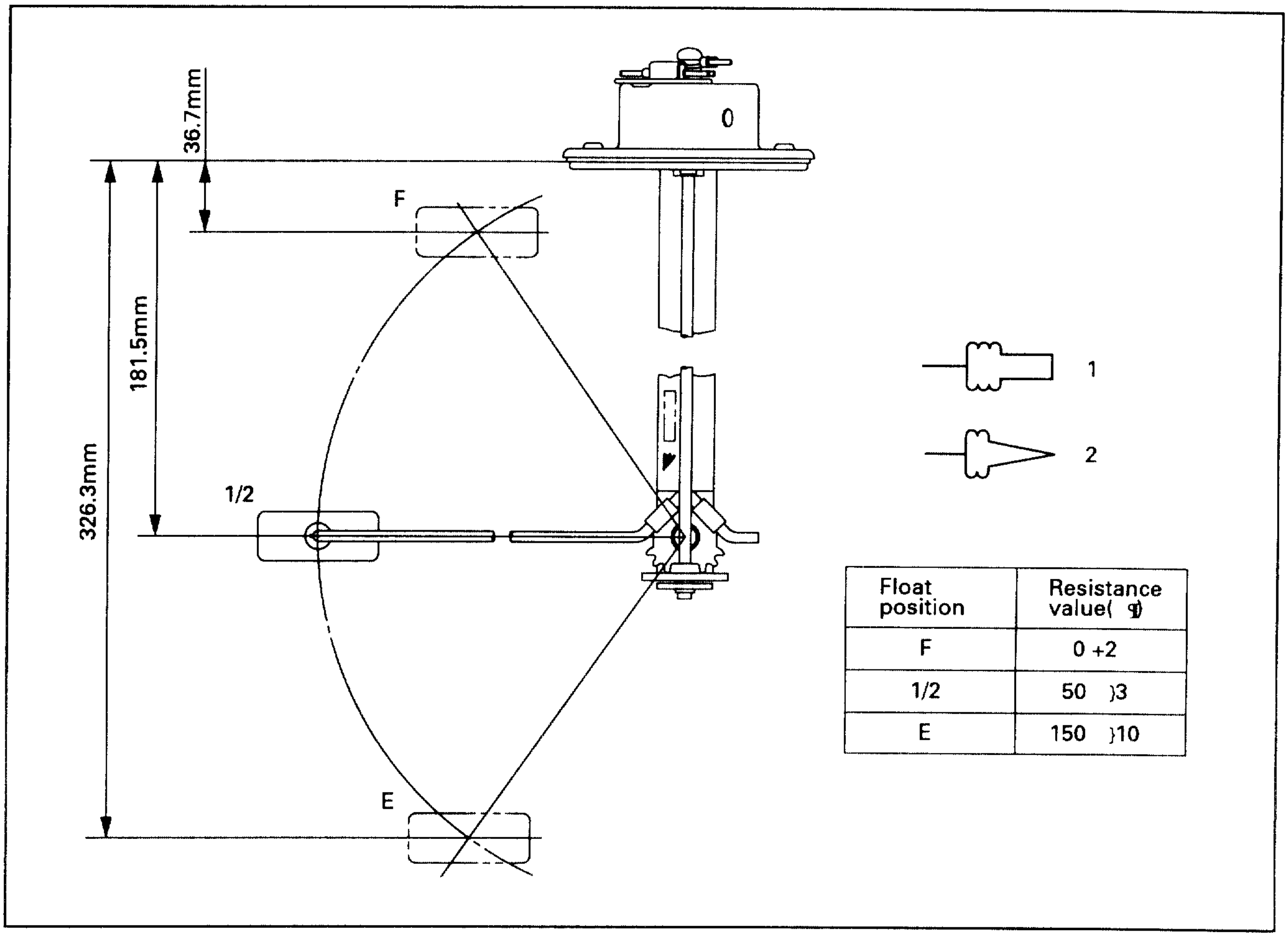
Replace the sensor if the result of inspection is found abnormal.

FUEL TANK UNIT

The tank unit varies the internal resistance according to the float position (fluid level) to operate the fuel meter needle.

INSPECTION

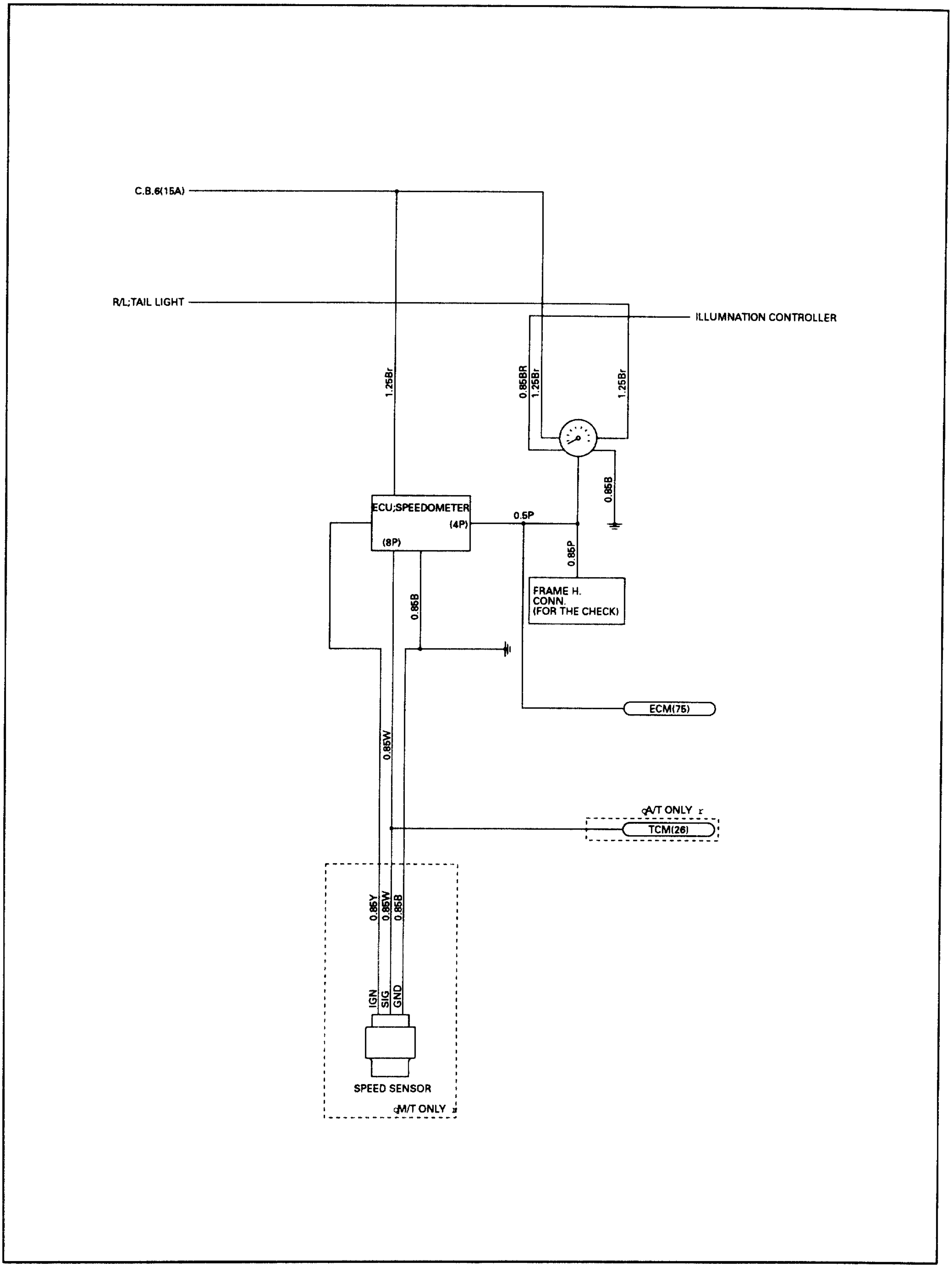
Check the resistance between the connector terminals "1" and "2" while shifting the float from "E" to "F" point. If found defective replace the fuel tank unit.



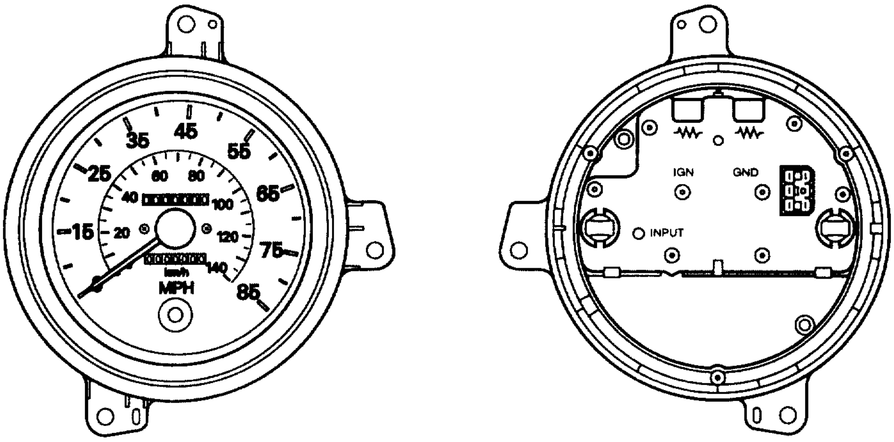
Float position	Resistance value(Ω)
F	0 +2
1/2	50 }3
E	150 }10

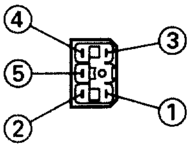
SPEEDOMETER

CIRCUIT DIAGRAM



SPEEDOMETER

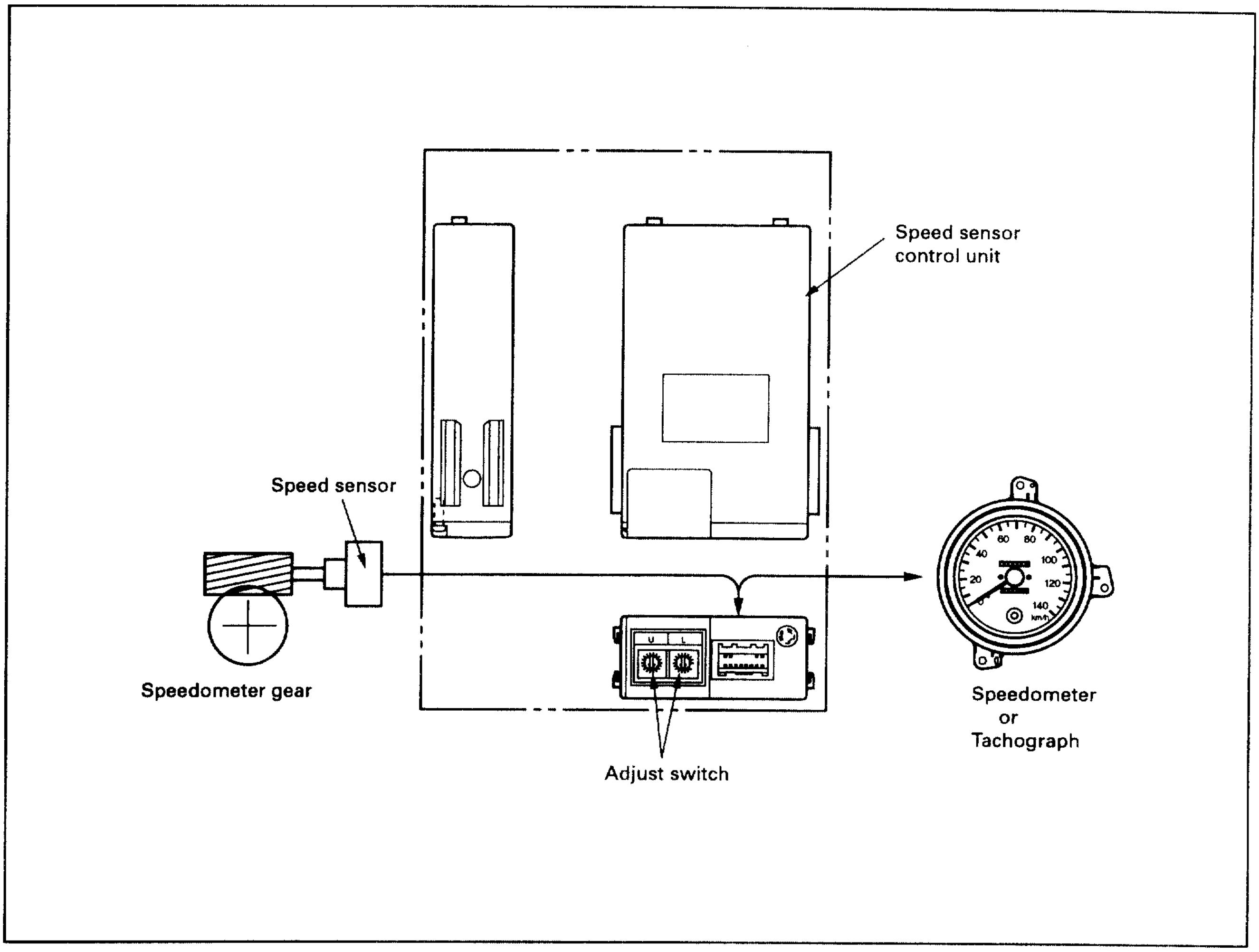




No.	Connected to
1	Illumi(GND)
2	Illumination
3	IGN
4	GND
5	Pulse

821MY008

SPEEDOMETER CONTROL UNIT



Adjustment of speed sensor control unit

1. After obtaining the conversion ratio $1/\gamma$ by using the expression given below, get from the list of conversion ratio a switch adjustment value corresponding to the value closest to the $1/\gamma$ value obtained.

NOTE:

On this occasion, be sure to get a switch adjustment value equal to the obtained conversion ratio $1/\gamma$, or a larger value most approximate to it.

2. Set "U" and "L" of the adjust switch of the speed speedometer control unit to the switch adjustment value obtained in Step 1 above. At this time, be sure to leave the harness connector connected to the control unit.

Expression:

$$\frac{1}{\gamma} = \frac{15925}{\frac{10^3}{2\pi R} \times A \times \frac{M}{N} \times 25} \times \frac{1}{X}$$

R: Dynamic load radius (m) of the tire

$\left(\begin{array}{l}\text{Tire size: 225/70R19.5}\\ \text{R: 0.395m}\end{array}\right)$

A: Final ratio

$\frac{M}{N}$: Coefficient of the speedometer

$\left(\begin{array}{l}\text{2/3 for MLD,}\\ \text{10/17 for AT542 with} \times 100\text{,}\\ \text{6/14 for Fuller FS8209 and Fuller RT7608LL,}\\ \text{9/14 for ZF 9S - 75,}\\ \text{11/17 for ZF 9S - 109}\end{array}\right)$

X: Correction ratio

SW set value U L	Conversion Ratio 1/γ	SW set value U L	Conversion Ratio 1/γ	SW set value U L	Conversion Ratio 1/γ	SW set value U L	Conversion Ratio 1/γ
0 0	0.4375	1 0	0.4853	2 0	0.5384	3 0	0.5973
0 1	0.4404	1 1	0.4885	2 1	0.5419	3 1	0.6011
0 2	0.4433	1 2	0.4917	2 2	0.5454	3 2	0.6050
0 3	0.4462	1 3	0.4949	2 3	0.5489	3 3	0.6090
0 4	0.4490	1 4	0.4981	2 4	0.5525	3 4	0.6128
0 5	0.4520	1 5	0.5013	2 5	0.5561	3 5	0.6169
0 6	0.4549	1 6	0.5046	2 6	0.5597	3 6	0.6208
0 7	0.4579	1 7	0.5079	2 7	0.5634	3 7	0.6250
0 8	0.4608	1 8	0.5112	2 8	0.5670	3 8	0.6290
0 9	0.4639	1 9	0.5144	2 9	0.5706	3 9	0.6331
0 A	0.4668	1 A	0.5178	2 A	0.5745	3 A	0.6372
0 B	0.4698	1 B	0.5213	2 B	0.5782	3 B	0.6414
0 C	0.4730	1 C	0.5246	2 C	0.5820	3 C	0.6454
0 D	0.4761	1 D	0.5280	2 D	0.5856	3 D	0.6497
0 E	0.4791	1 E	0.5314	2 E	0.5895	3 E	0.6539
0 F	0.4822	1 F	0.5349	2 F	0.5933	3 F	0.6581

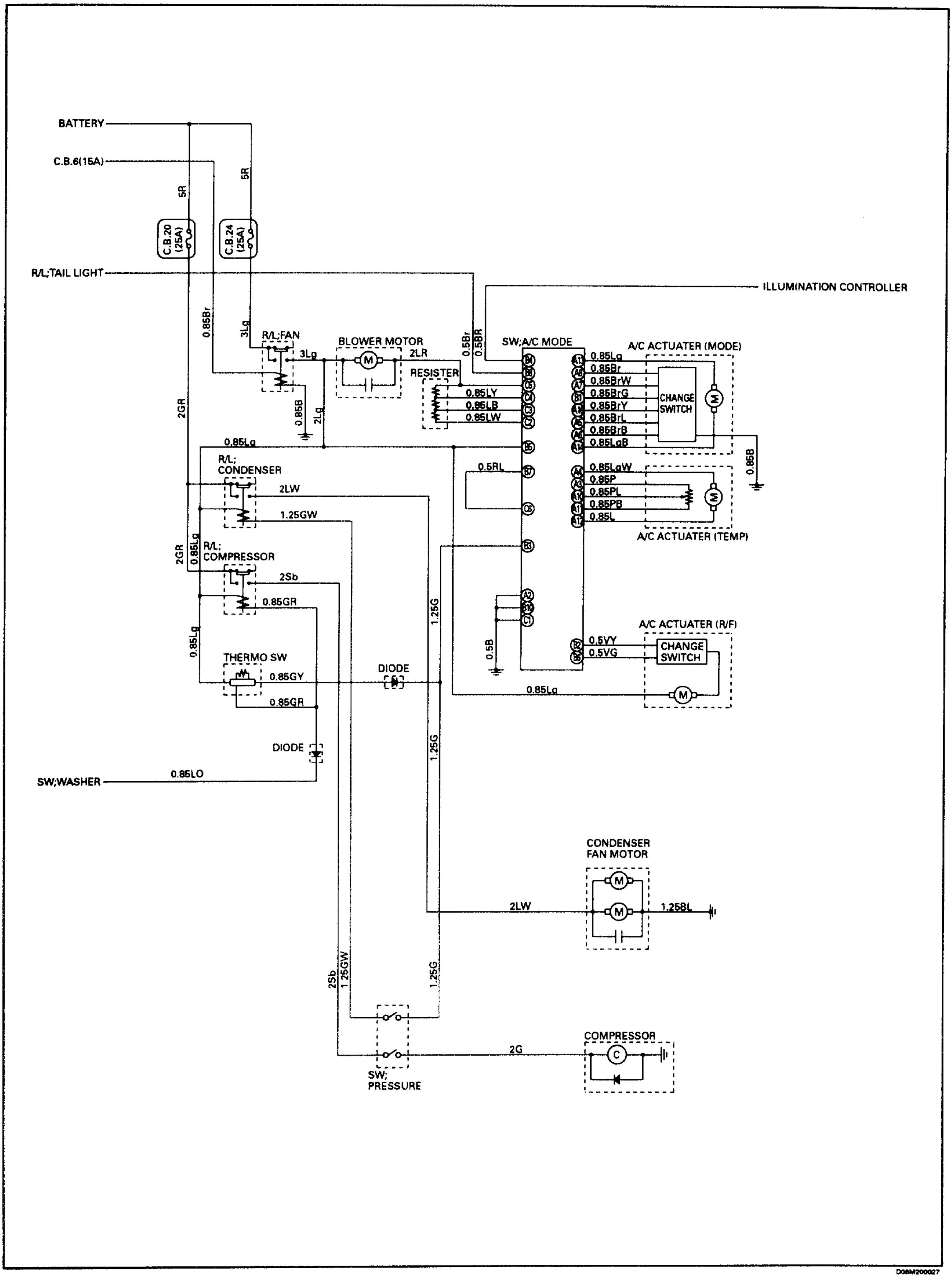
SW set value U L	Conversion Ratio $1/\gamma$	SW set value U L	Conversion Ratio $1/\gamma$	SW set value U L	Conversion Ratio $1/\gamma$	SW set value U L	Conversion Ratio $1/\gamma$
4 0	0.6624	7 0	0.9042	A 0	1.2337	D 0	1.6842
4 1	0.6667	7 1	0.9098	A 1	1.2420	D 1	1.6954
4 2	0.6710	7 2	0.9159	A 2	1.2503	D 2	1.7067
4 3	0.6755	7 3	0.9217	A 3	1.2580	D 3	1.7181
4 4	0.6797	7 4	0.9280	A 4	1.2665	D 4	1.7283
4 5	0.6843	7 5	0.9339	A 5	1.2744	D 5	1.7400
4 6	0.6886	7 6	0.9399	A 6	1.2832	D 6	1.7504
4 7	0.6931	7 7	0.9460	A 7	1.2913	D 7	1.7625
4 8	0.6978	7 8	0.9521	A 8	1.2995	D 8	1.7747
4 9	0.7023	7 9	0.9584	A 9	1.3078	D 9	1.7855
4 A	0.7067	7 A	0.9647	A A	1.3170	D A	1.7965
4 B	0.7114	7 B	0.9711	A B	1.3266	D B	1.8092
4 C	0.7161	7 C	0.9771	A C	1.3342	D C	1.8204
4 D	0.7206	7 D	0.9837	A D	1.3421	D D	1.8318
4 E	0.7252	7 E	0.9899	A E	1.3509	D E	1.8450
4 F	0.7301	7 F	0.9966	A F	1.3599	D F	1.8568
5 0	0.7348	8 0	1.0029	B 0	1.3690	E 0	1.8686
5 1	0.7396	8 1	1.0094	B 1	1.3782	E 1	1.8806
5 2	0.7445	8 2	1.0159	B 2	1.3866	E 2	1.8928
5 3	0.7494	8 3	1.0225	B 3	1.3960	E 3	1.9051
5 4	0.7541	8 4	1.0291	B 4	1.4047	E 4	1.9176
5 5	0.7591	8 5	1.0359	B 5	1.4177	E 5	1.9303
5 6	0.7639	8 6	1.0428	B 6	1.4232	E 6	1.9431
5 7	0.7688	8 7	1.0492	B 7	1.4322	E 7	1.9561
5 8	0.7740	8 8	1.0562	B 8	1.4412	E 8	1.9673
5 9	0.7790	8 9	1.0633	B 9	1.4515	E 9	1.9807
5 A	0.7841	8 A	1.0700	B A	1.4608	E A	1.9942
5 B	0.7892	8 B	1.0768	B B	1.4702	E B	2.0059
5 C	0.7941	8 C	1.0842	B C	1.4798	E C	2.0197
5 D	0.7994	8 D	1.0911	B D	1.4895	E D	2.0317
5 E	0.8047	8 E	1.0981	B E	1.4993	E E	2.0460
5 F	0.8098	8 F	1.1052	B F	1.5081	E F	2.0583
6 0	0.8150	9 0	1.1124	C 0	1.5182	F 0	2.0729
6 1	0.8205	9 1	1.1197	C 1	1.5284	F 1	2.0855
6 2	0.8258	9 2	1.1271	C 2	1.5387	F 2	2.1005
6 3	0.8312	9 3	1.1346	C 3	1.5480	F 3	2.1135
6 4	0.8366	9 4	1.1416	C 4	1.5586	F 4	2.1267
6 5	0.8418	9 5	1.1493	C 5	1.5681	F 5	2.1400
6 6	0.8473	9 6	1.1564	C 6	1.5790	F 6	2.1558
6 7	0.8530	9 7	1.1643	C 7	1.5888	F 7	2.1695
6 8	0.8583	9 8	1.1716	C 8	1.5988	F 8	2.1834
6 9	0.8641	9 9	1.1790	C 9	1.6101	F 9	2.1974
6 A	0.8696	9 A	1.1872	C A	1.6203	F A	2.2117
6 B	0.8752	9 B	1.1949	C B	1.6306	F B	2.2261
6 C	0.8809	9 C	1.2026	C C	1.6410	F C	2.2407
6 D	0.8866	9 D	1.2104	C D	1.6516	F D	2.2555
6 E	0.8924	9 E	1.2183	C E	1.6623	F E	2.2705
6 F	0.8982	9 F	1.2263	C F	1.6732	F F	2.2832

HEATER, VENTILATION AND AIR CONDITIONING

GENERAL DESCRIPTION

The circuit consists of compressor, blower motor, condenser fan motor, A/C mode switch, A./C mode actuator, A/C actuator (R/F), resistor and relay.

CIRCUIT DIAGRAM



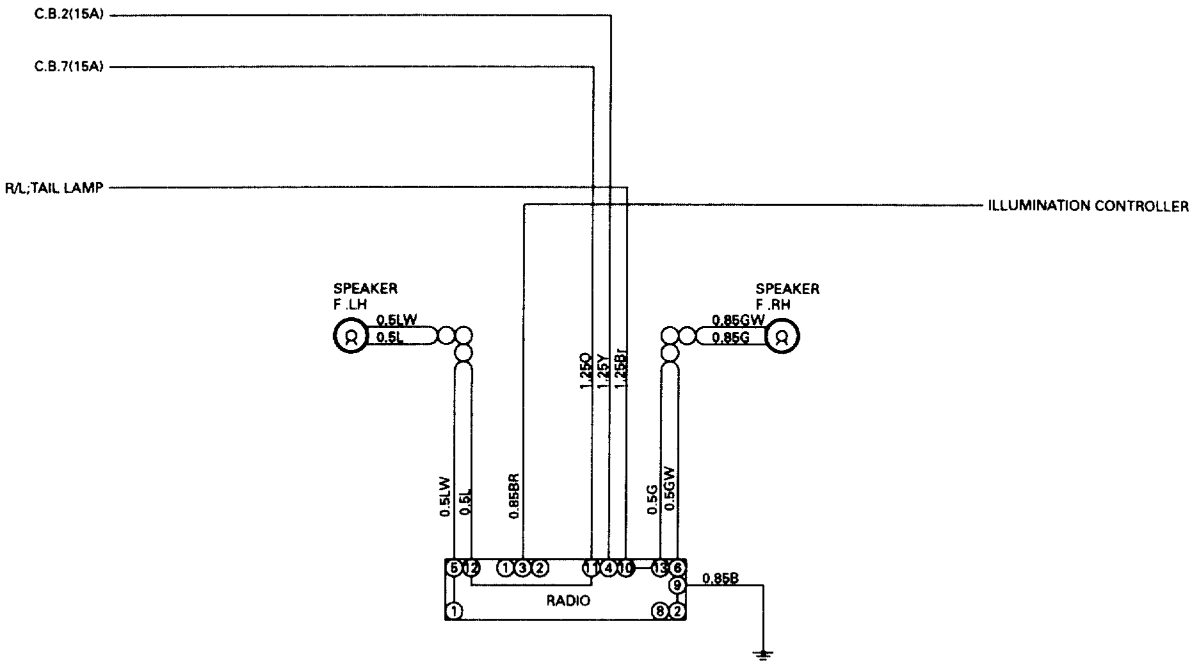
D08M200027

RADIO

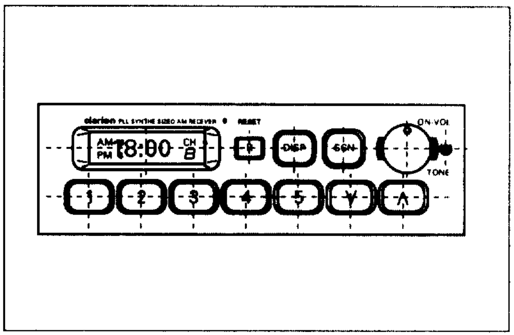
GENERAL DESCRIPTION

The circuit consists of radio and speaker. Battery voltage is always applied to memory circuit inside of radio regardless of starter switch position. When radio switch is turned on with starter switch in "ACC" or "ON", battery voltage is applied to receiver circuit of radio.

CIRCUIT DIAGRAM



D08MY033



890MT001

6	5	4	☒	3	2	1
13	12	11	10	9	8	7

No.	Connected to
1	
2	
3	
4	ACC(+)
5	SPEAKER-LH(+)
6	SPEAKER-RH(+)
7	
8	
9	GROUND
10	ILLUMINATION(+)
11	BACK UP
12	SPEAKER-LH(-)
13	SPEAKER-RH(-)

890MT002

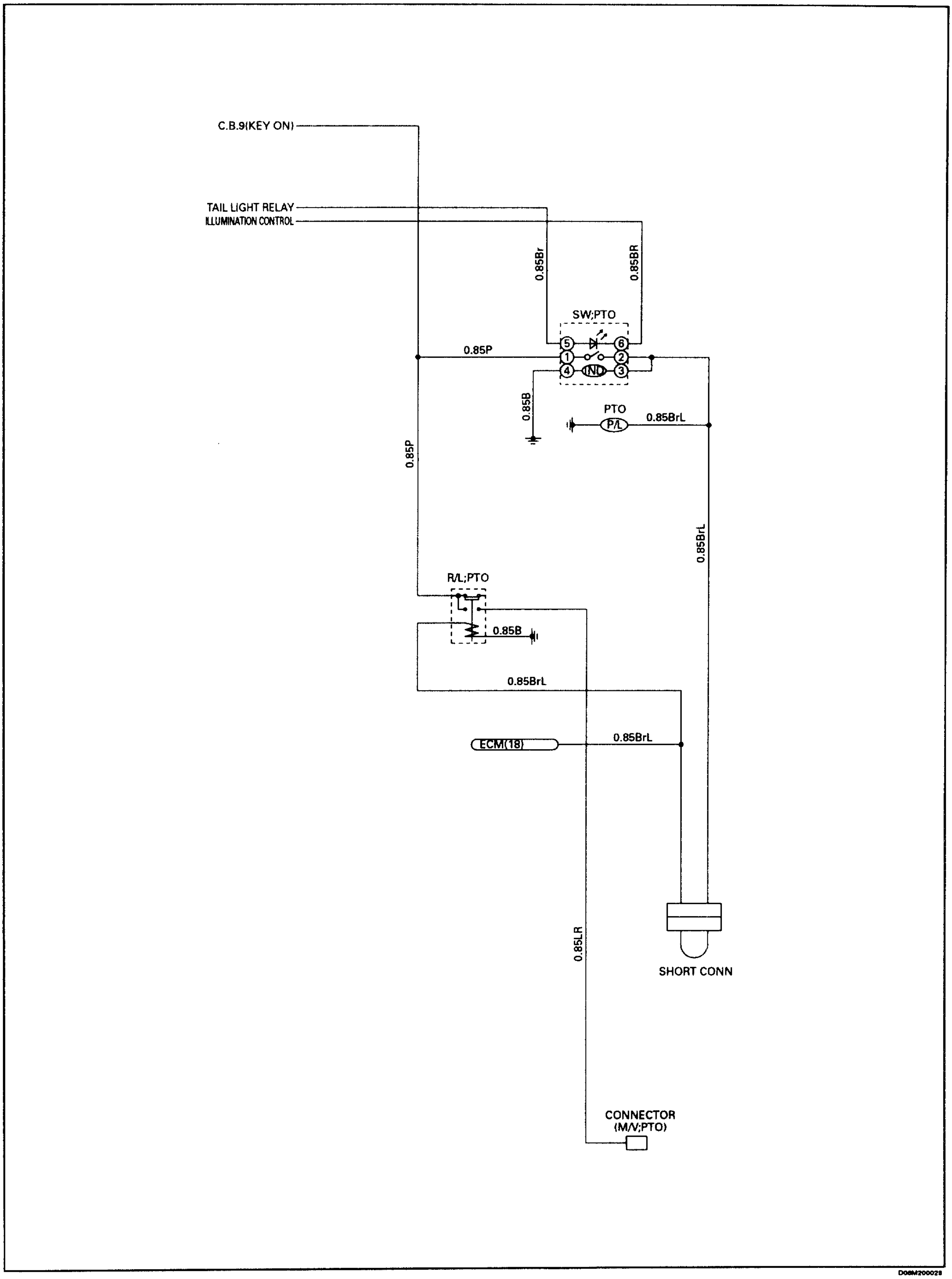
RADIO

POWER TAKE OFF (PTO)

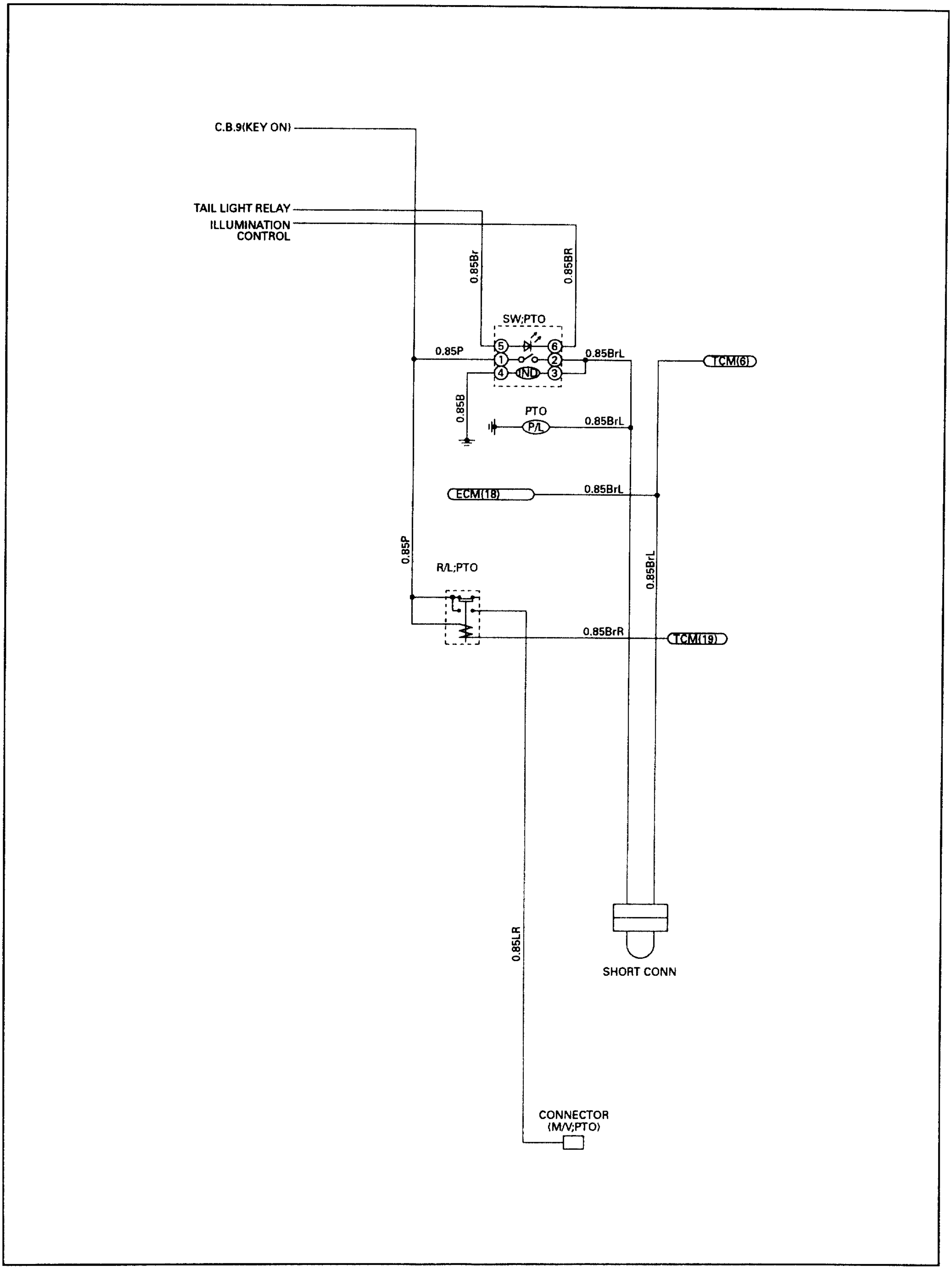
GENERAL DESCRIPTION

The circuit consists of the starter switch, pto switch, clutch switch, vacuum switching valve and relay.

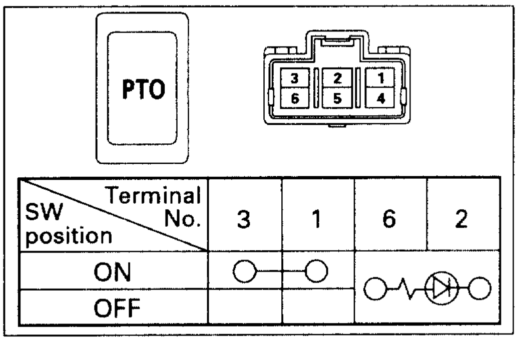
CIRCUIT DIAGRAM (M/T)



CIRCUIT DIAGRAM (A/T)



D08M200029



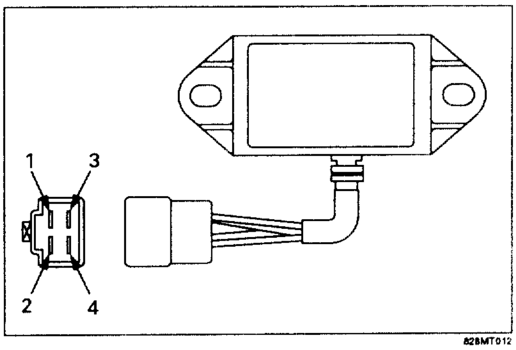
Terminal No. / SW position	3	1	6	2
ON	○—	—○	○–/\/–⊳|–○	
OFF				

PTO SWITCH

INSPECTION

1. Check the continuity between the dome light switch connector terminals.

   Repair or replace the switch when the result of inspection is found abnormal.



PTO RELAY (SIDE)

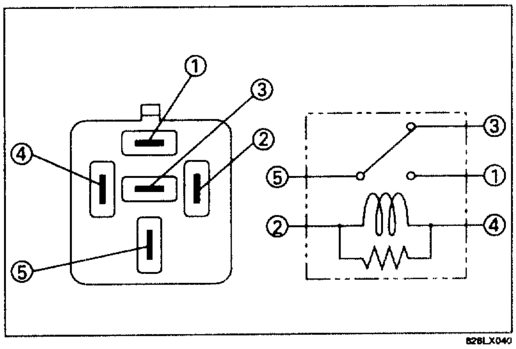
Terminal Arrangement

① ... Earth

② .... M/V; P.T.O

③ .... SW; P.T.O

④ .... C.B. 13



PTO RELAY (CLUTCH)

INSPECTION

Check to see if there is any continuity between the relay terminals.

Repair or replace the switch when the result of inspection is found abnormal.

Replace the relay when the result of inspection is found abnormal.

---

③ – ⑤ ..... Continuity

① – ⑤ ..... No continuity

(When battery voltage is applied between ② – ④)

③ – ⑤ ..... No Continuity

① – ⑤ ..... Continuity

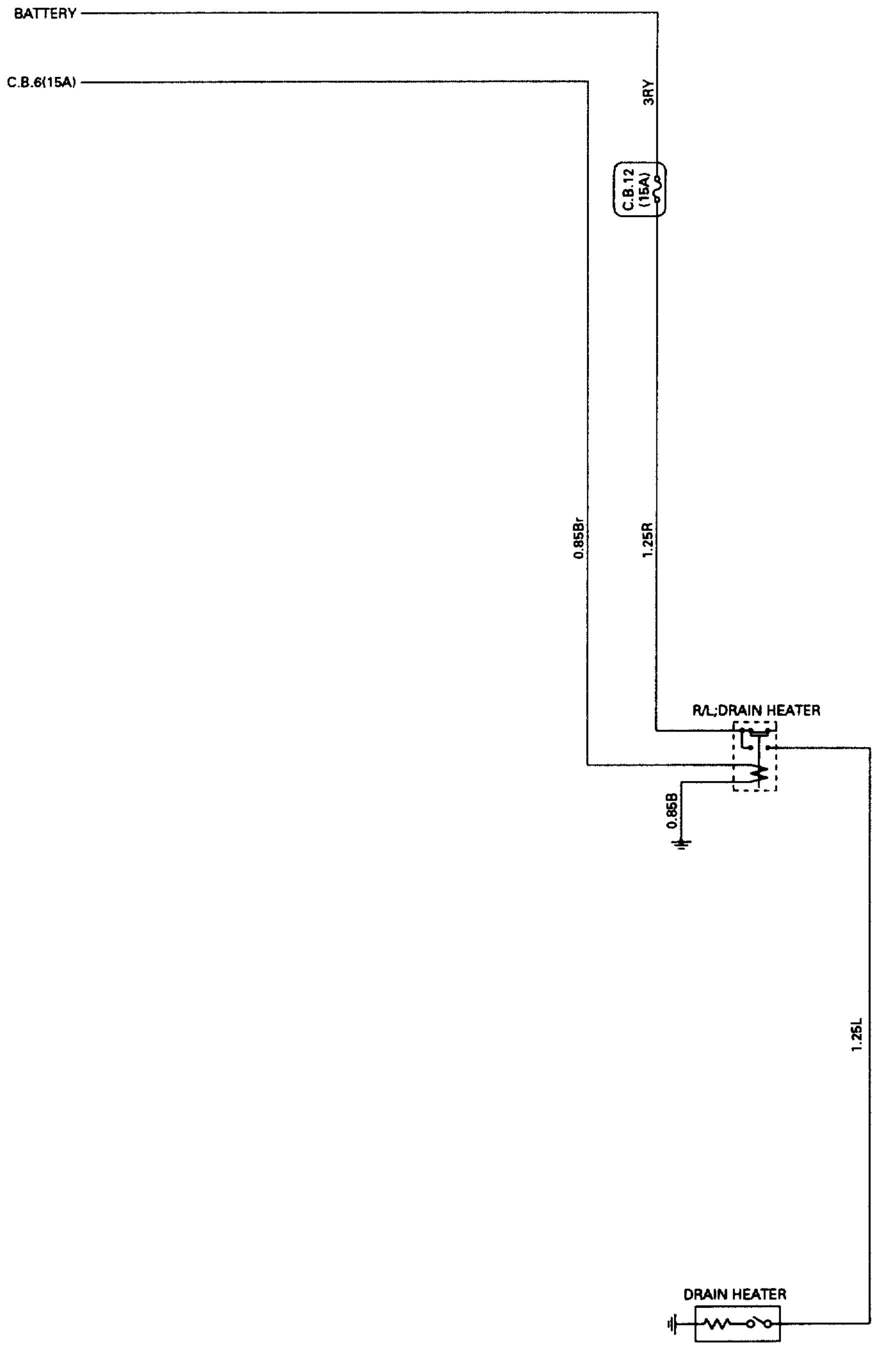
DRAIN HEATER

GENERAL DESCRIPTION

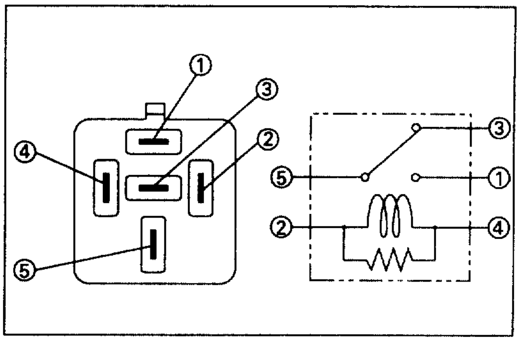
The circuit consists of the starter switch, the drain heater and the drain heater.

The drain heater is installed on the air tank to warm up the air in the tank. With the starter switch turned to the ON position, the battery voltage is applied to the drain heater through the drain heater relay.

CIRCUIT DIAGRAM



D08M200030



DRAIN HEATER RELAY

INSPECTION

Check to see if there is any continuity between the relay terminals.

Replace the relay when the result of inspection is found abnormal.

③ – ⑤..... Continuity
① – ⑤..... No continuity

(When battery voltage is applied between ② – ④)

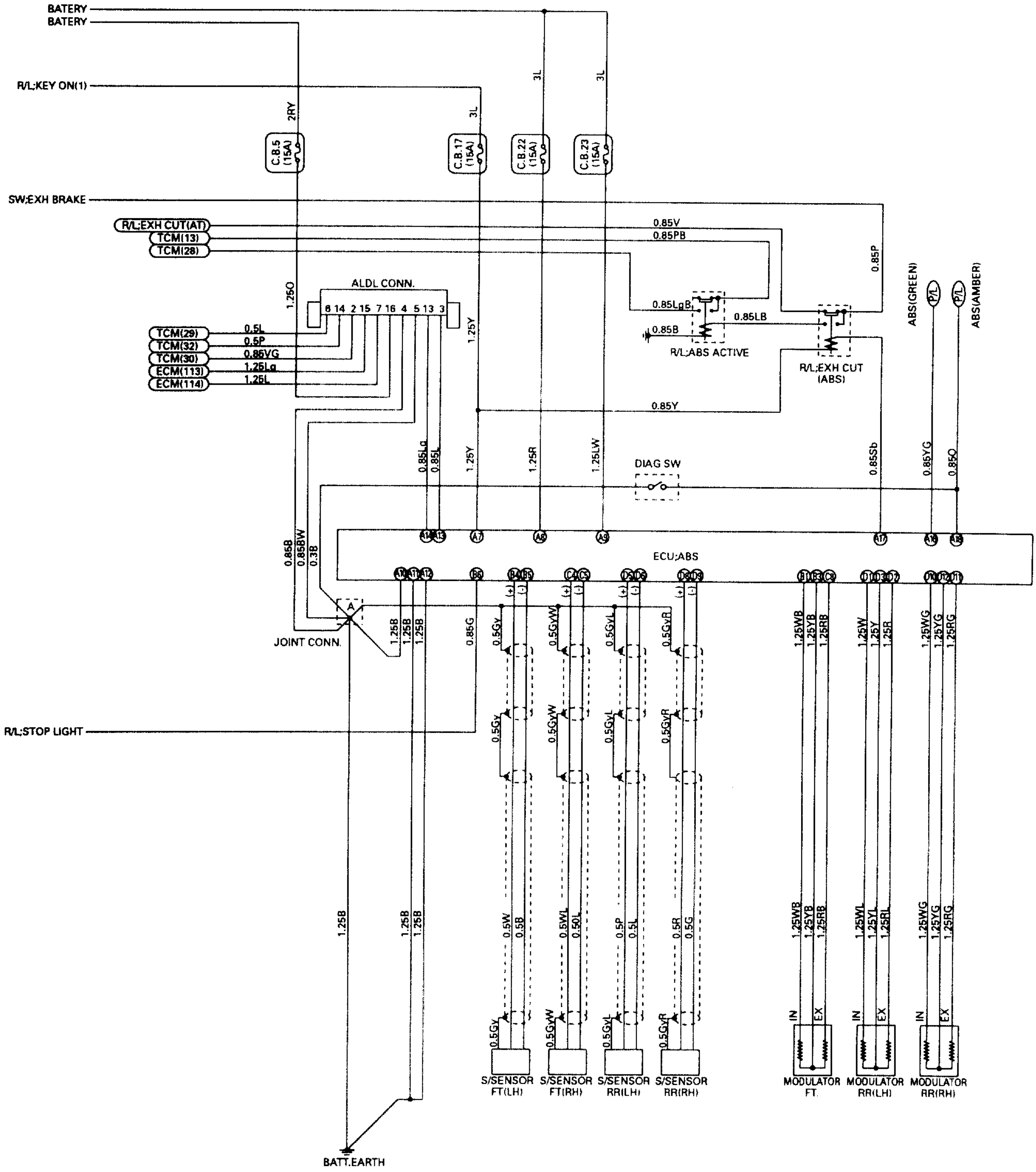
③ – ⑤..... No Continuity
① – ⑤..... Continuity

ANTI-LOCK BRAKE SYSTEM (ABS)

GENERAL DESCRIPTION

Refer to section 5A4 Anti-lock Brake System in detail.

CIRCUIT DIAGRAM

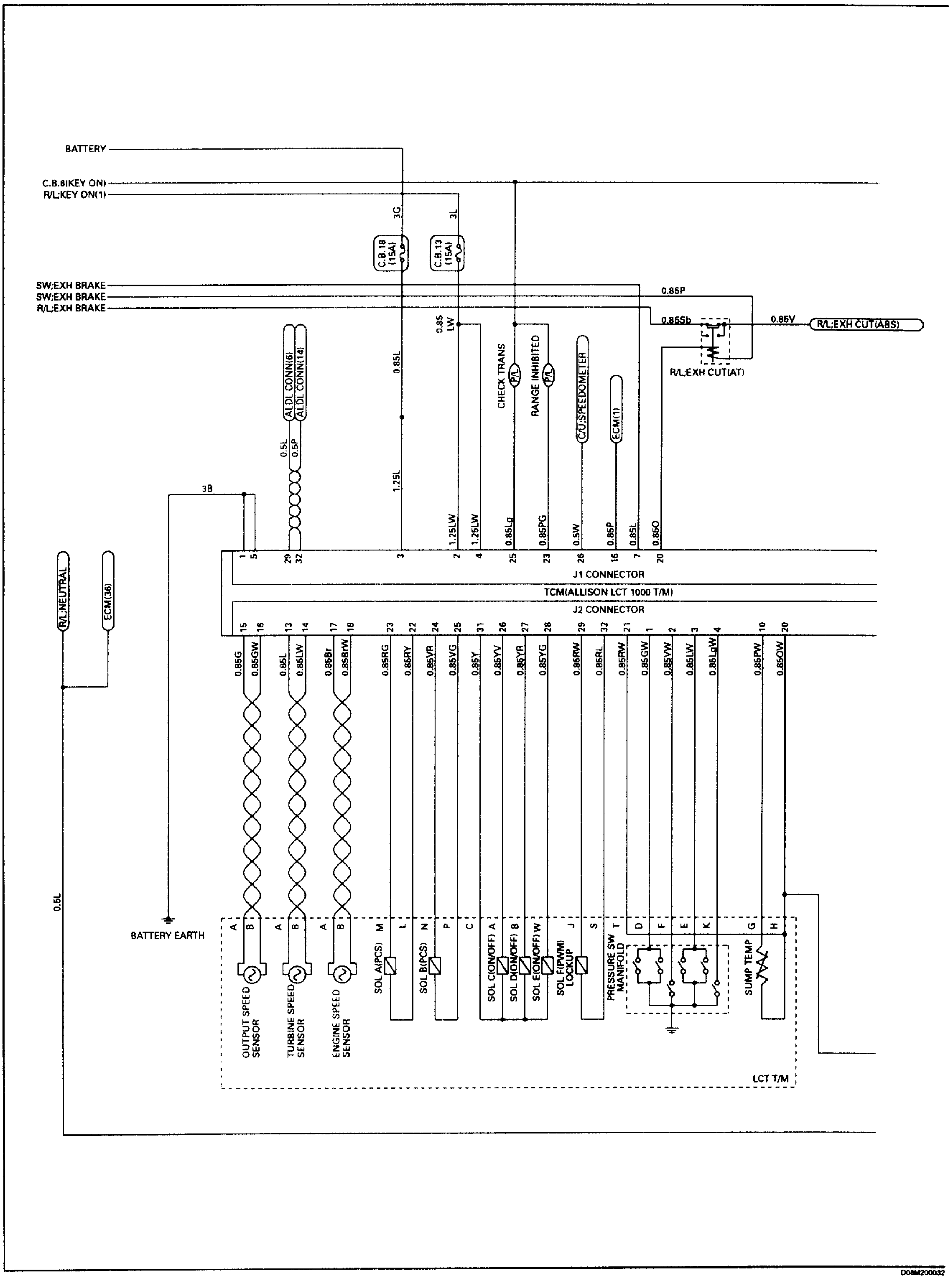


D08M200031

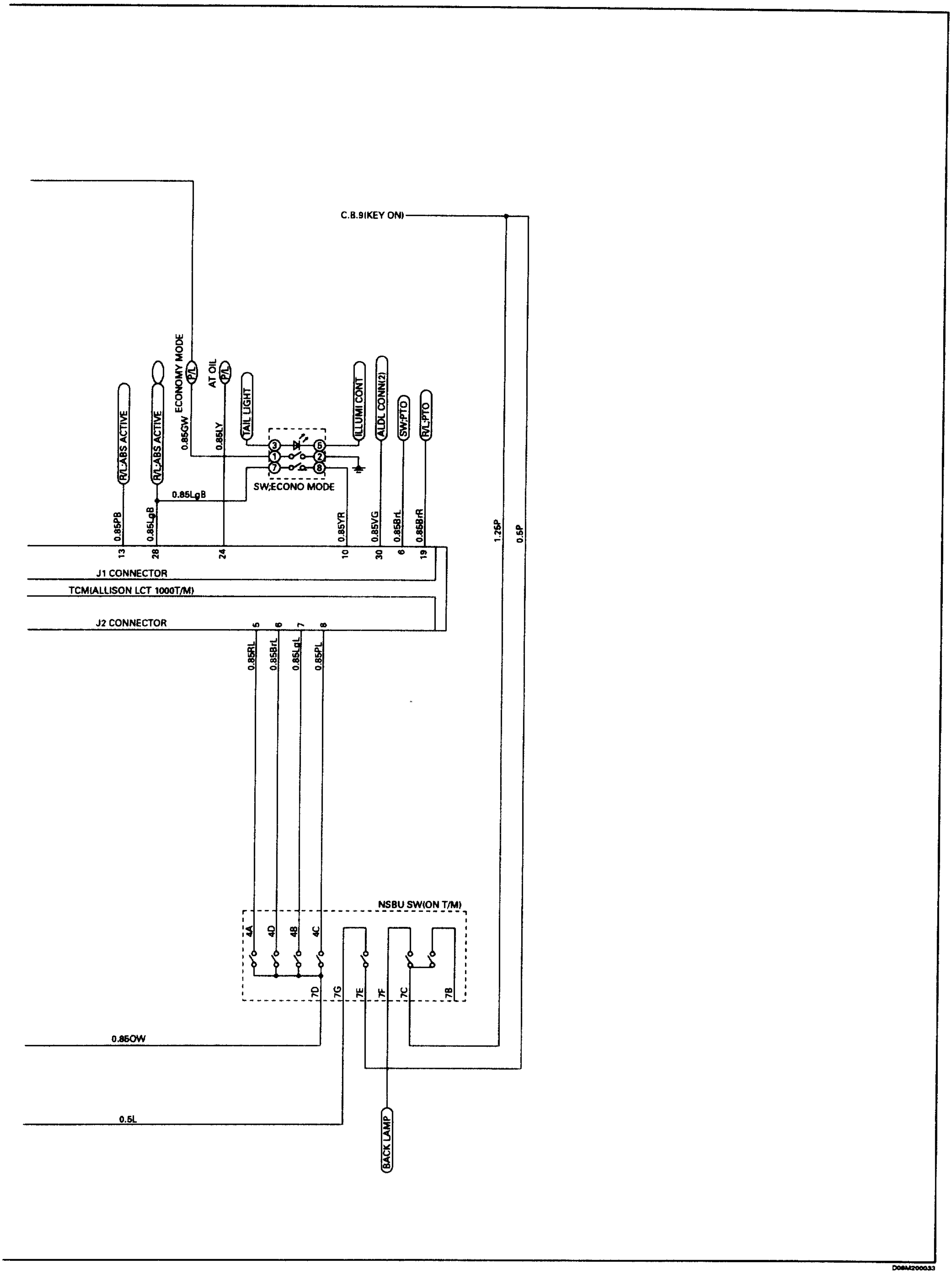
MEMO

TRANSMISSION CONTROL MODULE

CIRCUIT DIAGRAM

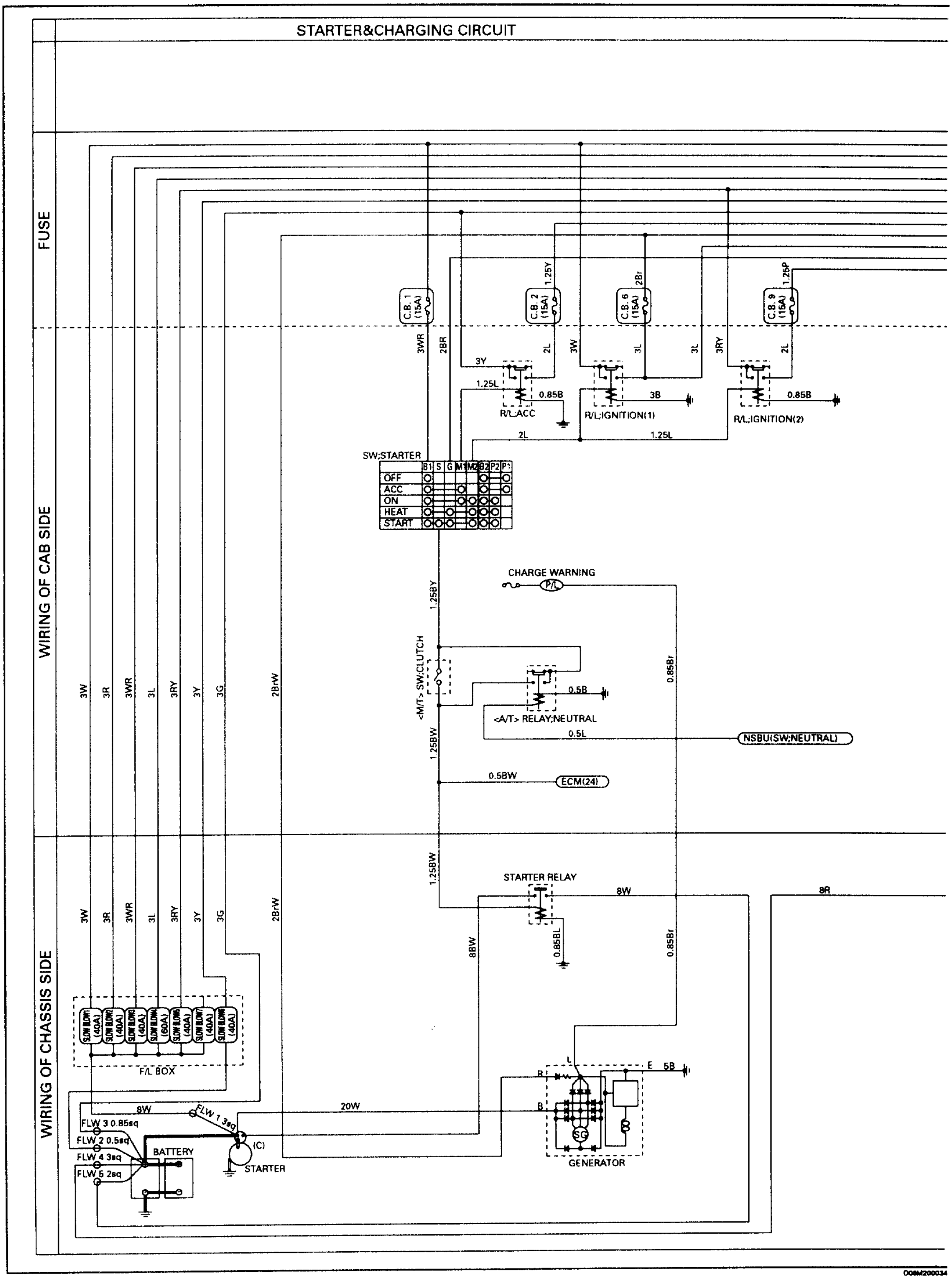


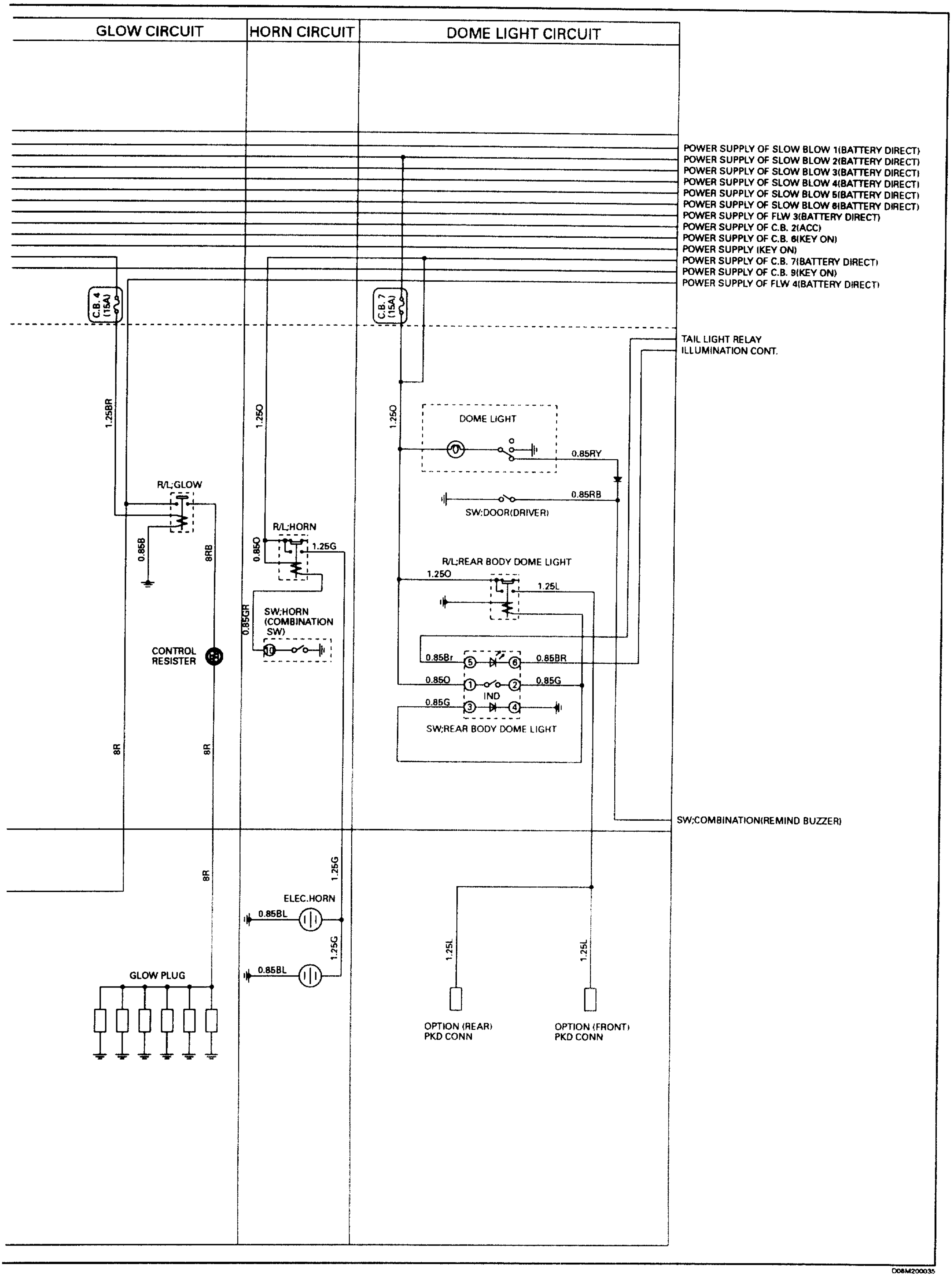
D08M200032

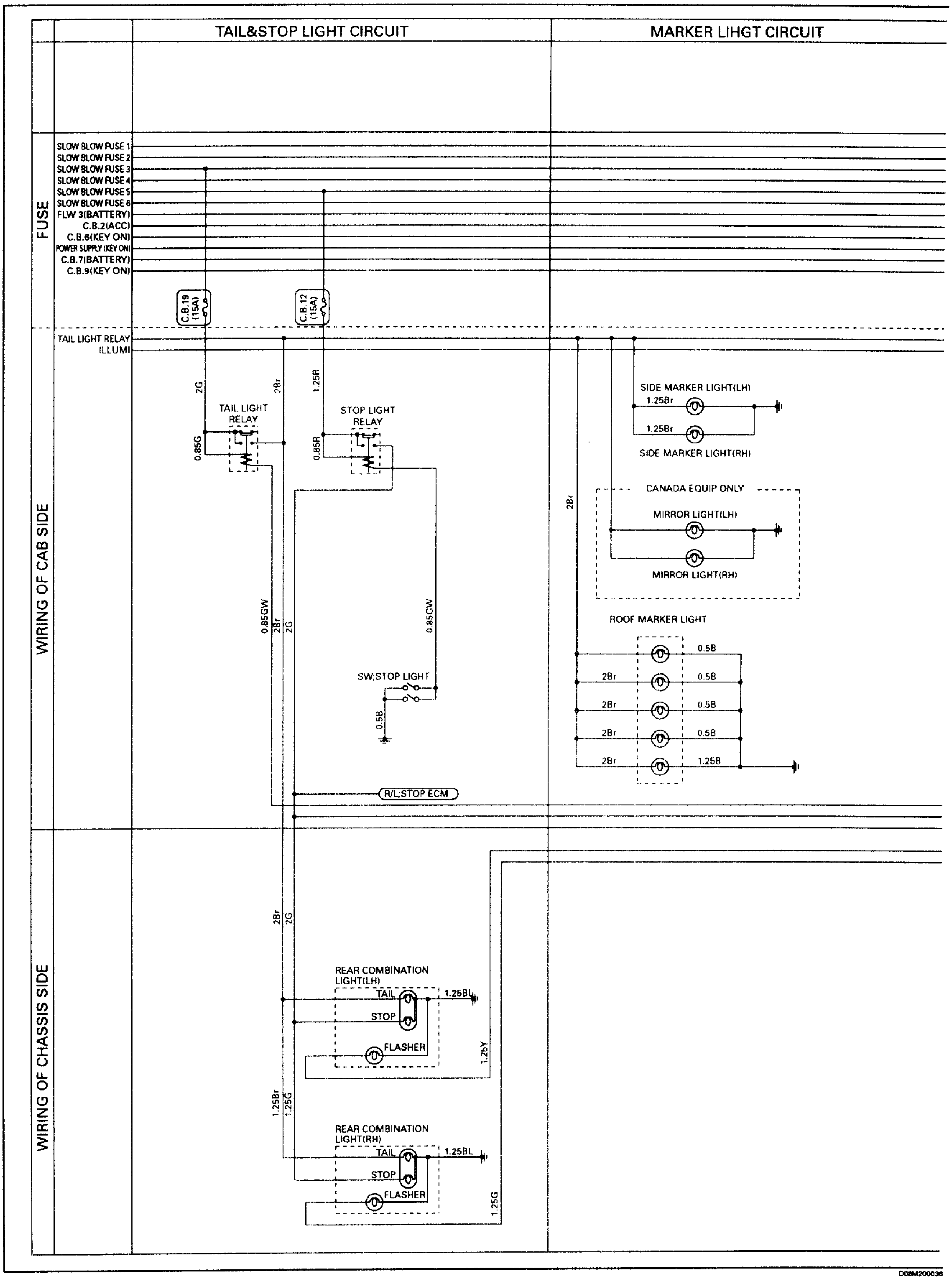

C.B.9(KEY ON)
R/L:ABS ACTIVE
R/L:ABS ACTIVE
ECONOMY MODE
P/L
AT OIL
P/L
TAIL LIGHT
ILLUMI CONT
ALDL CONN(2)
SW;PTO
R/L;PTO
0.85GW
0.85LY
3
1
7
5
2
8
SW;ECONO MODE
0.85LgB
0.85PB
0.85LgB
0.85YR
0.85VG
0.85BrL
0.85BrR
1.25P
0.5P
13
28
24
10
30
6
19
J1 CONNECTOR
TCM(ALLISON LCT 1000T/M)
J2 CONNECTOR
5
6
7
8
0.85RL
0.85BrL
0.85LgL
0.85PL
NSBU SW(ON T/M)
4A
4D
4B
4C
7D
7G
7E
7F
7C
7B
0.85OW
0.5L
BACK LAMP
D08M200033

MEMO

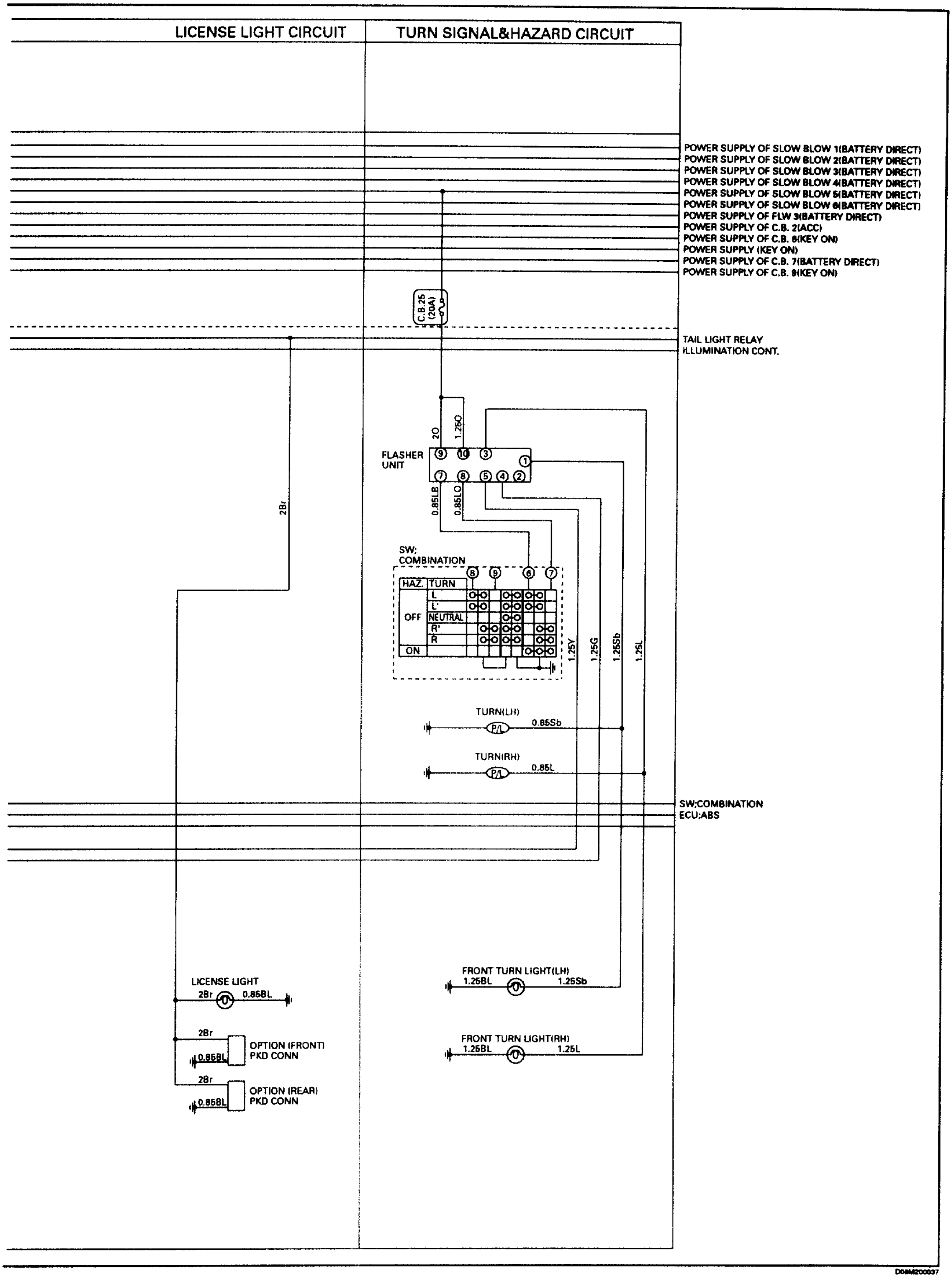
WIRING DIAGRAM

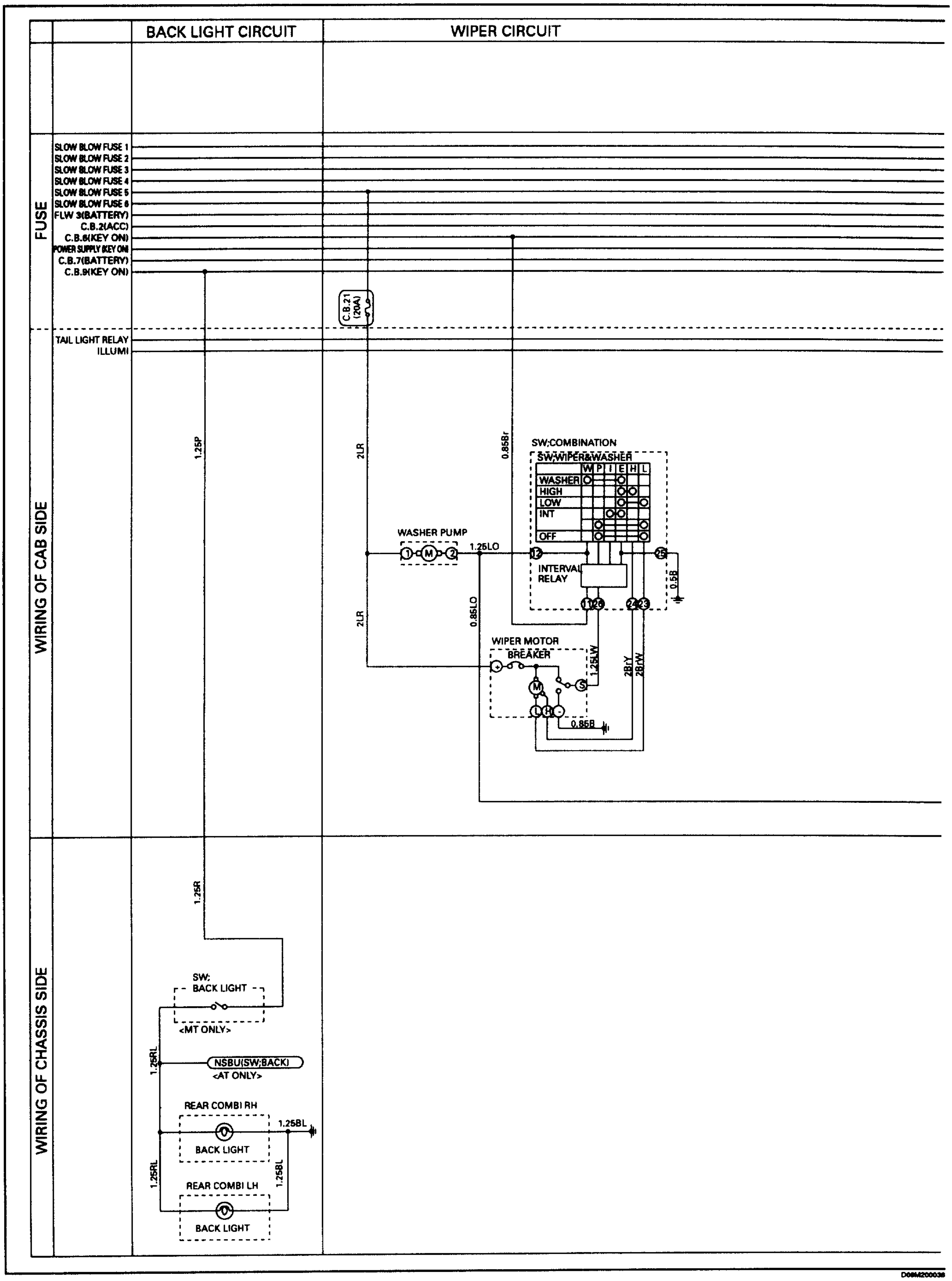

STARTER&CHARGING CIRCUIT
FUSE
WIRING OF CAB SIDE
WIRING OF CHASSIS SIDE
C.B. 1 (15A)
C.B. 2 (15A)
C.B. 6 (15A)
C.B. 9 (15A)
1.25Y
2Br
1.25P
3WR
2BR
3Y
1.25L
2L
3W
3L
3RY
0.85B
3B
R/L;ACC
R/L;IGNITION(1)
R/L;IGNITION(2)
1.25L
SW;STARTER
B1
S
G
M1
M2
B2
P2
P1
OFF
ACC
ON
HEAT
START
1.25BY
CHARGE WARNING
P/L
0.85Br
<M/T> SW;CLUTCH
0.5B
<A/T> RELAY;NEUTRAL
0.5L
NSBU(SW;NEUTRAL)
1.25BW
0.5BW
ECM(24)
STARTER RELAY
8W
8R
0.85BL
8BW
3W
3R
3WR
3L
3RY
3Y
3G
2BrW
SLOW BLOW1 (40A)
SLOW BLOW2 (40A)
SLOW BLOW3 (40A)
SLOW BLOW4 (60A)
SLOW BLOW6 (40A)
SLOW BLOW7 (40A)
SLOW BLOW8 (40A)
F/L BOX
8W
FLW 1 3sq
FLW 3 0.85sq
FLW 2 0.5sq
FLW 4 3sq
FLW 5 2sq
BATTERY
(C)
STARTER
20W
L
R
B
E
5B
SG
GENERATOR
O08M200034

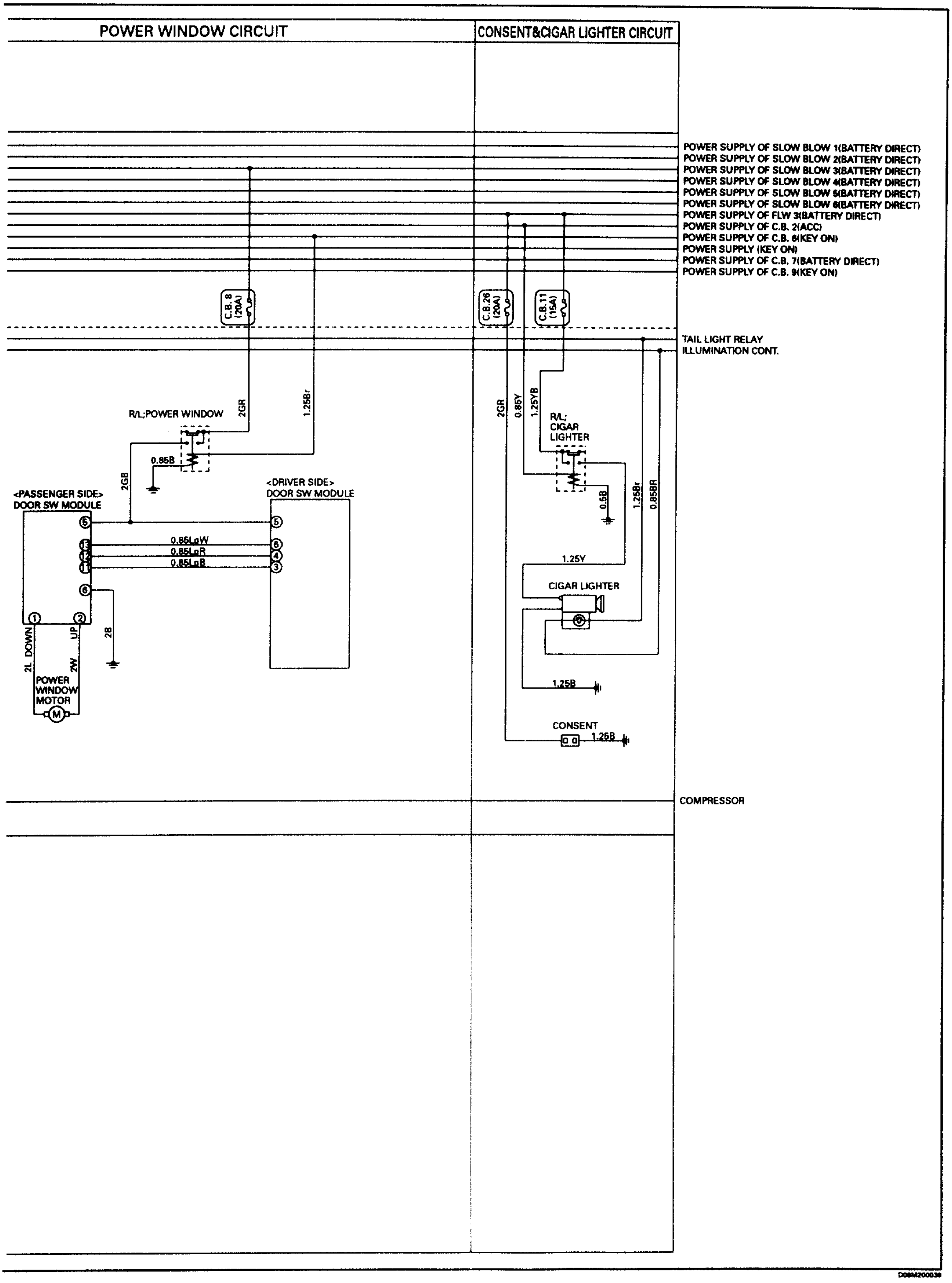

GLOW CIRCUIT
HORN CIRCUIT
DOME LIGHT CIRCUIT
POWER SUPPLY OF SLOW BLOW 1(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 2(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 3(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 4(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 5(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 6(BATTERY DIRECT)
POWER SUPPLY OF FLW 3(BATTERY DIRECT)
POWER SUPPLY OF C.B. 2(ACC)
POWER SUPPLY OF C.B. 6(KEY ON)
POWER SUPPLY (KEY ON)
POWER SUPPLY OF C.B. 7(BATTERY DIRECT)
POWER SUPPLY OF C.B. 9(KEY ON)
POWER SUPPLY OF FLW 4(BATTERY DIRECT)
C.B. 4 (15A)
C.B. 7 (15A)
TAIL LIGHT RELAY
ILLUMINATION CONT.
1.25BR
1.25O
1.25O
DOME LIGHT
0.85RY
0.85RB
SW;DOOR(DRIVER)
R/L;GLOW
0.85B
8RB
R/L;HORN
0.85O
1.25G
R/L;REAR BODY DOME LIGHT
1.25O
1.25L
0.85GR
SW;HORN (COMBINATION SW)
10
CONTROL RESISTER
0.85Br
5
6
0.85BR
0.85O
1
2
0.85G
IND
0.85G
3
4
SW;REAR BODY DOME LIGHT
8R
8R
SW;COMBINATION(REMIND BUZZER)
8R
1.25G
ELEC.HORN
0.85BL
1.25G
0.85BL
GLOW PLUG
1.25L
1.25L
OPTION (REAR) PKD CONN
OPTION (FRONT) PKD CONN
D08M200035


TAIL&STOP LIGHT CIRCUIT
MARKER LIHGT CIRCUIT
FUSE
SLOW BLOW FUSE 1
SLOW BLOW FUSE 2
SLOW BLOW FUSE 3
SLOW BLOW FUSE 4
SLOW BLOW FUSE 5
SLOW BLOW FUSE 6
FLW 3(BATTERY)
C.B.2(ACC)
C.B.6(KEY ON)
POWER SUPPLY (KEY ON)
C.B.7(BATTERY)
C.B.9(KEY ON)
C.B.19 (15A)
C.B.12 (15A)
WIRING OF CAB SIDE
TAIL LIGHT RELAY
ILLUMI
2G
2Br
1.25R
TAIL LIGHT RELAY
STOP LIGHT RELAY
0.85G
0.85R
SIDE MARKER LIGHT(LH)
1.25Br
1.25Br
SIDE MARKER LIGHT(RH)
CANADA EQUIP ONLY
2Br
MIRROR LIGHT(LH)
MIRROR LIGHT(RH)
0.85GW
2Br
2G
0.85GW
ROOF MARKER LIGHT
0.5B
2Br
0.5B
2Br
0.5B
2Br
0.5B
2Br
1.25B
SW;STOP LIGHT
0.5B
R/L;STOP ECM
WIRING OF CHASSIS SIDE
2Br
2G
REAR COMBINATION LIGHT(LH)
TAIL
STOP
FLASHER
1.25BL
1.25Y
1.25Br
1.25G
REAR COMBINATION LIGHT(RH)
TAIL
STOP
FLASHER
1.25BL
1.25G

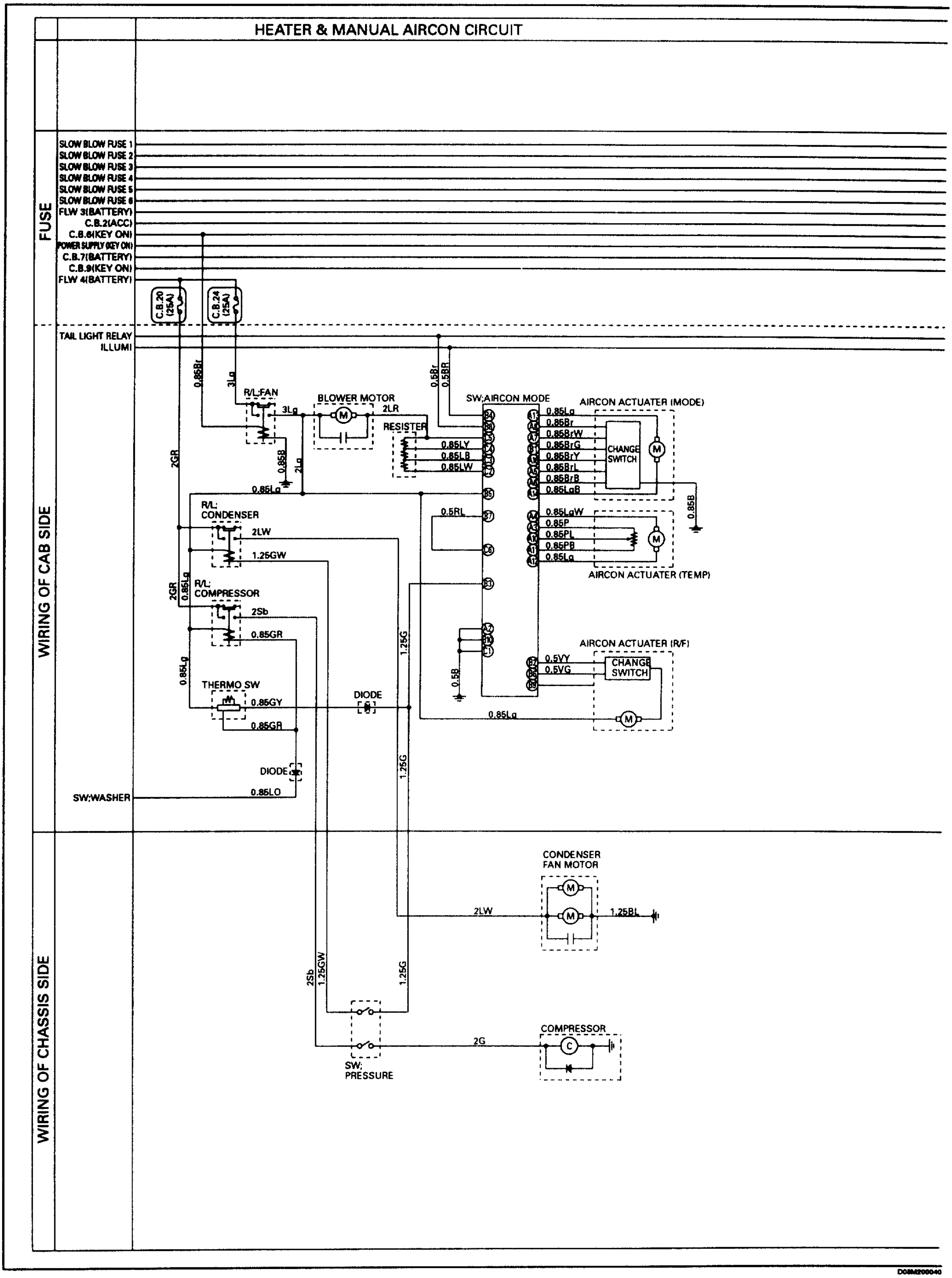
D08M200036


LICENSE LIGHT CIRCUIT
TURN SIGNAL&HAZARD CIRCUIT
POWER SUPPLY OF SLOW BLOW 1(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 2(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 3(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 4(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 5(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 6(BATTERY DIRECT)
POWER SUPPLY OF FLW 3(BATTERY DIRECT)
POWER SUPPLY OF C.B. 2(ACC)
POWER SUPPLY OF C.B. 8(KEY ON)
POWER SUPPLY (KEY ON)
POWER SUPPLY OF C.B. 7(BATTERY DIRECT)
POWER SUPPLY OF C.B. 9(KEY ON)
C.B.25 (20A)
TAIL LIGHT RELAY
ILLUMINATION CONT.
2Br
2O
1.25O
FLASHER UNIT
9
10
3
1
7
8
5
4
2
0.85LB
0.85LO
SW; COMBINATION
8
9
6
7
HAZ.
TURN
L
L'
OFF
NEUTRAL
R'
R
ON
1.25Y
1.25G
1.25Sb
1.25L
TURN(LH)
P/L
0.85Sb
TURN(RH)
P/L
0.85L
SW;COMBINATION
ECU;ABS
LICENSE LIGHT
2Br
0.85BL
2Br
0.85BL
OPTION (FRONT) PKD CONN
2Br
0.85BL
OPTION (REAR) PKD CONN
FRONT TURN LIGHT(LH)
1.25BL
1.25Sb
FRONT TURN LIGHT(RH)
1.25BL
1.25L
D08M200037

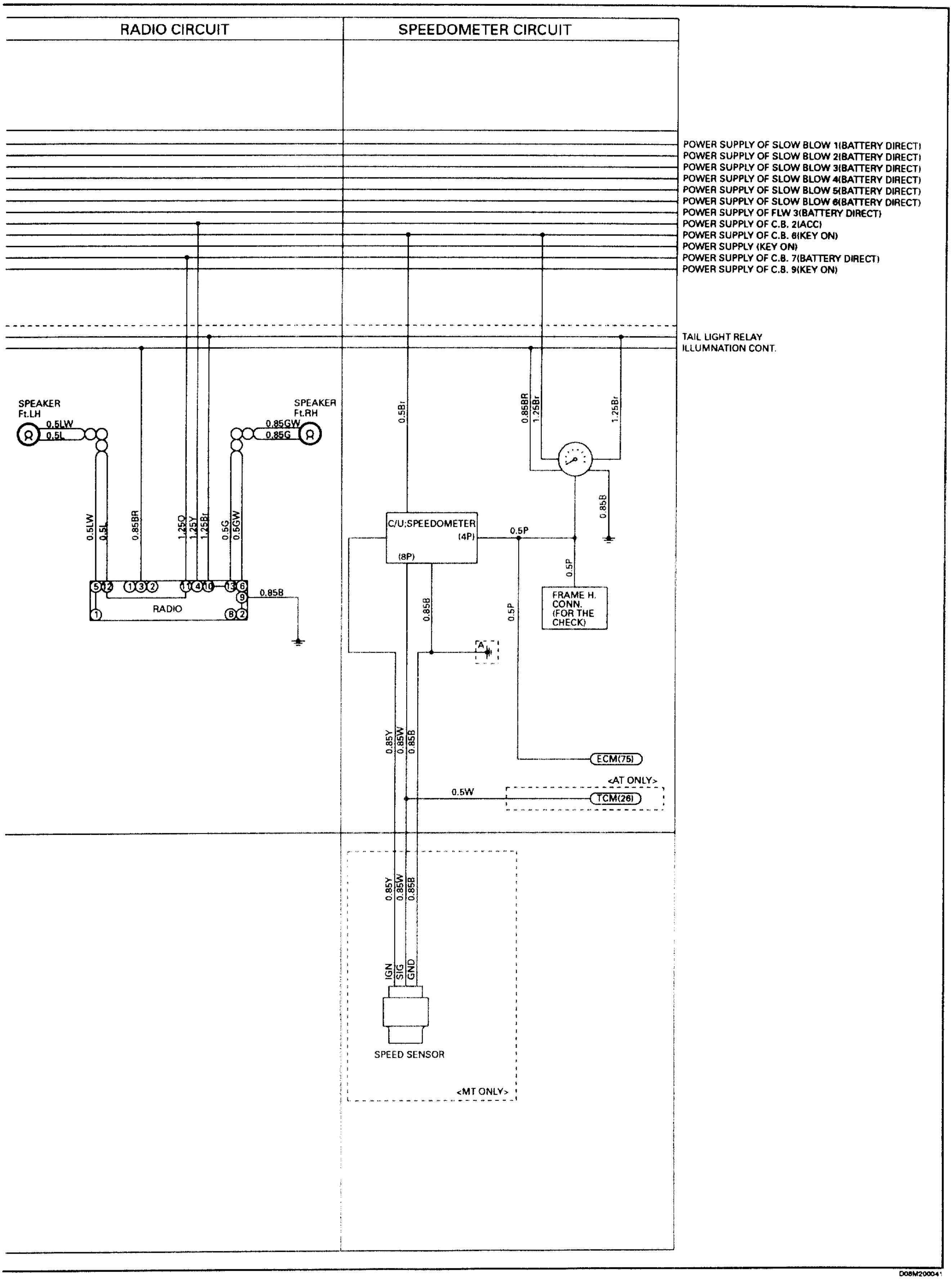

BACK LIGHT CIRCUIT
WIPER CIRCUIT
FUSE
SLOW BLOW FUSE 1
SLOW BLOW FUSE 2
SLOW BLOW FUSE 3
SLOW BLOW FUSE 4
SLOW BLOW FUSE 5
SLOW BLOW FUSE 6
FLW 3(BATTERY)
C.B.2(ACC)
C.B.6(KEY ON)
POWER SUPPLY (KEY ON)
C.B.7(BATTERY)
C.B.9(KEY ON)
C.B.21 (20A)
TAIL LIGHT RELAY
ILLUMI
WIRING OF CAB SIDE
1.25P
2LR
0.85Br
SW;COMBINATION
SW;WIPER&WASHER
W P I E H L
WASHER
HIGH
LOW
INT
OFF
WASHER PUMP
1 M 2
1.25LO
12
25
0.5B
INTERVAL RELAY
11 26 24 23
2LR
0.85LO
WIPER MOTOR
BREAKER
M
S
L H -
1.25LW
2BrY
2BrW
0.85B
WIRING OF CHASSIS SIDE
1.25R
SW; BACK LIGHT
<MT ONLY>
1.25RL
NSBU(SW;BACK)
<AT ONLY>
REAR COMBI RH
BACK LIGHT
1.25BL
1.25RL
1.25BL
REAR COMBI LH
BACK LIGHT
D08M200038


POWER WINDOW CIRCUIT
CONSENT&CIGAR LIGHTER CIRCUIT
POWER SUPPLY OF SLOW BLOW 1(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 2(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 3(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 4(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 5(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 6(BATTERY DIRECT)
POWER SUPPLY OF FLW 3(BATTERY DIRECT)
POWER SUPPLY OF C.B. 2(ACC)
POWER SUPPLY OF C.B. 6(KEY ON)
POWER SUPPLY (KEY ON)
POWER SUPPLY OF C.B. 7(BATTERY DIRECT)
POWER SUPPLY OF C.B. 9(KEY ON)
C.B. 8 (20A)
C.B.26 (20A)
C.B.11 (15A)
TAIL LIGHT RELAY
ILLUMINATION CONT.
R/L;POWER WINDOW
2GR
1.25Br
0.85B
2GB
<PASSENGER SIDE> DOOR SW MODULE
<DRIVER SIDE> DOOR SW MODULE
⑤
0.85LgW
0.85LgR
0.85LgB
⑬
⑫
⑪
⑥
④
③
①
②
2L DOWN
2W UP
2B
POWER WINDOW MOTOR
M
2GR
0.85Y
1.25YB
R/L; CIGAR LIGHTER
0.5B
1.25Br
0.85BR
1.25Y
CIGAR LIGHTER
1.25B
CONSENT
1.25B
COMPRESSOR

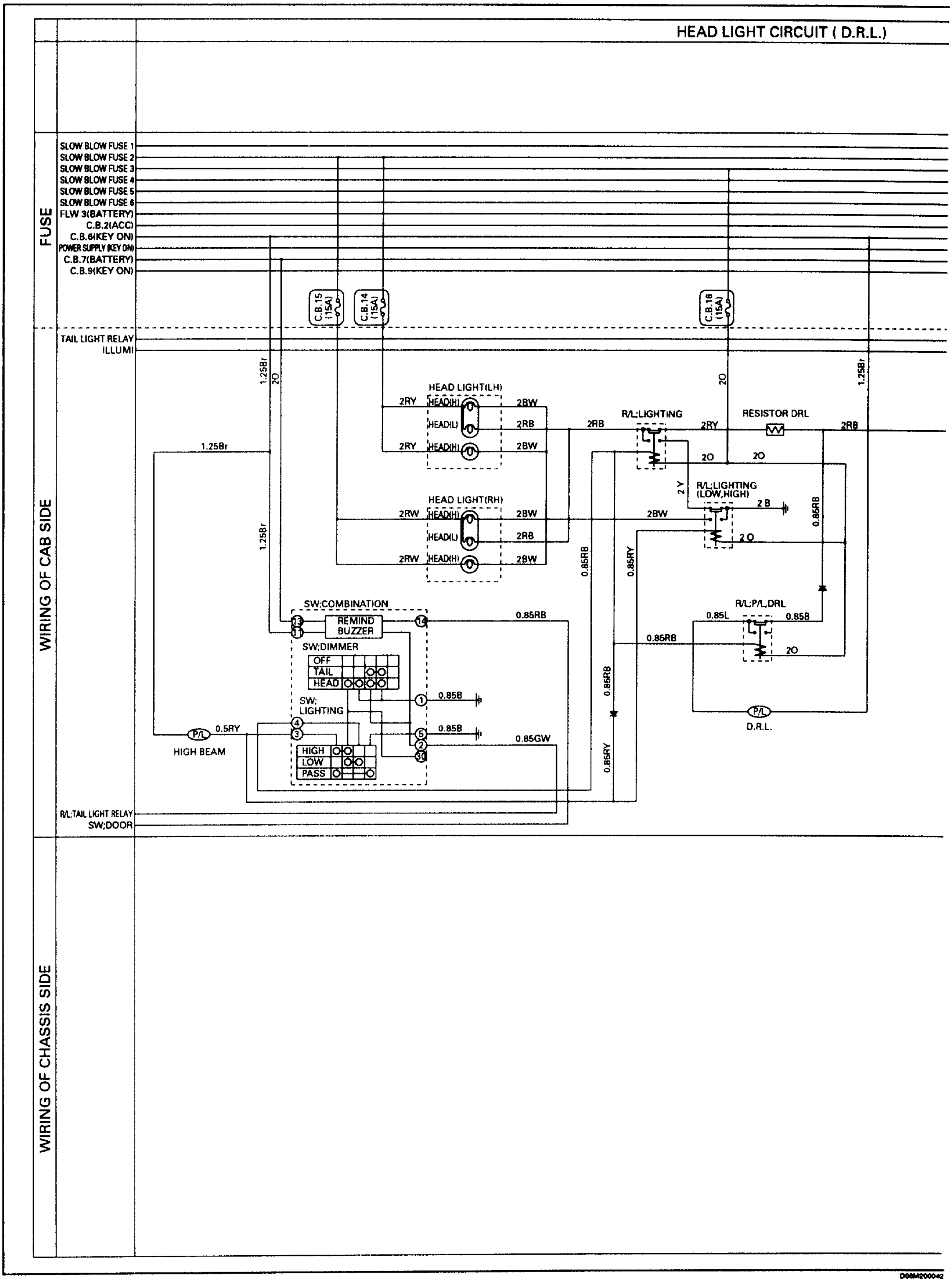
D08M200638

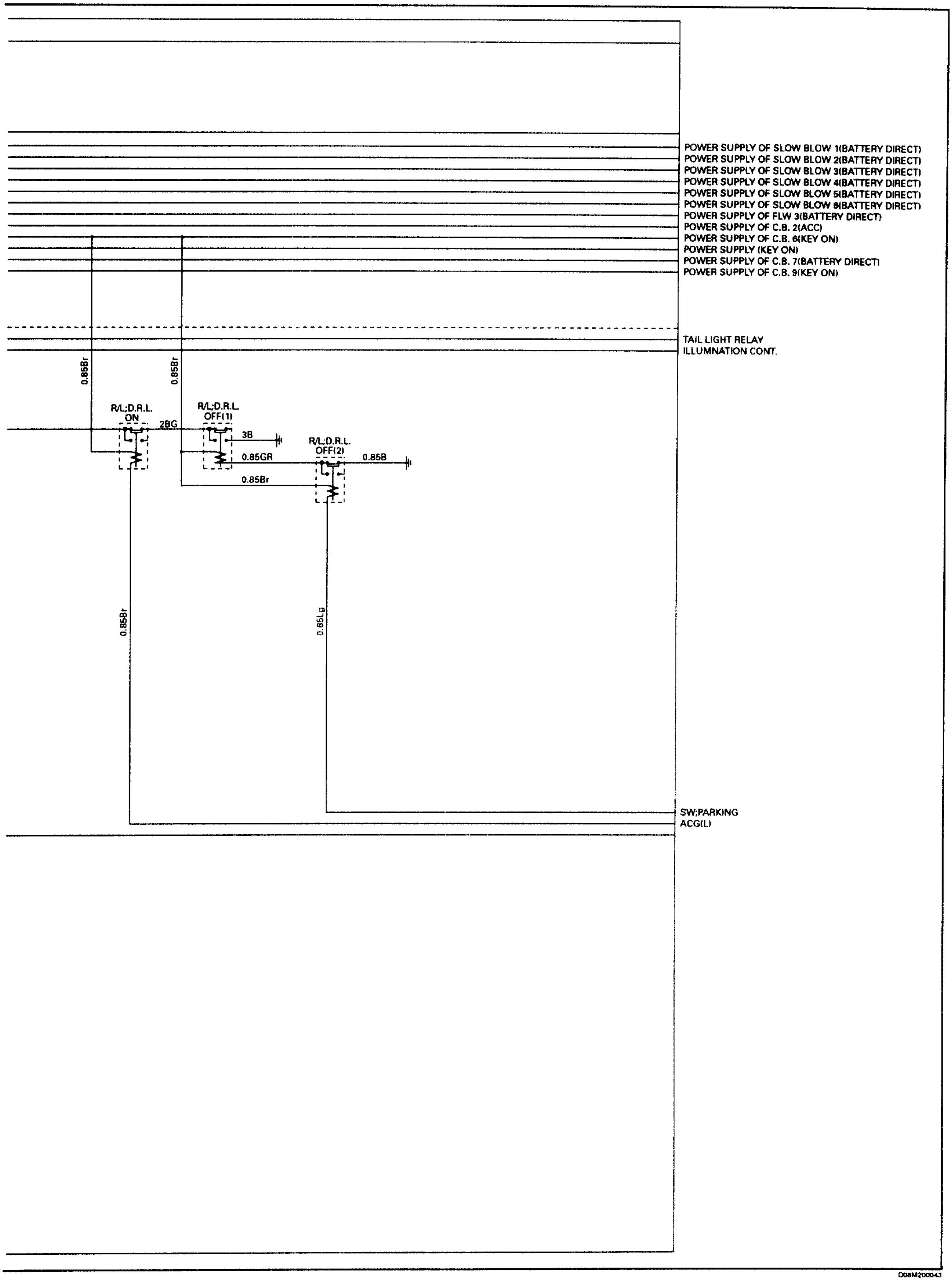

HEATER & MANUAL AIRCON CIRCUIT
FUSE
SLOW BLOW FUSE 1
SLOW BLOW FUSE 2
SLOW BLOW FUSE 3
SLOW BLOW FUSE 4
SLOW BLOW FUSE 5
SLOW BLOW FUSE 6
FLW 3(BATTERY)
C.B.2(ACC)
C.B.6(KEY ON)
POWER SUPPLY (KEY ON)
C.B.7(BATTERY)
C.B.9(KEY ON)
FLW 4(BATTERY)
C.B.20 (25A)
C.B.24 (25A)
WIRING OF CAB SIDE
TAIL LIGHT RELAY
ILLUMI
0.85Br
3Lg
0.5Br
0.5BR
R/L;FAN
3Lg
BLOWER MOTOR
2LR
RESISTER
SW;AIRCON MODE
AIRCON ACTUATER (MODE)
0.85LY
0.85LB
0.85LW
0.85B
2Lg
2GR
0.85Lg
B4
B8
C5
C4
C3
C2
B5
B7
C6
B3
A2
B10
C1
A13
A6
A7
B1
A5
A4
A14
A3
A10
A11
A12
B2
B6
B9
0.85Lg
0.85Br
0.85BrW
0.85BrG
0.85BrY
0.85BrL
0.85BrB
0.85LgB
CHANGE SWITCH
M
0.85B
0.85LgW
0.85P
0.85PL
0.85PB
0.85Lg
AIRCON ACTUATER (TEMP)
0.5RL
R/L; CONDENSER
2LW
1.25GW
2GR
0.85Lg
R/L; COMPRESSOR
2Sb
0.85GR
1.25G
0.5B
AIRCON ACTUATER (R/F)
0.5VY
0.5VG
CHANGE SWITCH
0.85Lg
THERMO SW
0.85GY
DIODE
0.85GR
DIODE
SW;WASHER
0.85LO
1.25G
WIRING OF CHASSIS SIDE
CONDENSER FAN MOTOR
2LW
1.25BL
2Sb
1.25GW
1.25G
SW; PRESSURE
2G
COMPRESSOR
C

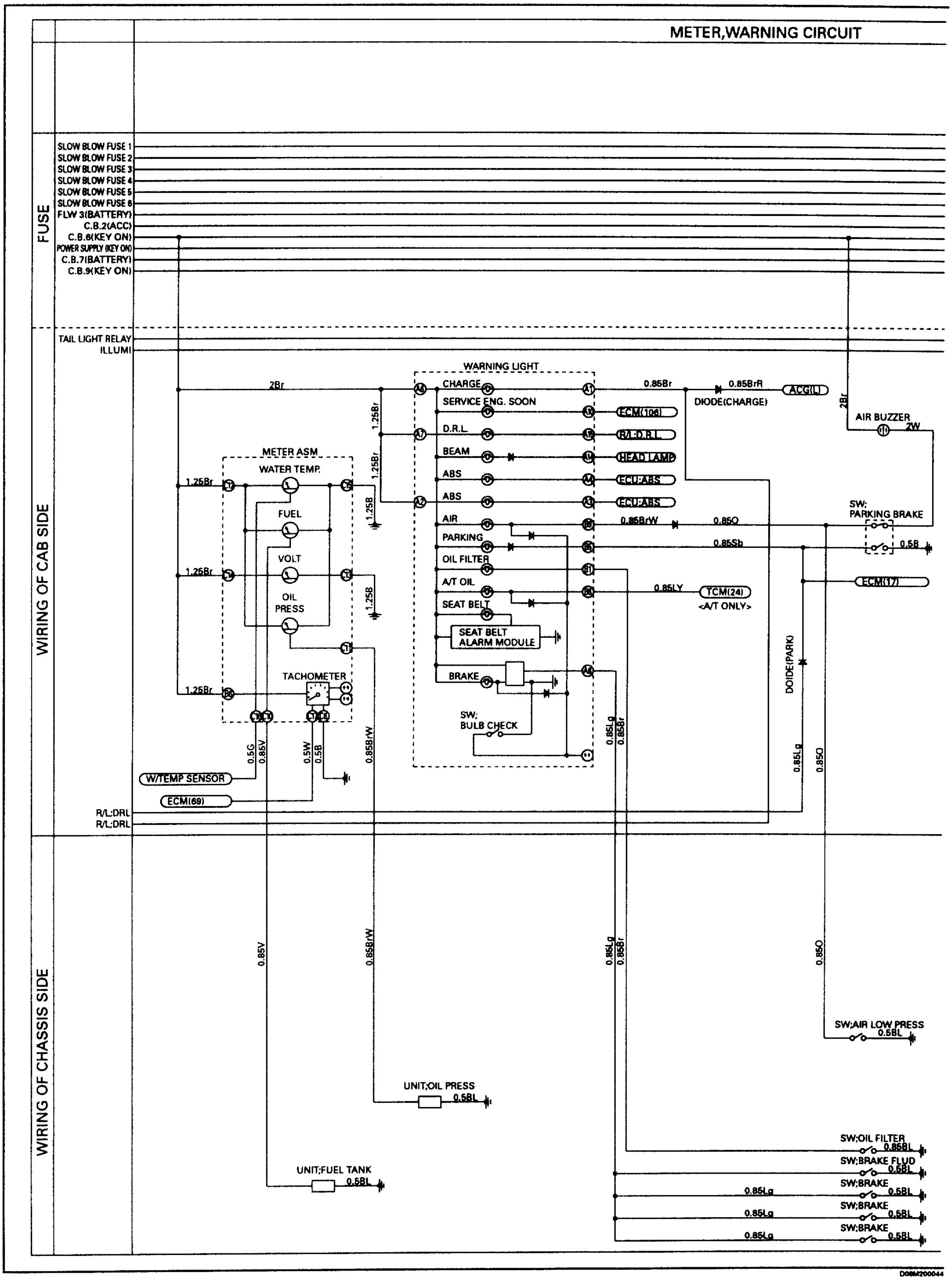
D08M200040

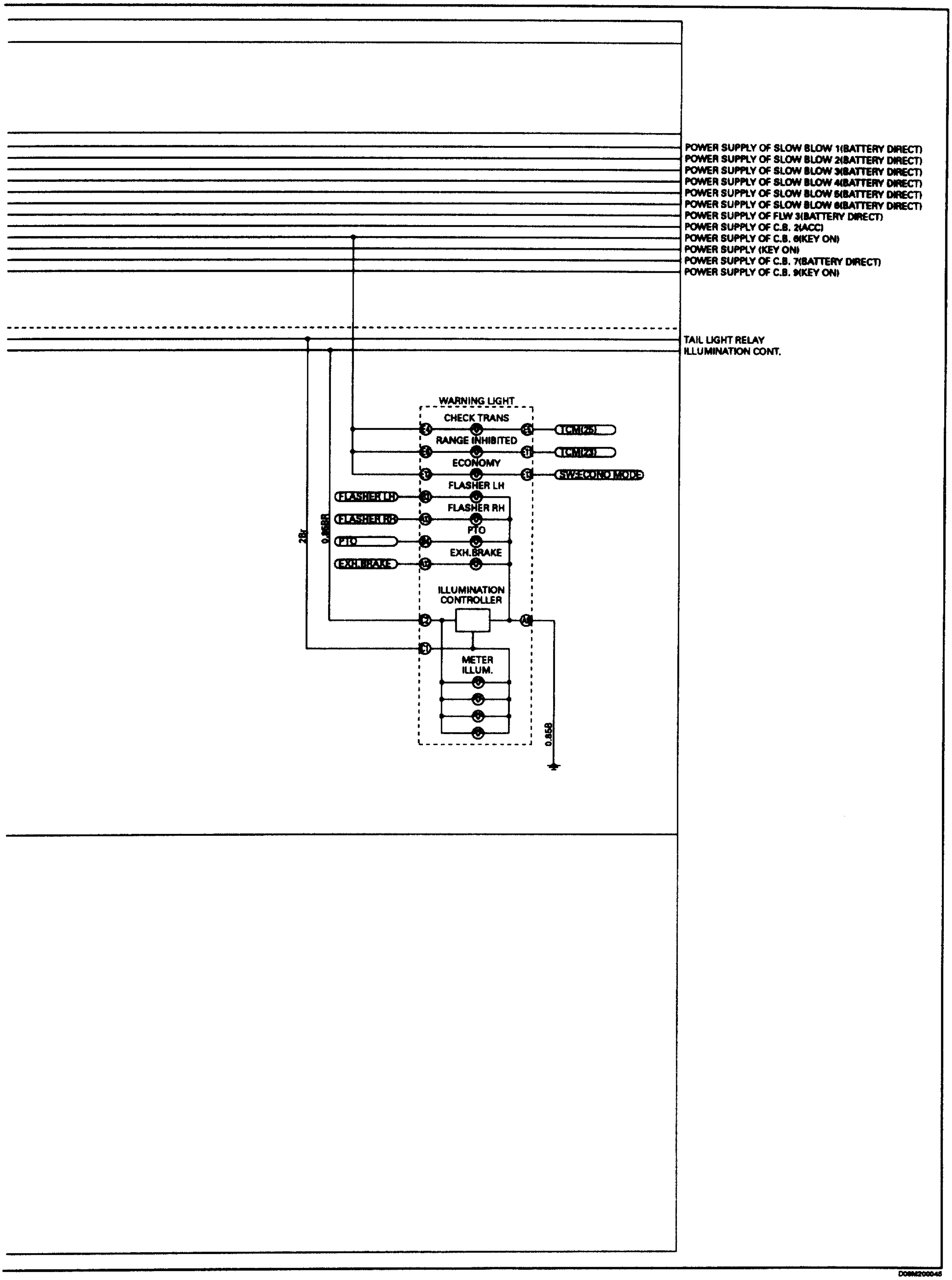

RADIO CIRCUIT
SPEEDOMETER CIRCUIT
POWER SUPPLY OF SLOW BLOW 1(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 2(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 3(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 4(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 5(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 6(BATTERY DIRECT)
POWER SUPPLY OF FLW 3(BATTERY DIRECT)
POWER SUPPLY OF C.B. 2(ACC)
POWER SUPPLY OF C.B. 6(KEY ON)
POWER SUPPLY (KEY ON)
POWER SUPPLY OF C.B. 7(BATTERY DIRECT)
POWER SUPPLY OF C.B. 9(KEY ON)
TAIL LIGHT RELAY
ILLUMNATION CONT.
SPEAKER Ft.LH
0.5LW
0.5L
SPEAKER Ft.RH
0.85GW
0.85G
0.5LW
0.5L
0.85BR
1.25O
1.25Y
1.25Br
0.5G
0.5GW
5 12 1 3 2 11 4 10 13 6 9
1 8 2
RADIO
0.85B
0.5Br
0.85BR
1.25Br
1.25Br
0.85B
C/U;SPEEDOMETER
(4P)
(8P)
0.5P
0.5P
0.85B
0.5P
FRAME H. CONN. (FOR THE CHECK)
A
0.85Y
0.85W
0.85B
ECM(75)
<AT ONLY>
0.5W
TCM(26)
0.85Y
0.85W
0.85B
IGN
SIG
GND
SPEED SENSOR
<MT ONLY>
D08M200041

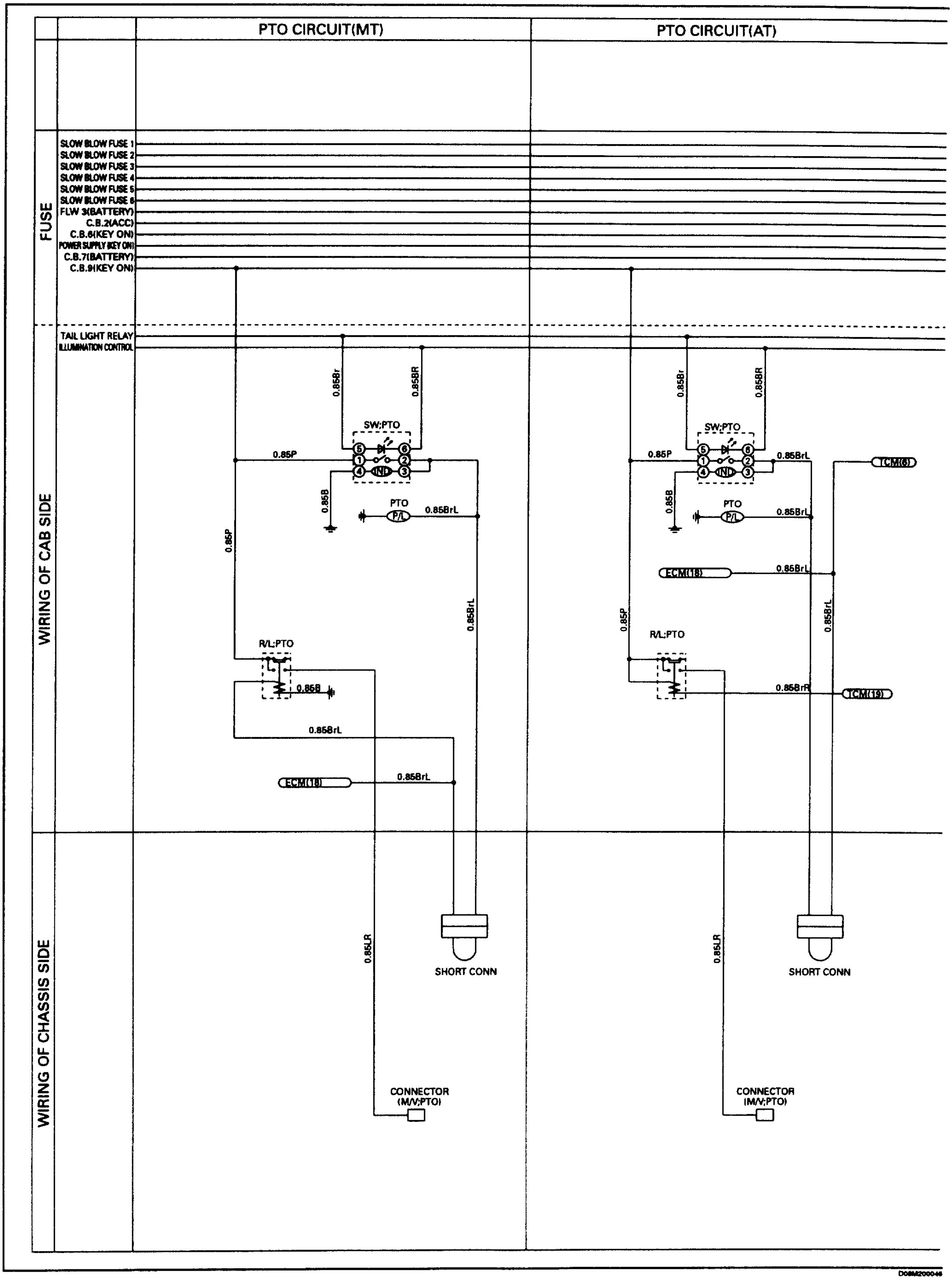
HEAD LIGHT CIRCUIT (D.R.L.)




POWER SUPPLY OF SLOW BLOW 1(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 2(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 3(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 4(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 5(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 6(BATTERY DIRECT)
POWER SUPPLY OF FLW 3(BATTERY DIRECT)
POWER SUPPLY OF C.B. 2(ACC)
POWER SUPPLY OF C.B. 6(KEY ON)
POWER SUPPLY (KEY ON)
POWER SUPPLY OF C.B. 7(BATTERY DIRECT)
POWER SUPPLY OF C.B. 9(KEY ON)
TAIL LIGHT RELAY
ILLUMNATION CONT.
0.85Br
0.85Br
R/L;D.R.L.
ON
2BG
R/L;D.R.L.
OFF(1)
3B
0.85GR
R/L;D.R.L.
OFF(2)
0.85B
0.85Br
0.85Br
0.85Lg
SW;PARKING
ACG(L)
D08M200043

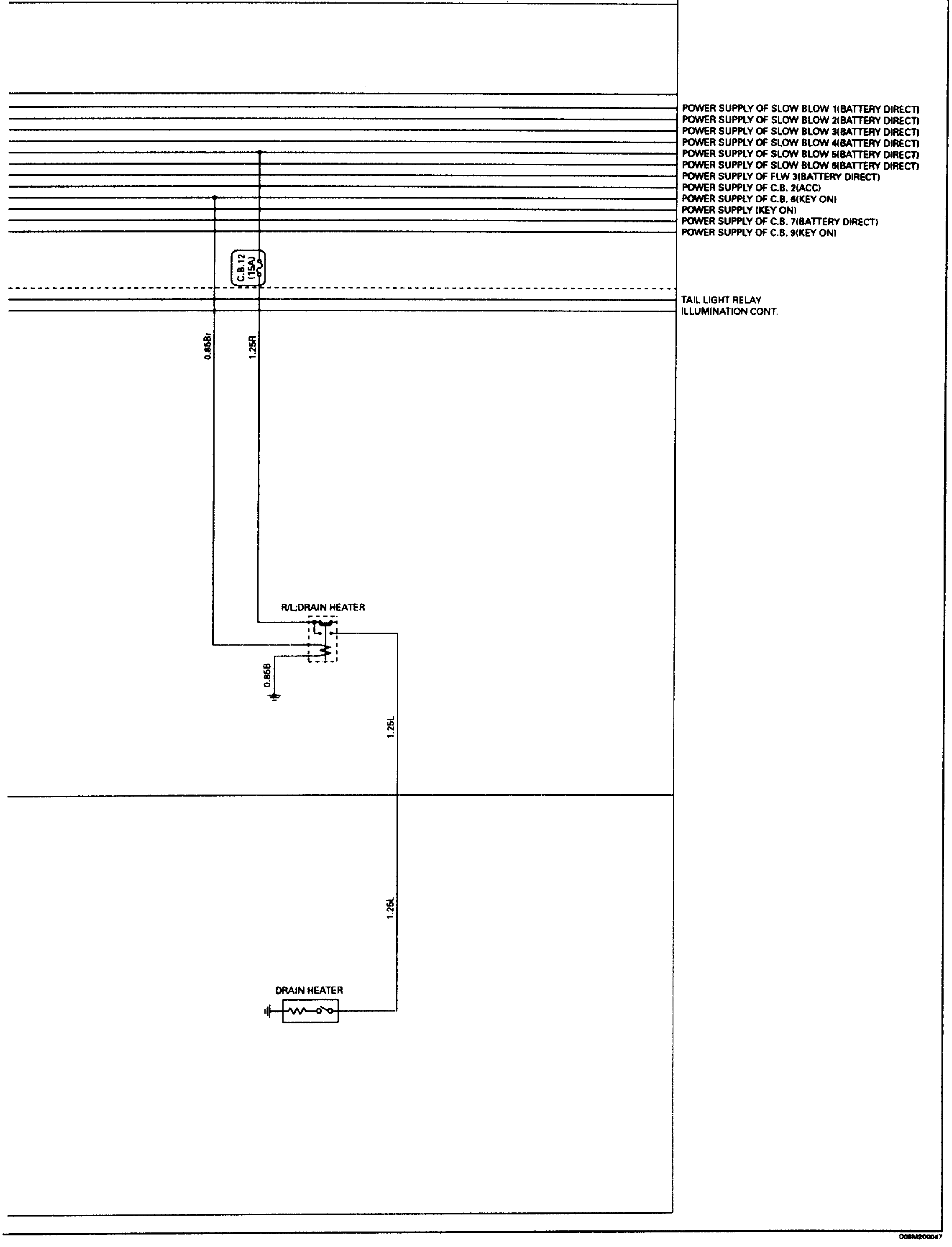

METER,WARNING CIRCUIT
FUSE
SLOW BLOW FUSE 1
SLOW BLOW FUSE 2
SLOW BLOW FUSE 3
SLOW BLOW FUSE 4
SLOW BLOW FUSE 5
SLOW BLOW FUSE 6
FLW 3(BATTERY)
C.B.2(ACC)
C.B.6(KEY ON)
POWER SUPPLY (KEY ON)
C.B.7(BATTERY)
C.B.9(KEY ON)
WIRING OF CAB SIDE
TAIL LIGHT RELAY
ILLUMI
2Br
1.25Br
1.25B
METER ASM
WATER TEMP.
FUEL
VOLT
OIL PRESS
TACHOMETER
WARNING LIGHT
CHARGE
SERVICE ENG. SOON
D.R.L.
BEAM
ABS
ABS
AIR
PARKING
OIL FILTER
A/T OIL
SEAT BELT
SEAT BELT ALARM MODULE
BRAKE
SW; BULB CHECK
0.85Br
0.85BrR
ACG(L)
DIODE(CHARGE)
ECM(106)
R/L:D.R.L.
HEAD LAMP
ECU:ABS
ECU:ABS
0.85BrW
0.85O
0.85Sb
0.85LY
TCM(24)
<A/T ONLY>
2Br
AIR BUZZER
2W
SW; PARKING BRAKE
0.5B
ECM(17)
DOIDE(PARK)
0.85Lg
0.85O
0.85Lg
0.85Br
0.5G
0.85V
0.5W
0.5B
0.85BrW
W/TEMP SENSOR
ECM(69)
R/L:DRL
R/L:DRL
WIRING OF CHASSIS SIDE
0.85V
0.85BrW
0.85Lg
0.85Br
0.85O
SW:AIR LOW PRESS
0.5BL
UNIT;OIL PRESS
0.5BL
UNIT;FUEL TANK
0.5BL
SW;OIL FILTER
0.85BL
SW;BRAKE FLUD
0.5BL
SW;BRAKE
0.85Lg
0.5BL
SW;BRAKE
0.85Lg
0.5BL
SW;BRAKE
0.85Lg
0.5BL
D08M200044

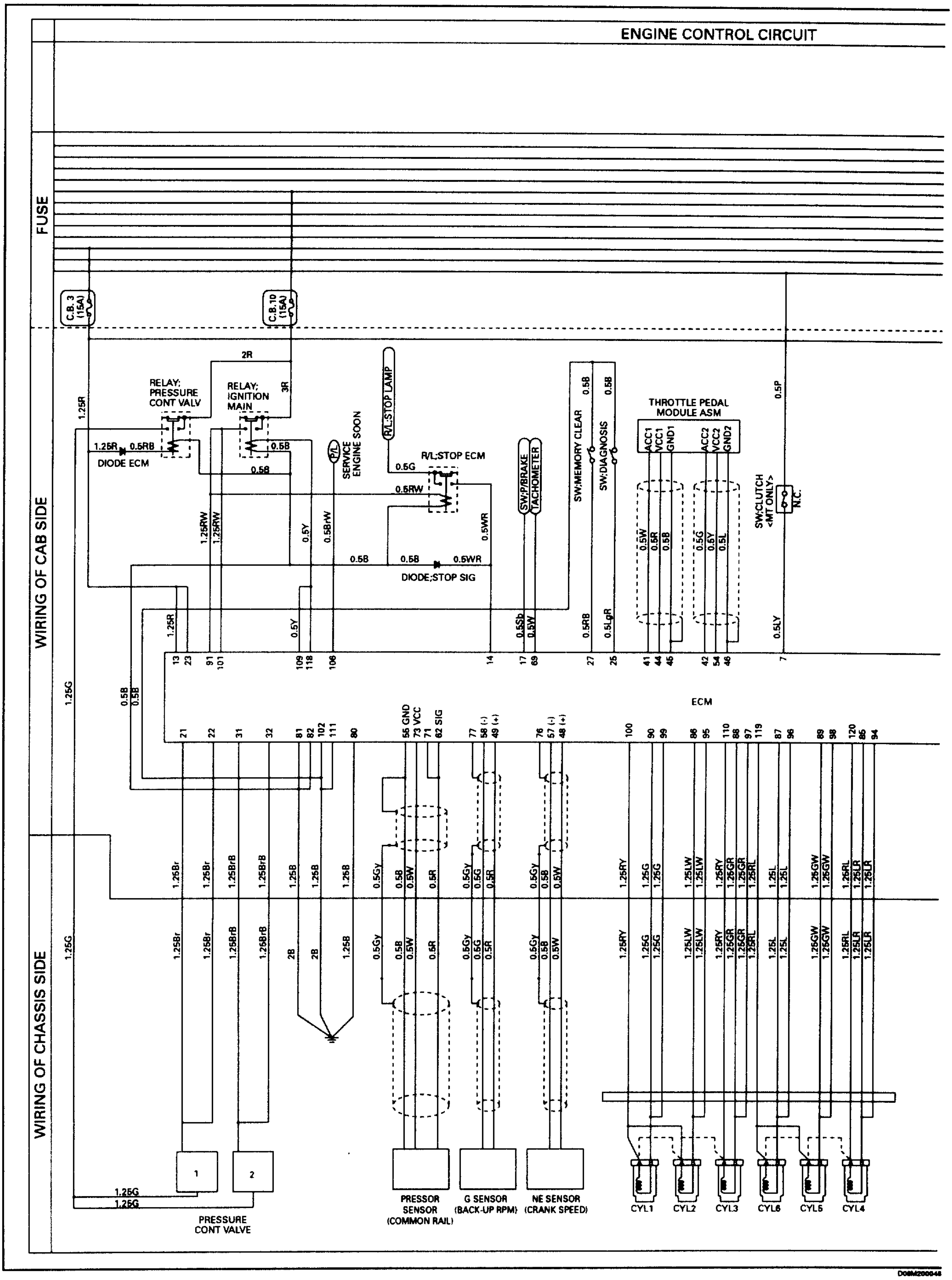

POWER SUPPLY OF SLOW BLOW 1(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 2(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 3(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 4(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 5(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 6(BATTERY DIRECT)
POWER SUPPLY OF FLW 3(BATTERY DIRECT)
POWER SUPPLY OF C.B. 2(ACC)
POWER SUPPLY OF C.B. 6(KEY ON)
POWER SUPPLY (KEY ON)
POWER SUPPLY OF C.B. 7(BATTERY DIRECT)
POWER SUPPLY OF C.B. 9(KEY ON)
TAIL LIGHT RELAY
ILLUMINATION CONT.
WARNING LIGHT
CHECK TRANS
TCM(25)
RANGE INHIBITED
TCM(23)
ECONOMY
SW:ECONO MODE
FLASHER LH
FLASHER LH
FLASHER RH
FLASHER RH
PTO
PTO
EXH.BRAKE
EXH.BRAKE
2Br
0.85BR
ILLUMINATION
CONTROLLER
METER
ILLUM.
0.85B
D08M200045

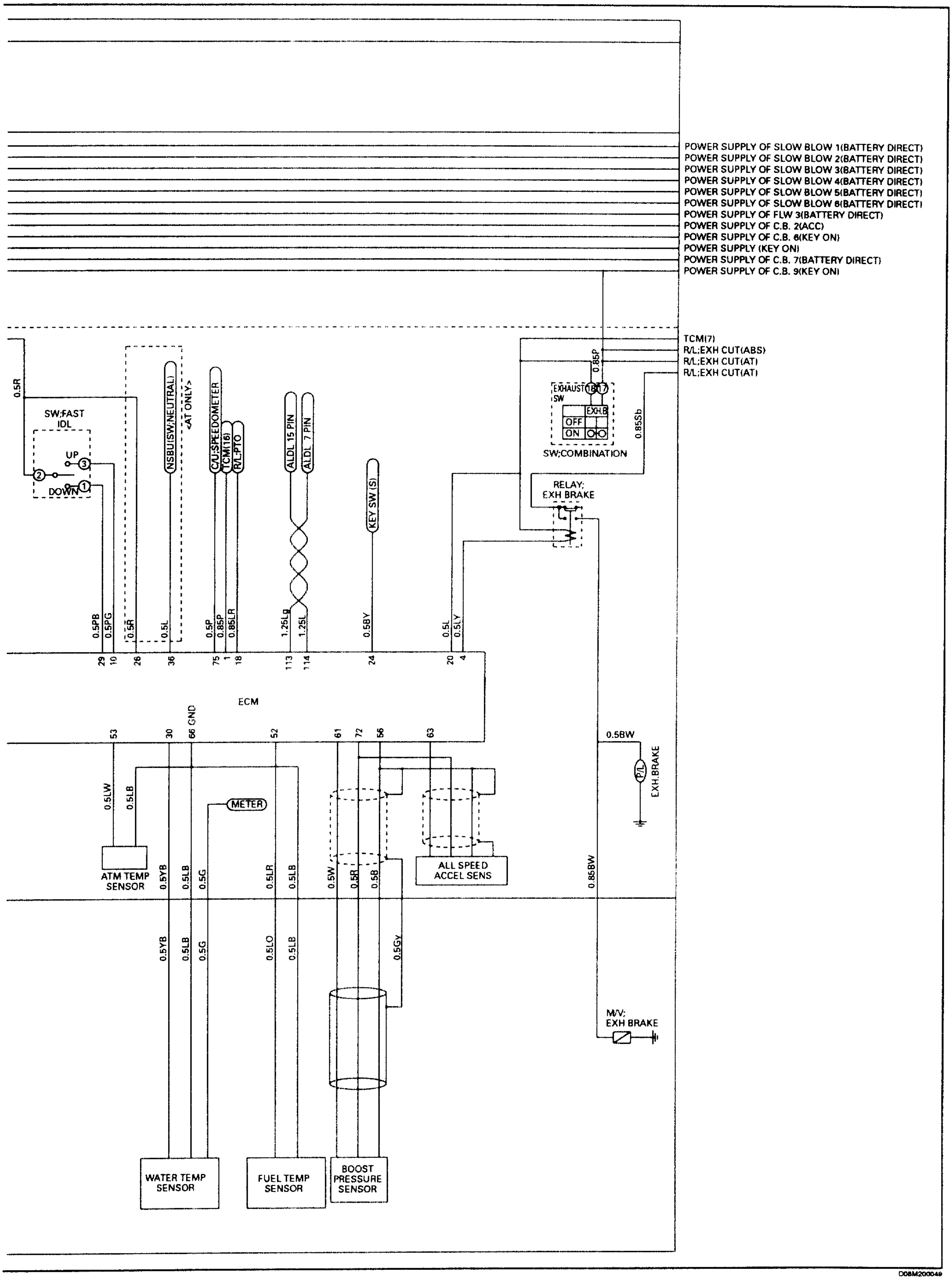

PTO CIRCUIT(MT)
PTO CIRCUIT(AT)
FUSE
WIRING OF CAB SIDE
WIRING OF CHASSIS SIDE
SLOW BLOW FUSE 1
SLOW BLOW FUSE 2
SLOW BLOW FUSE 3
SLOW BLOW FUSE 4
SLOW BLOW FUSE 5
SLOW BLOW FUSE 6
FLW 3(BATTERY)
C.B.2(ACC)
C.B.6(KEY ON)
POWER SUPPLY (KEY ON)
C.B.7(BATTERY)
C.B.9(KEY ON)
TAIL LIGHT RELAY
ILLUMINATION CONTROL
0.85Br
0.85R
SW;PTO
0.85P
0.85B
PTO
P/L
0.85BrL
IND
R/L;PTO
0.85B
0.85BrL
ECM(18)
0.85BrL
0.85LR
SHORT CONN
CONNECTOR (M/V;PTO)
0.85Br
0.85R
SW;PTO
0.85P
0.85BrL
TCM(6)
0.85B
PTO
P/L
0.85BrL
ECM(18)
0.85BrL
0.85P
R/L;PTO
0.85BrR
TCM(19)
0.85BrL
0.85LR
SHORT CONN
CONNECTOR (M/V;PTO)

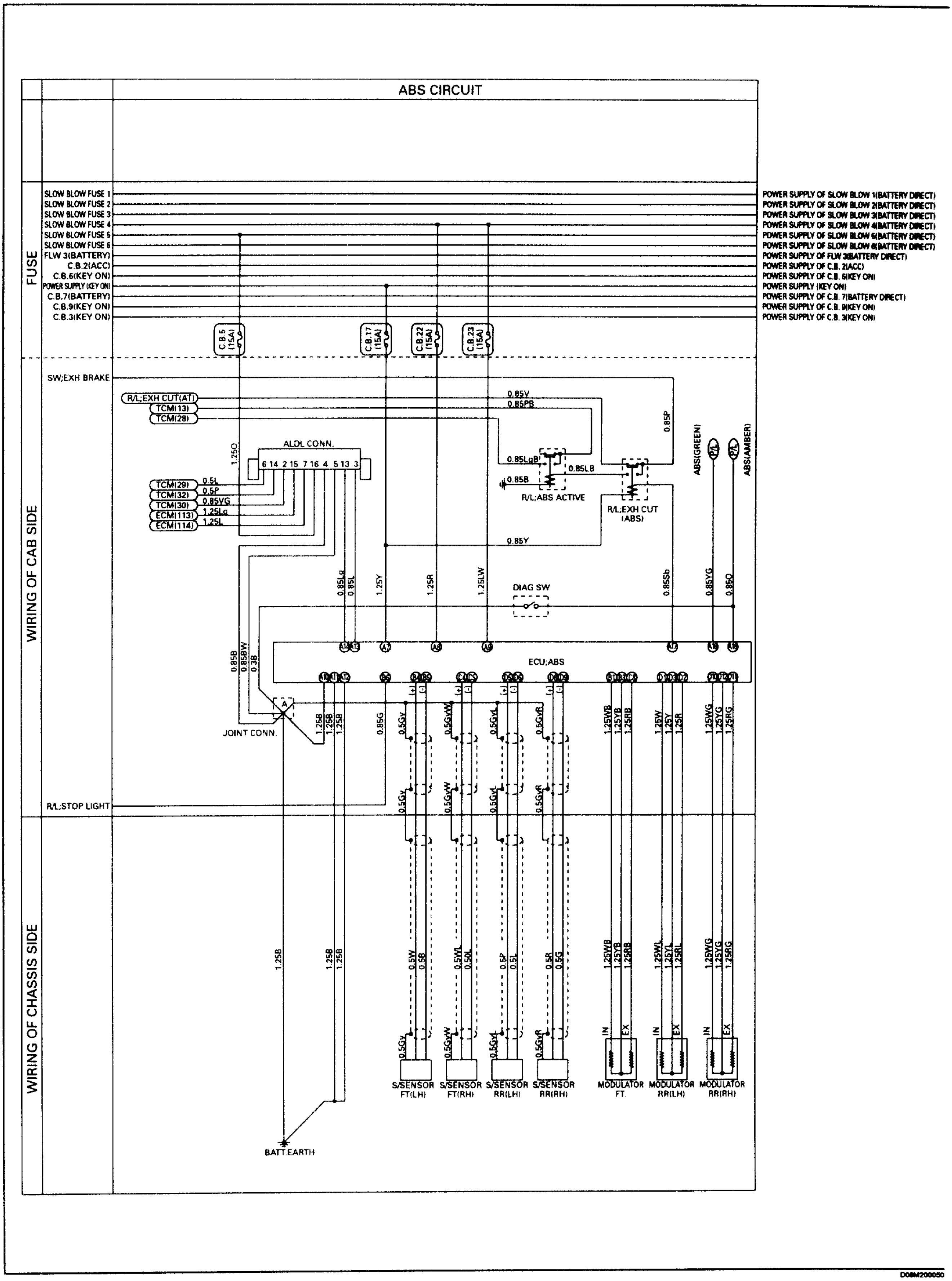
D08M200046

DRAIN HEATER CIRCUIT



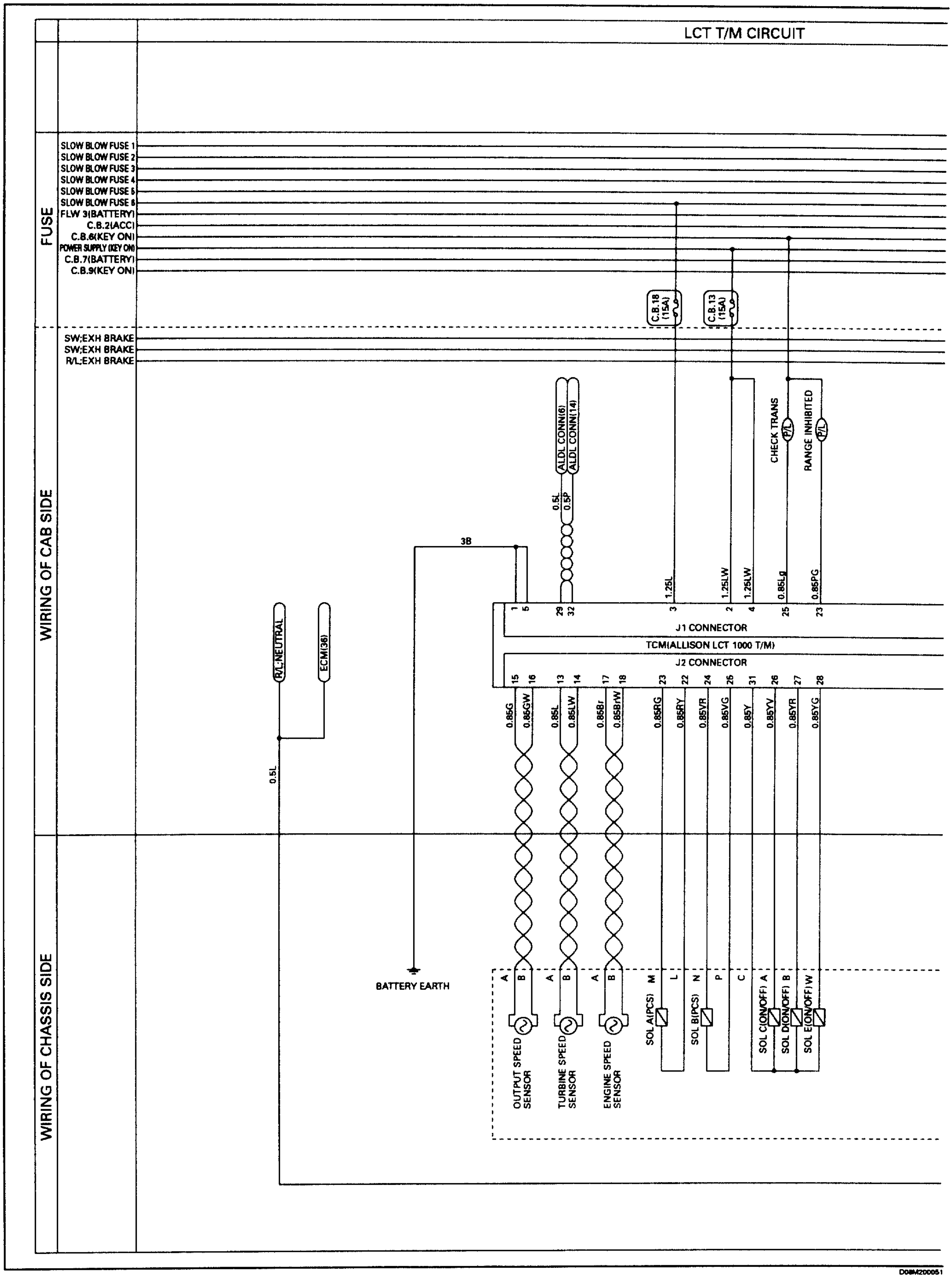

ENGINE CONTROL CIRCUIT
FUSE
WIRING OF CAB SIDE
WIRING OF CHASSIS SIDE
C.B.3 (15A)
C.B.10 (15A)
2R
3R
1.25R
RELAY; PRESSURE CONT VALV
RELAY; IGNITION MAIN
1.25R
0.5RB
DIODE ECM
0.5B
SERVICE ENGINE SOON
P/L
R/L;STOP LAMP
R/L;STOP ECM
0.5G
0.5RW
0.5WR
DIODE;STOP SIG
SW;P/BRAKE
TACHOMETER
SW;MEMORY CLEAR
SW;DIAGNOSIS
THROTTLE PEDAL MODULE ASM
ACC1
VCC1
GND1
ACC2
VCC2
GND2
SW;CLUTCH <MT ONLY>
N.C.
0.5P
0.5LY
1.25RW
0.5Y
0.5BrW
0.5Sb
0.5W
0.5RB
0.5LgR
ECM
56 GND
73 VCC
71
62 SIG
77
58 (-)
49 (+)
76
57 (-)
48 (+)
1.25G
1.25Br
1.25BrB
1.25B
2B
0.5Gy
0.5R
1.25RY
1.25LW
1.25GR
1.25RL
1.25L
1.25GW
1.25LR
1
2
PRESSURE CONT VALVE
PRESSOR SENSOR (COMMON RAIL)
G SENSOR (BACK-UP RPM)
NE SENSOR (CRANK SPEED)
CYL1
CYL2
CYL3
CYL6
CYL5
CYL4
D08M200048

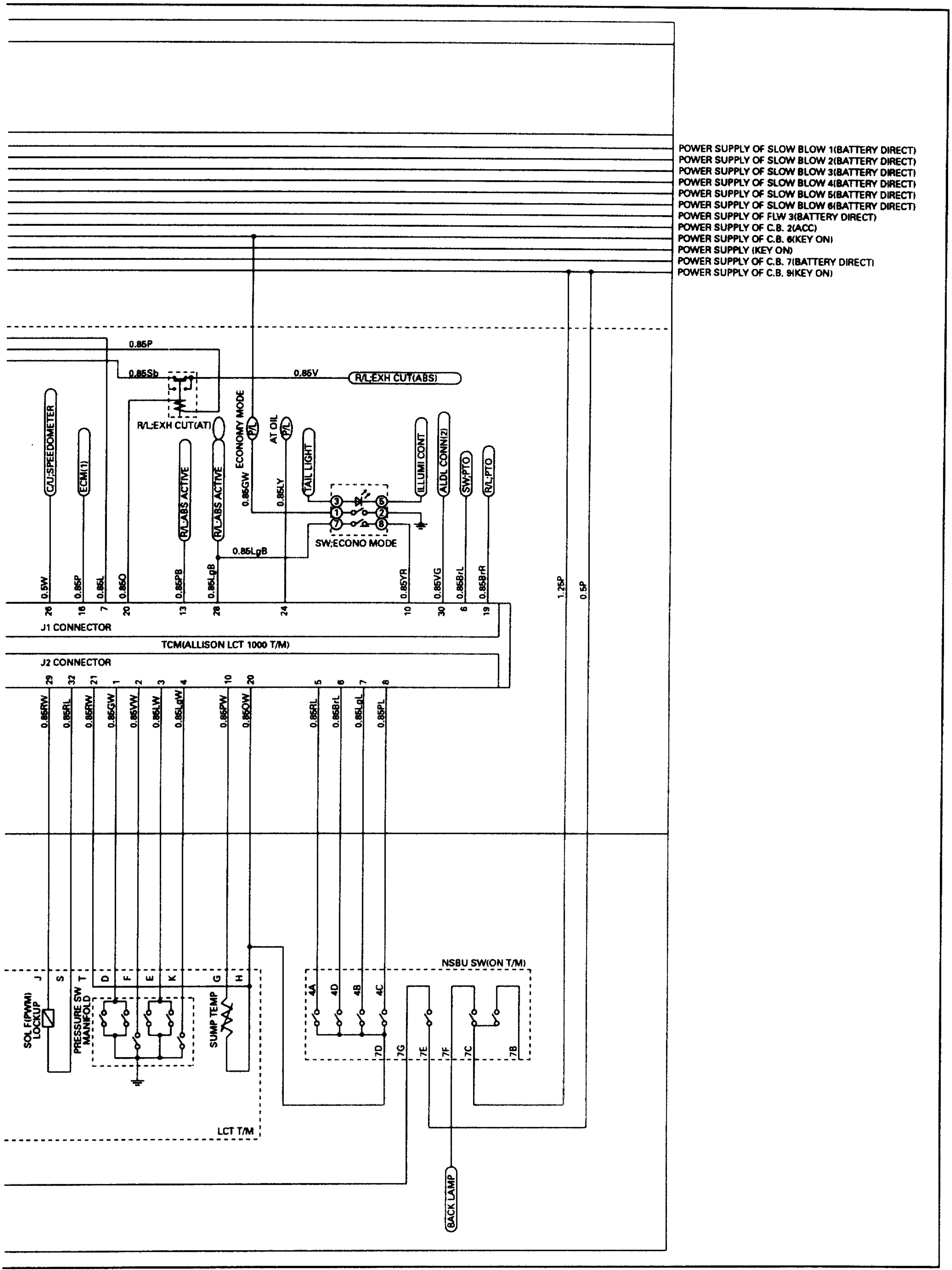

POWER SUPPLY OF SLOW BLOW 1(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 2(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 3(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 4(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 5(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 6(BATTERY DIRECT)
POWER SUPPLY OF FLW 3(BATTERY DIRECT)
POWER SUPPLY OF C.B. 2(ACC)
POWER SUPPLY OF C.B. 6(KEY ON)
POWER SUPPLY (KEY ON)
POWER SUPPLY OF C.B. 7(BATTERY DIRECT)
POWER SUPPLY OF C.B. 9(KEY ON)
TCM(7)
R/L;EXH CUT(ABS)
R/L;EXH CUT(AT)
R/L;EXH CUT(AT)
0.5R
SW;FAST IDL
UP
DOWN
2
3
1
NSBU(SW;NEUTRAL)
<AT ONLY>
C/U;SPEEDOMETER
TCM(16)
R/L;PTO
ALDL 15 PIN
ALDL 7 PIN
KEY SW (S)
0.85P
EXHAUST SW
18
17
EXH.B
OFF
ON
0.85Sb
SW;COMBINATION
RELAY; EXH BRAKE
0.5PB
0.5PG
0.5R
0.5L
0.5P
0.85P
0.85LR
1.25Lg
1.25L
0.5BY
0.5L
0.5LY
29
10
26
36
75
1
18
113
114
24
20
4
ECM
53
30
66 GND
52
61
72
56
63
0.5BW
P/L
EXH.BRAKE
0.5LW
0.5LB
METER
ATM TEMP SENSOR
0.5YB
0.5LB
0.5G
0.5LR
0.5LB
0.5W
0.5R
0.5B
ALL SPEED ACCEL SENS
0.85BW
0.5YB
0.5LB
0.5G
0.5LO
0.5LB
0.5Gy
M/V; EXH BRAKE
WATER TEMP SENSOR
FUEL TEMP SENSOR
BOOST PRESSURE SENSOR
D08M200049


ABS CIRCUIT
FUSE
WIRING OF CAB SIDE
WIRING OF CHASSIS SIDE
SLOW BLOW FUSE 1
SLOW BLOW FUSE 2
SLOW BLOW FUSE 3
SLOW BLOW FUSE 4
SLOW BLOW FUSE 5
SLOW BLOW FUSE 6
FLW 3(BATTERY)
C.B.2(ACC)
C.B.6(KEY ON)
POWER SUPPLY (KEY ON)
C.B.7(BATTERY)
C.B.9(KEY ON)
C.B.3(KEY ON)
POWER SUPPLY OF SLOW BLOW 1(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 2(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 3(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 4(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 5(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 6(BATTERY DIRECT)
POWER SUPPLY OF FLW 3(BATTERY DIRECT)
POWER SUPPLY OF C.B. 2(ACC)
POWER SUPPLY OF C.B. 6(KEY ON)
POWER SUPPLY (KEY ON)
POWER SUPPLY OF C.B. 7(BATTERY DIRECT)
POWER SUPPLY OF C.B. 9(KEY ON)
POWER SUPPLY OF C.B. 3(KEY ON)
C.B.5 (15A)
C.B.17 (15A)
C.B.22 (15A)
C.B.23 (15A)
SW;EXH BRAKE
R/L;EXH CUT(AT)
TCM(13)
TCM(28)
0.85V
0.85PB
0.85P
ALDL CONN.
1.25O
6 14 2 15 7 16 4 5 13 3
TCM(29) 0.5L
TCM(32) 0.5P
TCM(30) 0.85VG
ECM(113) 1.25Lg
ECM(114) 1.25L
0.85LgB
0.85LB
0.85B
R/L;ABS ACTIVE
R/L;EXH CUT (ABS)
ABS(GREEN)
P/L
P/L
ABS(AMBER)
0.85Y
0.85Lg
0.85L
1.25Y
1.25R
1.25LW
DIAG SW
0.85Sb
0.85YG
0.85O
0.85B
0.85BW
0.3B
A14 A13 A7 A8 A9 A17 A16 A18
ECU;ABS
A10 A11 A12 B6 B4 B5 C4 C5 D5 D6 D8 D9 B1 B3 C3 D1 D3 D2 D10 D12 D11
(+) (-)
A
JOINT CONN.
1.25B
1.25B
1.25B
0.85G
0.5Gy
0.5GyW
0.5GyL
0.5GyR
1.25WB
1.25YB
1.25RB
1.25W
1.25Y
1.25R
1.25WG
1.25YG
1.25RG
R/L;STOP LIGHT
1.25B
1.25B
1.25B
0.5W
0.5B
0.5WL
0.5OL
0.5P
0.5L
0.5R
0.5G
1.25WL
1.25YL
1.25RL
IN
EX
S/SENSOR FT(LH)
S/SENSOR FT(RH)
S/SENSOR RR(LH)
S/SENSOR RR(RH)
MODULATOR FT.
MODULATOR RR(LH)
MODULATOR RR(RH)
BATT.EARTH

D08M200060

MEMO


LCT T/M CIRCUIT
FUSE
SLOW BLOW FUSE 1
SLOW BLOW FUSE 2
SLOW BLOW FUSE 3
SLOW BLOW FUSE 4
SLOW BLOW FUSE 5
SLOW BLOW FUSE 6
FLW 3(BATTERY)
C.B.2(ACC)
C.B.6(KEY ON)
POWER SUPPLY (KEY ON)
C.B.7(BATTERY)
C.B.9(KEY ON)
C.B.18 (15A)
C.B.13 (15A)
WIRING OF CAB SIDE
SW;EXH BRAKE
SW;EXH BRAKE
R/L;EXH BRAKE
ALDL CONN(6)
ALDL CONN(14)
0.5L
0.5P
CHECK TRANS
P/L
RANGE INHIBITED
P/L
3B
1.25L
1.25LW
1.25LW
0.85Lg
0.85PG
1
5
29
32
3
2
4
25
23
J1 CONNECTOR
TCM(ALLISON LCT 1000 T/M)
J2 CONNECTOR
15
16
13
14
17
18
23
22
24
25
31
26
27
28
R/L;NEUTRAL
ECM(36)
0.85G
0.85GW
0.85L
0.85LW
0.85Br
0.85BrW
0.85RG
0.85RY
0.85VR
0.85VG
0.85Y
0.85YV
0.85YR
0.85YG
0.5L
WIRING OF CHASSIS SIDE
BATTERY EARTH
A
B
A
B
A
B
M
L
N
P
C
A
B
W
OUTPUT SPEED SENSOR
TURBINE SPEED SENSOR
ENGINE SPEED SENSOR
SOL A(PCS)
SOL B(PCS)
SOL C(ON/OFF)
SOL D(ON/OFF)
SOL E(ON/OFF)
D08M200051


POWER SUPPLY OF SLOW BLOW 1(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 2(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 3(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 4(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 5(BATTERY DIRECT)
POWER SUPPLY OF SLOW BLOW 6(BATTERY DIRECT)
POWER SUPPLY OF FLW 3(BATTERY DIRECT)
POWER SUPPLY OF C.B. 2(ACC)
POWER SUPPLY OF C.B. 6(KEY ON)
POWER SUPPLY (KEY ON)
POWER SUPPLY OF C.B. 7(BATTERY DIRECT)
POWER SUPPLY OF C.B. 9(KEY ON)
0.85P
0.85Sb
0.85V
R/L;EXH CUT(ABS)
R/L;EXH CUT(AT)
C/U;SPEEDOMETER
ECM(1)
R/L;ABS ACTIVE
R/L;ABS ACTIVE
ECONOMY MODE
P/L
AT OIL
P/L
TAIL LIGHT
ILLUMI CONT
ALDL CONN(2)
SW;PTO
R/L;PTO
0.85GW
0.85LY
3
1
7
5
2
8
SW;ECONO MODE
0.85LgB
0.5W
0.85P
0.85L
0.85O
0.85PB
0.85LgB
0.85YR
0.85VG
0.85BrL
0.85BrR
1.25P
0.5P
26
16
7
20
13
28
24
10
30
6
19
J1 CONNECTOR
TCM(ALLISON LCT 1000 T/M)
J2 CONNECTOR
29
32
21
1
2
3
4
10
20
5
6
7
8
0.85RW
0.85RL
0.85RW
0.85GW
0.85VW
0.85LW
0.85LgW
0.85PW
0.85OW
0.85RL
0.85BrL
0.85LgL
0.85PL
J
S
T
D
F
E
K
G
H
SOL F(PWM) LOCKUP
PRESSURE SW MANIFOLD
SUMP TEMP
LCT T/M
NSBU SW(ON T/M)
4A
4D
4B
4C
7D
7G
7E
7F
7C
7B
BACK LAMP

D08M200052

MEMO

SECTION 9

METRIC AND FASTENER INFORMATION

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

MEMO

SECTION 10

CAB

CONTENTS

MEMO

MEMO

MEMO

MEMO

MEMO

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