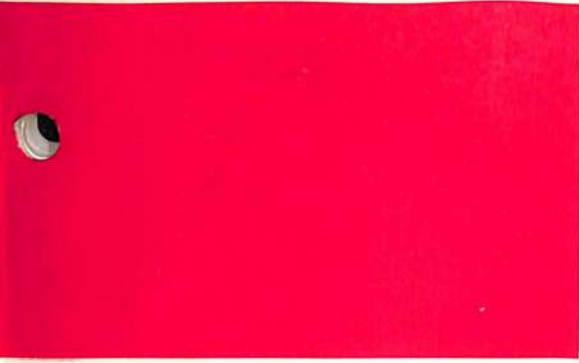




TOYOTA **SUPRA**

New Car Features
1986

For More Effective Sales and Service Activities

TOYOTA

FOREWORD

This manual has been prepared to familiarize you with the new features of the new Toyota Supra.

Applicable models: MA70 series

For detailed service specifications and repair procedures, refer to the relevant Repair Manuals.

All information contained herein is the most up-to-date at the time of publication. We reserve the right to make changes without prior notice.

TOYOTA MOTOR CORPORATION

FOREWORD

The purpose of this book is to provide you with a guide to the world of Toyota.

It is a book for you, the owner of a Toyota.

It is a book for you, the person who is interested in the world of Toyota.

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TOYOTA MOTOR CORPORATION

NEW CAR FEATURES

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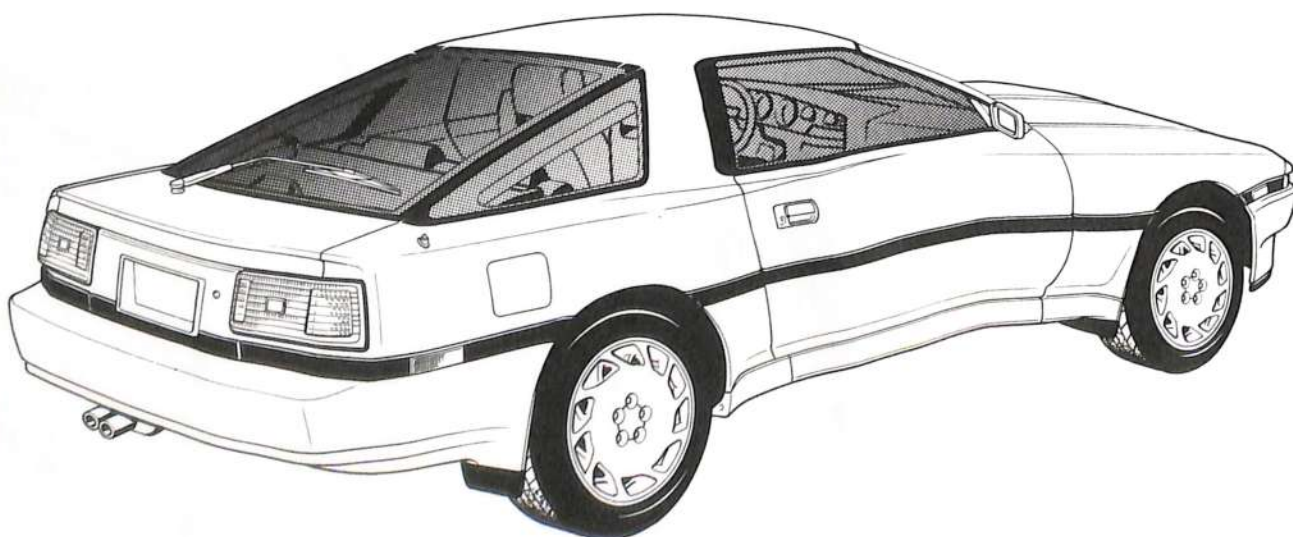
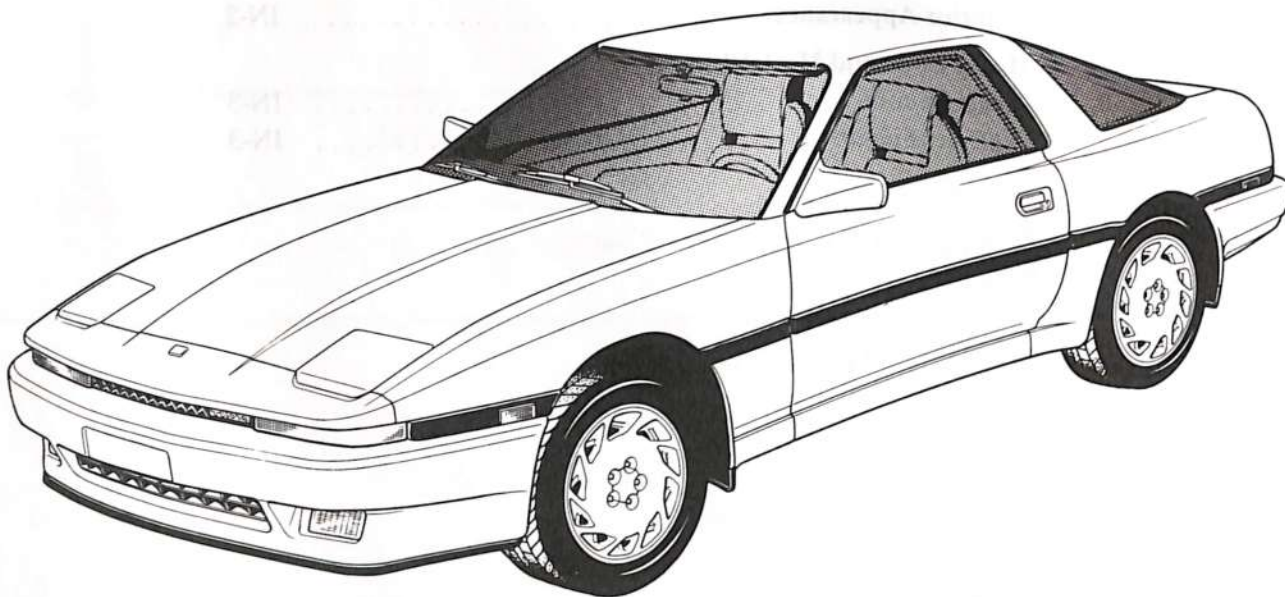
NEW CAR FEATURES

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Exterior Appearance



Model Code and Model Line-up

Model Code

MA70L-BLMVFA

BASIC MODEL CODE

MA70: With 7M-GE
Engine

STEERING WHEEL POSITION

L : Left-hand Drive

MODEL NAME

B : Toyota Supra

BODY TYPE

L : Liftback

DESTINATION

A : U. S. A.
K : Canada

ENGINE SPECIFICATION

F : EFI and DOHC

GRADE

V : GT

GEARSHIFT TYPE

M : 5-speed Manual
P : 4-speed Automatic

Model Line-up

Transmission				W58 5-speed Manual	A340E 4-speed Automatic
Engine					
Grade					
Destination	Body Type				
U. S. A.	Liftback	GT	7M-GE	MA70L-BLMVFA	MA70L-BLPVFA
Canada				MA70L-BLMVFK	MA70L-BLPVFK

New Model Highlights

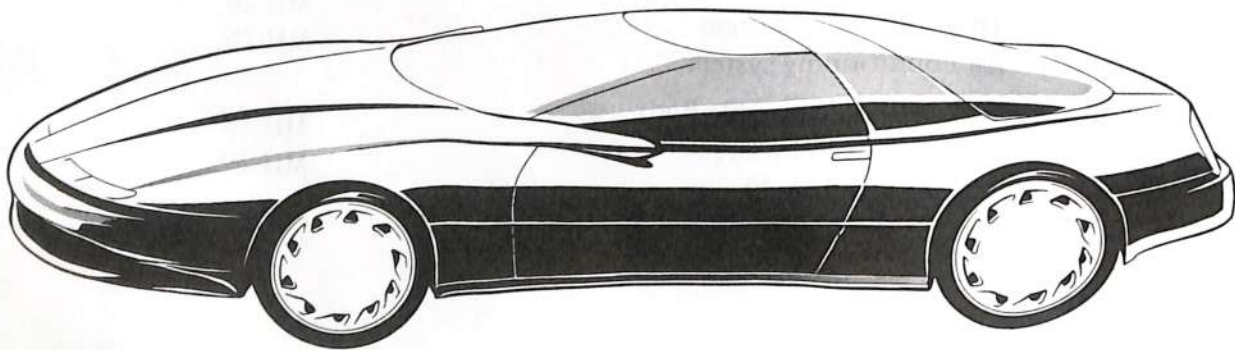
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Development Objectives

The Toyota Supra is Toyota's image leader car. The Supra has a good reputation, especially for its body styling and high performance. Market needs, however, have been shifting towards more luxurious and higher performance products. In response to this trend, Toyota has carried out a full model change to make the Toyota Supra a pioneer model engineered with Toyota's advanced technology as well as a real volume-sales sports car.

The new Toyota Supra has been developed with the following objectives in mind:

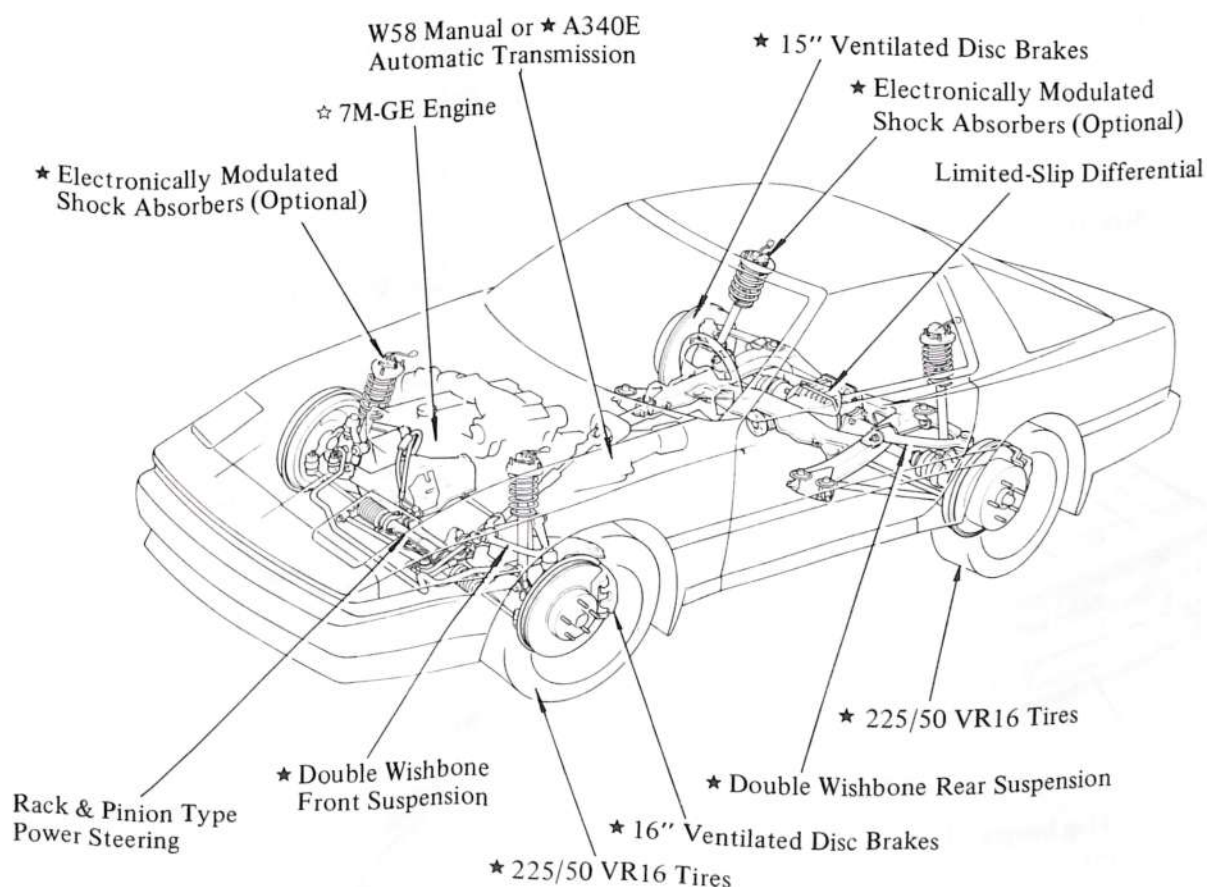
- ▶ High performance worthy of a real sports car
- ▶ Sporty and powerful exterior styling
- ▶ Sporty and high quality interior which gives the occupants a luxurious feeling
- ▶ Attractive new features and equipment



Outline

Driving Performance

- The engine is the newly developed high performance 3.0 liter DOHC 24 valve 7M-GE engine.
- For the suspension, a 4-wheel double wishbone suspension used on racing cars has been adopted. Also, the TEMS (Toyota Electronic Modulated Suspension), which controls the damping force of the shock absorbers electronically in accordance with driving conditions, is offered as an option.
- High performance 225/50 VR16 tires, which are the most suitable for the new suspension, are provided. This is the first time that Toyota has adopted high speed type tires with an aspect ratio of 50%.

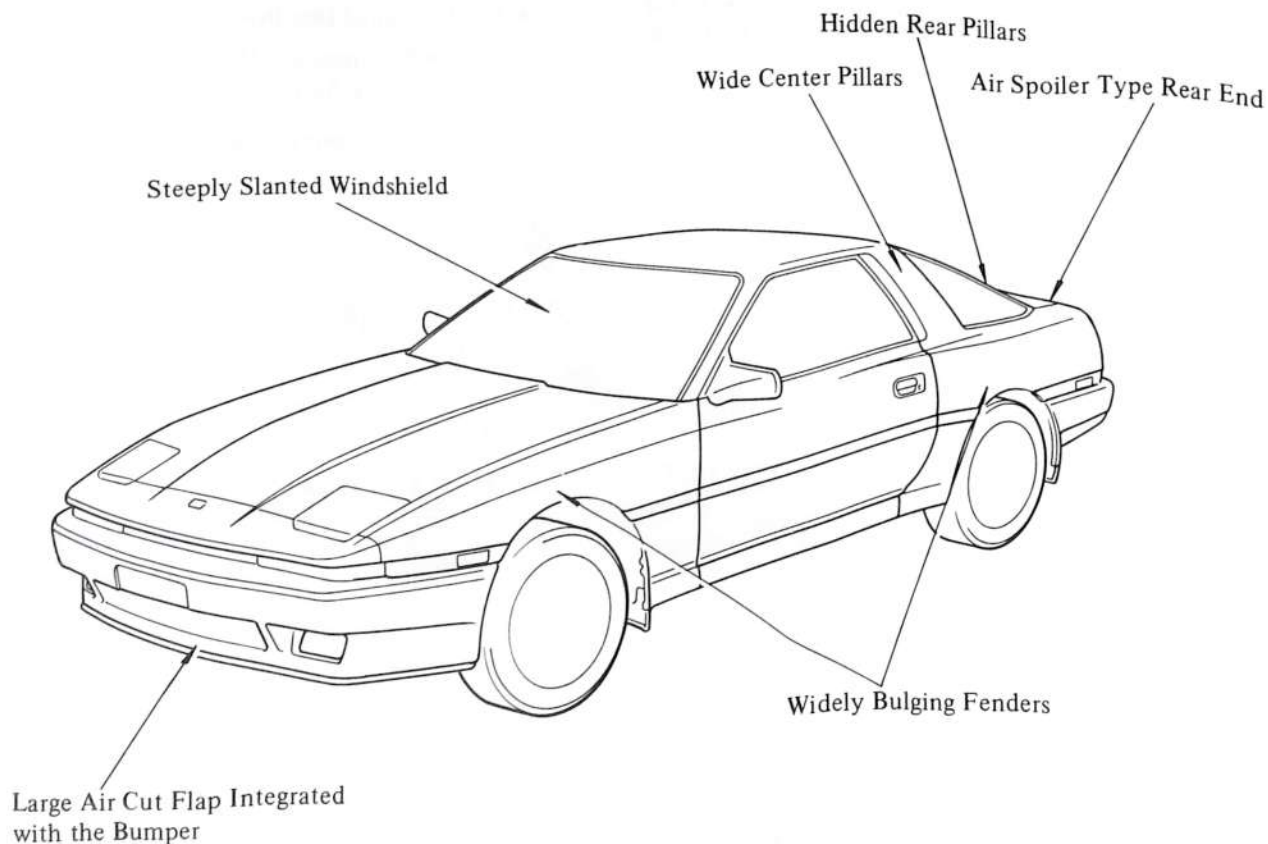


☆ : Newly Developed
 ★ : Newly Incorporated

Outline

Exterior

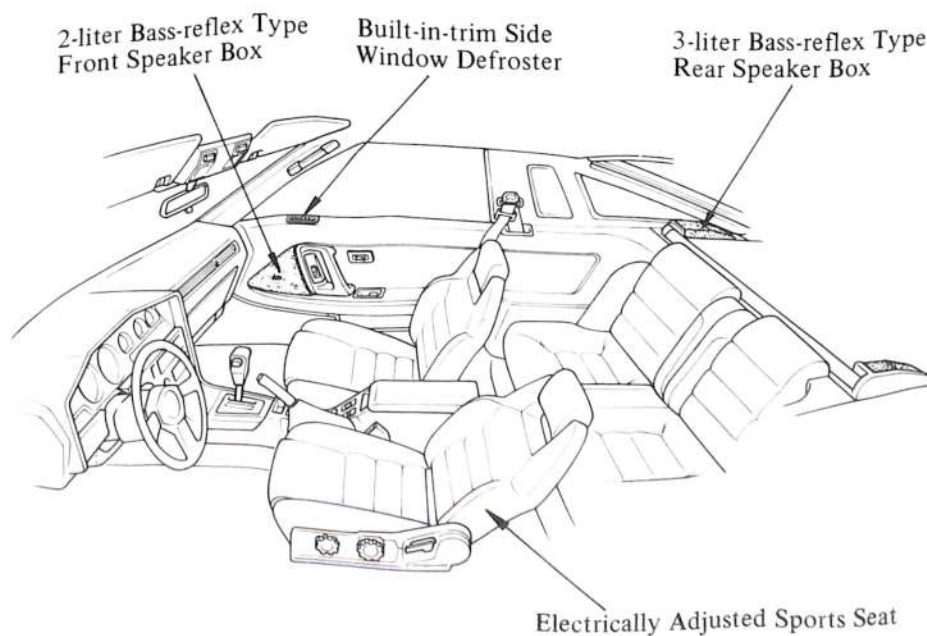
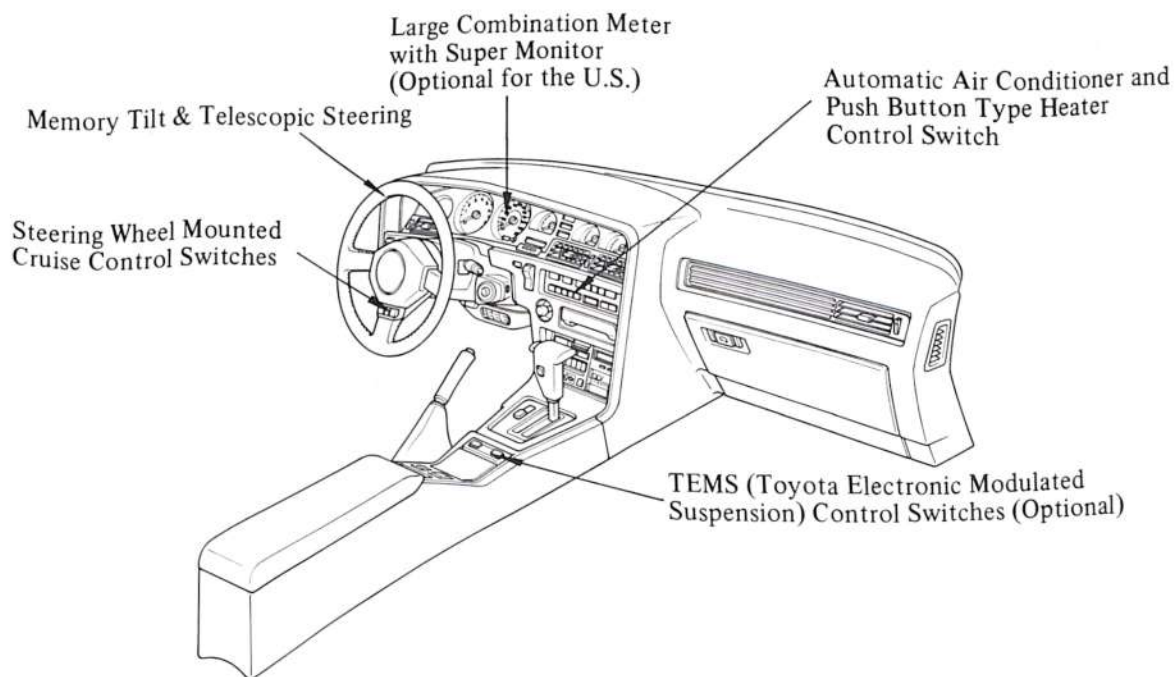
- Through the curved design and low overall height, the style has been made more sporty and aerodynamic.
- With its accentuated, widely bulging fenders, which envelop the wheels, the design is one which emphasizes the wide tread and gives a feel of stability.
- By Shortening the overall length by about 1.6 in. (40 mm) compared with the previous Supra, slanting the windshield steeply and widening the center pillars, the wide cabin looks compact and the Supra's sportiness is emphasized.



Outline

Interior

- The interior is given a high class feel by the use of carefully designed color coordinates and soft materials.
- By adopting a large combination meter and grouping the switches around the steering wheel, a functional cockpit appropriate for a sports car is created.
- Through the adoption of memory tilt and telescopic steering, lengthening the front seat sliding adjustment range by about 1.2 in. (30 mm) in the rear direction, and by providing about 1.6 in. (40 mm) more head clearance, even tall persons can sit in the optimum driving position.



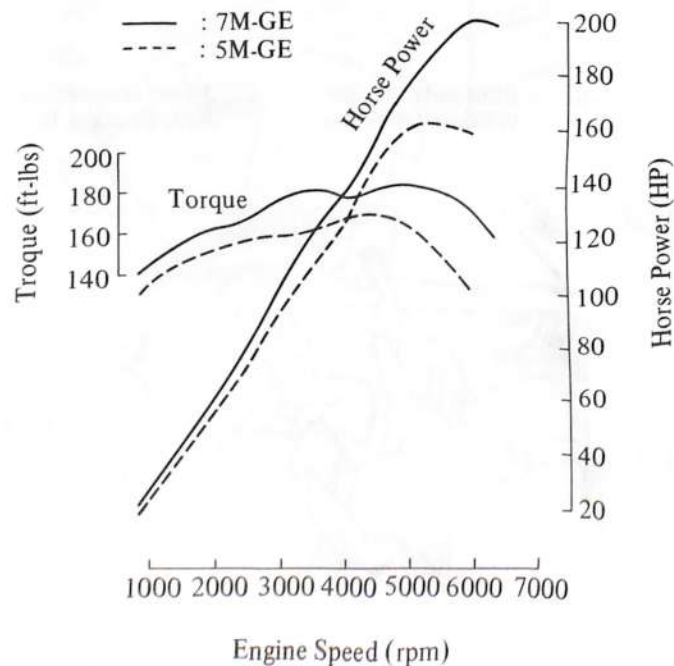
High-power and Economical Engine

7M-GE Engine

 TD-2

- The 7M-GE engine is a lightweight 3.0 liter DOHC engine which has been developed with the 5M-GE engine, mounted in the previous Supra, as a base.
- This successor to the 5M-GE engine incorporates 4 valves per cylinder, a new type Intake Air Control System, and the TCCS (Toyota Computer Controlled System), for a high output, super-responsive engine with good fuel economy.

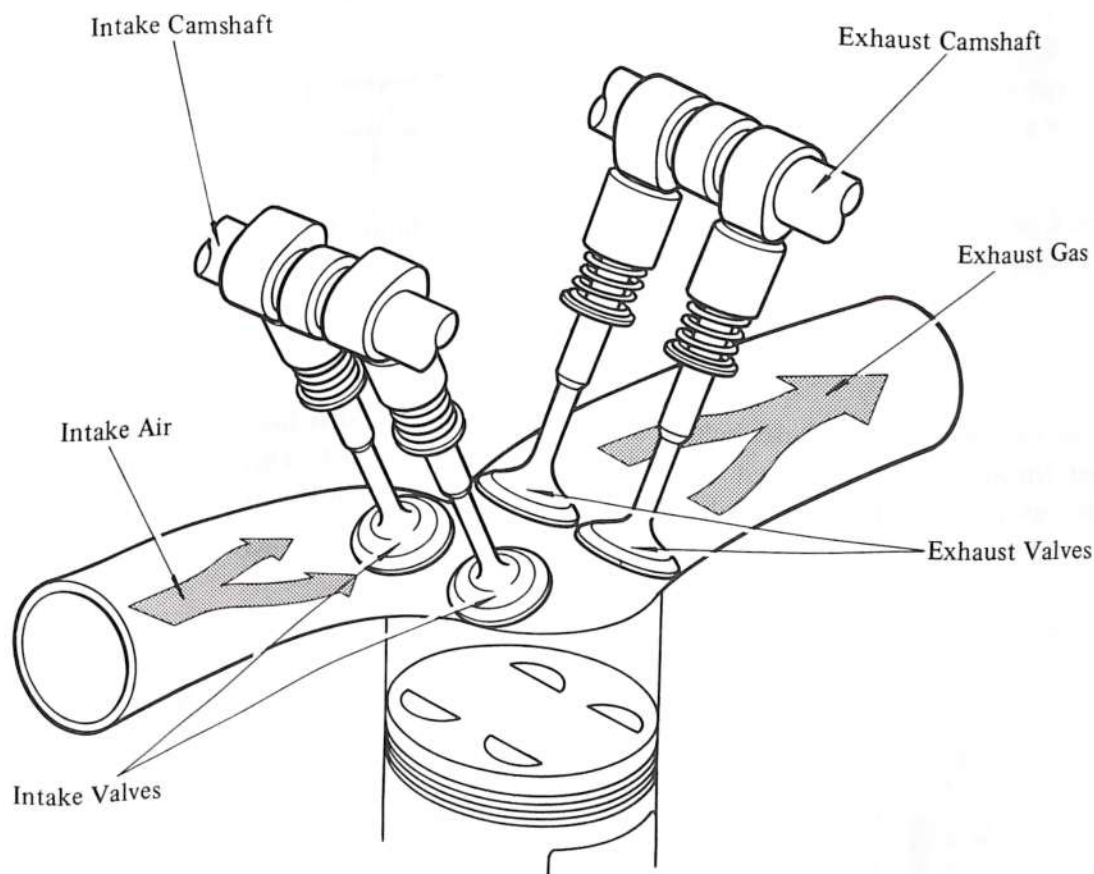
Engine		7M-GE	5M-GE (Previous Model)
Item			
No. of Cyls. & Arrangement		6 cylinder, In-line	←
Valve Mechanism		4 Valves, DOHC, Belt Drive	2 Valves, DOHC, Belt Drive
Combustion Chamber		Pentroof Type	Multi-spherical Type
Manifold		Cross-flow	←
Displacement	cu.in. (cc)	180.3 (2954)	168.4 (2759)
Bore × Stroke	in. (mm)	3.27 × 3.58 (83 × 91)	3.27 × 3.35 (83 × 85)
Compression Ratio		9.2	←
Max. Horsepower	(SAE-NET)	200 HP @ 6000 rpm	161 HP @ 5200 rpm
Max. Torque	(SAE-NET)	185 ft-lbs @ 4800 rpm	169 ft-lbs @ 4500 rpm



High-power and Economical Engine

1. High Output

- Through the adoption of 4 valves per cylinder (2 intake valves and 2 exhaust valves), the intake and exhaust surface area has been increased. As a result, intake and exhaust air resistance has been reduced, and efficiency, especially at high engine speeds, has been greatly improved.
- Since the camshafts operate the valves directly, the mass of the valve train is low. Through this means, precise valve motion all the way up to considerably high engine speeds has been made possible and high output has been obtained.

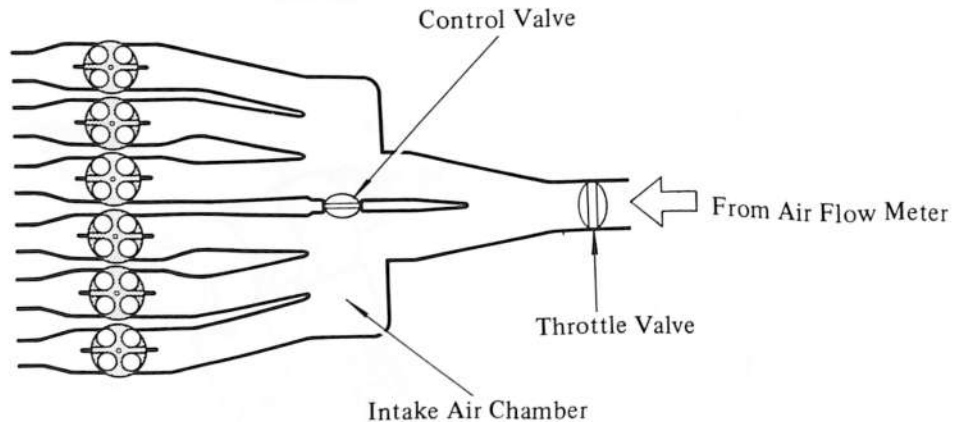


- The TCCS now includes a new type Intake Air Control System. Through its adoption, high output can be achieved over a wide range of engine speeds.

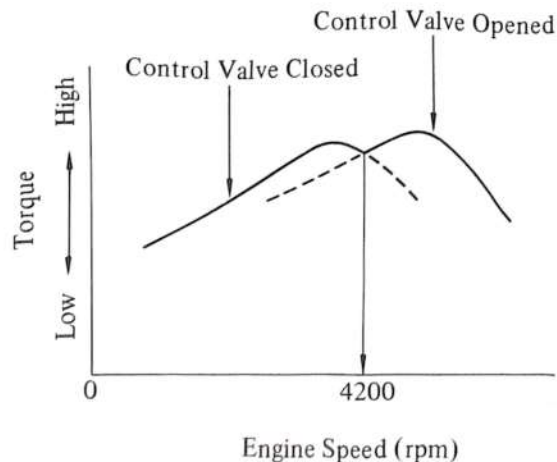
High-power and Economical Engine

What is the new type Intake Air Control System?

On the 7M-GE engine, a control valve is installed in the center of the intake air chamber, as seen in the figure below. This control valve opens and closes in accordance with the engine speed and the throttle opening angle and controls the air intake passage.



As can be seen in the figure below, when the engine speed is lower than 4200 rpm, higher torque can be obtained with the control valve closed. This is because at low engine speeds, the effect of intake air inertia is greater when the air intake passage is long, and therefore, the intake efficiency becomes better.

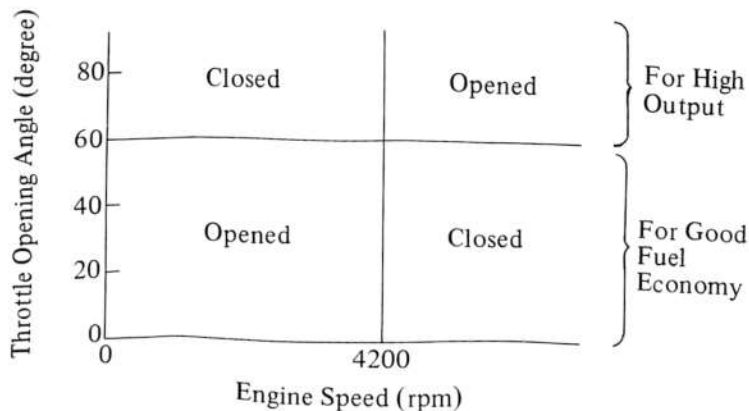


High-power and Economical Engine

On the other hand, when the engine speed is greater than 4200 rpm, higher torque can be obtained with the control valve open. This is because the intake air resistance is greater if the air intake passage is long, and as a result, intake efficiency drops.

As shown in the figure below, when the throttle opening angle is greater than 60 degrees, that is, when high output is necessary, closing the control valve at low engine speeds and opening the valve at high engine speeds, delivers high output over a wide range of engine speeds.

However, when the throttle opening angle is less than 60 degrees, that is, when high output is not necessary, opening and closing the control valve in the opposite pattern from above gives good fuel economy.



Control Valve Operation

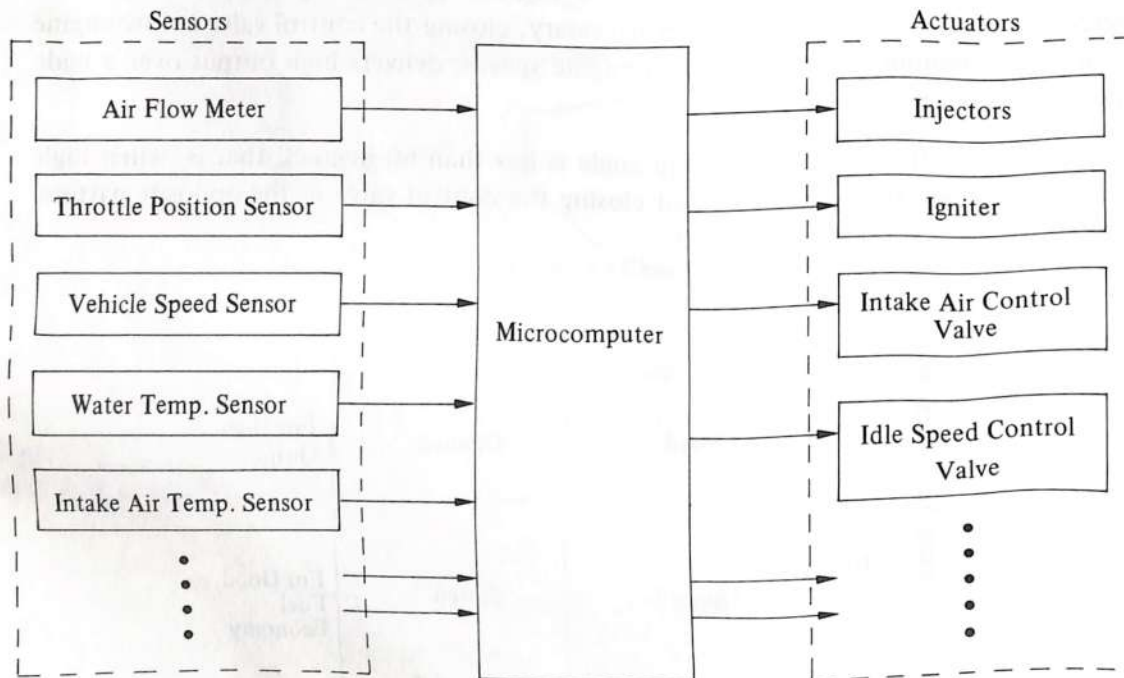
High-power and Economical Engine

2. Good Fuel Economy

- Through the TCCS (Toyota Computer Controlled System), the fuel injection volume and timing, ignition timing, etc. are controlled very closely to achieve optimum efficiency for the various running conditions.

How is the 7M-GE Engine Improved by the TCCS?

In the TCCS, the microcomputer detects the vehicle's running conditions through signals from the various sensors such as the air flow meter, throttle position sensor and vehicle speed sensor, and then controls the fuel injection volume and timing, ignition timing, the intake air control valve and engine idle speed, at the optimum conditions.



A three group fuel injection system has been adopted. In this system, the six cylinders are divided into three groups, and the proper amount of fuel is injected for each group (two cylinders) in the right timing once per cycle (two engine revolutions). With this system, even when engine condition changes suddenly, extremely fine adjustments of the amount of fuel injected and the injection timing are possible.

High-power and Economical Engine

Ignition timing control is carried out by the ESA (Electronic Spark Advance) system. In this system, the computer detects the current engine running conditions through the signals from each sensor. Then, based on those signals and the data already stored in memory on the optimum ignition timing for the engine's running conditions, the computer calculates the optimum ignition timing for the engine at that time and controls the ignition timing accordingly. This system allows for more precise ignition timing control than was possible with the old spark advance systems utilizing a vacuum controller and governor mechanism.

The TCCS in the 7M-GE engine includes the new type Intake Air Control System. With this system, high output is obtained over a wide range of engine speeds at the same time as good fuel economy.

In the case that part of the system breaks down, the computer detects it and informs the driver by turning the check engine lamp in the combination meter on and off. The computer also includes a diagnosis function which can be used by service technicians to pinpoint the failed part.



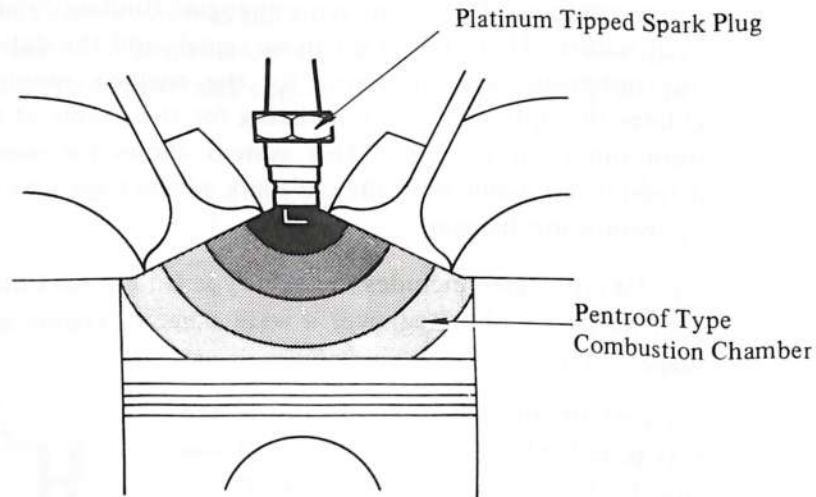
Check Engine Lamp

The computer is also equipped with a fail-safe function which can operate the engine based on data in its memory without the use of the signals from a particular sensor in the case that it breaks down. In this way, trouble on the road is kept to an absolute minimum.

Even in the unlikely event of a malfunction in the calculating function of the computer, a back-up function is included whereby it is possible to run the engine with the proper injection and ignition maintained.

High-power and Economical Engine

- By the use of platinum tipped spark plugs, ignition characteristics have been improved and more efficient combustion has been made possible.
- By adopting a pentroof type combustion chamber, the flame propagation distance has been shortened. This makes rapid, effective combustion possible.



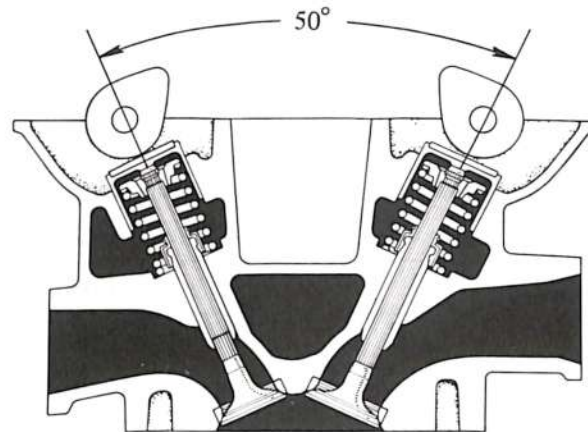
3. Super-response

- Through the use of a valve mechanism whereby the camshafts operate the valves directly, the valves' following characteristics have been improved.
- Through the adoption of a three group fuel injection system, as described before, even when the engine conditions change suddenly, extremely fine adjustments of the injected fuel amount and the injection timing have been made possible.
- The ignition timing can be precisely controlled by the ESA system.
- High performance fuel injectors, with good injected fuel atomization characteristics, have been adopted. Since the plunger in these injectors is small and lightweight, that is, since the moving parts have a low inertial mass, their response is outstanding.

High-power and Economical Engine

4. Others

- By narrowing the angle between the intake valves and the exhaust valves to 50 degrees, the cylinder head has been made compact.



- Since the maximum amount of fuel needed for a given period of time increases with higher performance engines, a fuel pump has been adopted which provides a high output capacity. With this system, when driving the car at high engine speeds with a heavy load, the output capacity increases. When driving under normal conditions, the output volume is decreased in order to reduce power consumption.

High-performance Drivetrain

Transmission

1. Manual Transmission

 TD-48

- The W58 manual transmission, which has been proven on the previous Supra, is used in the new Supra.

Manual Transmission		W58
Gear Ratio	1st	3.285
	2nd	1.894
	3rd	1.275
	4th	1.000
	5th	0.783
	Reverse	3.768
Type of Fluid		API GL-4 or GL-5 SAE 75W-90 or 80W-90
Fluid Volume		2.5 US qts. (2.4 liters, 2.1 Imp. qts.)

2. Automatic Transmission

 TD-49

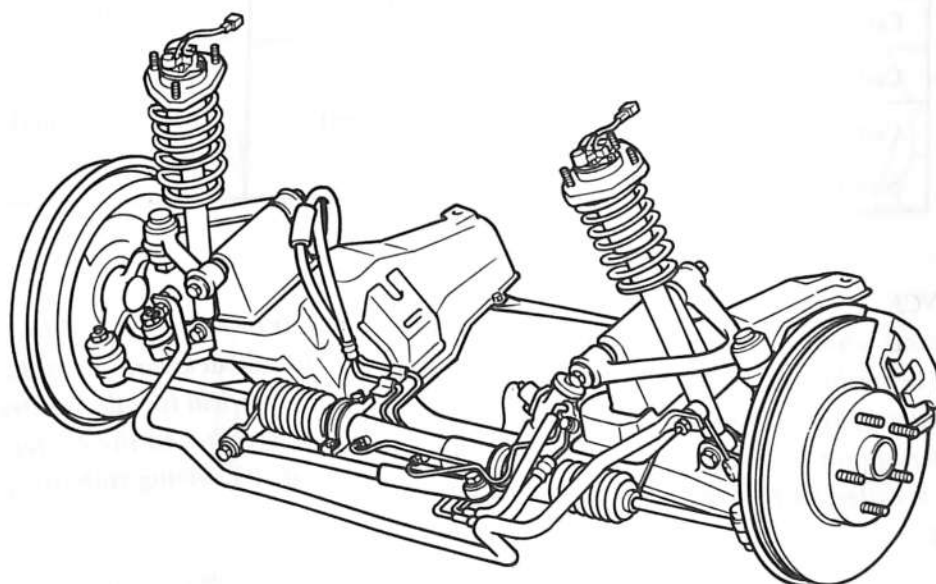
- The A340E Electronically-Controlled Transmission (ECT) which has been favorably evaluated on the Truck, is used in the new Supra.

Automatic Transmission		A340E
Gear Ratio	1st	2.804
	2nd	1.531
	3rd	1.000
	4th (Overdrive)	0.705
	Reverse	2.393
Type of Fluid		ATF type DEXRON® II
Fluid Volume		7.6 US qts. (7.2 liters, 6.3 Imp. qts.)

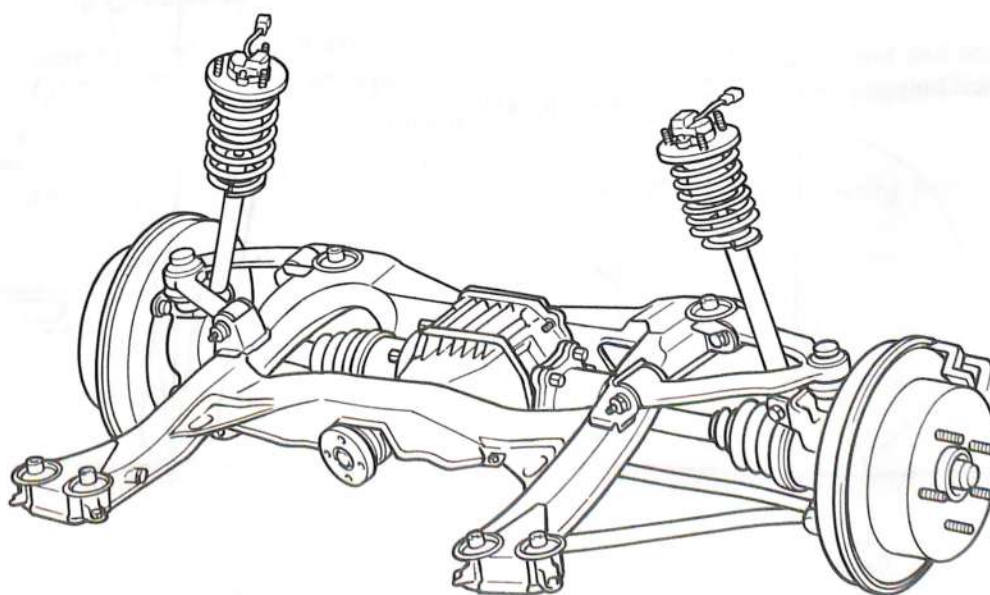
High-performance Chassis

Suspension

- A high performance suspension suitable for the new Supra as a high performance sports car has been developed with the following items as the chief aim. Also, as an option, the TEMS (Toyota Electronic Modulated Suspension) has been adopted.
 - ▶ Good directional stability during high speed driving
 - ▶ Good cornering performance during high speed driving
 - ▶ High performance combined with good riding comfort
- Both the front and the rear suspensions are double wishbone type with a geometry designed specifically for the new Supra.



Front Suspension



Rear Suspension

High-performance Chassis

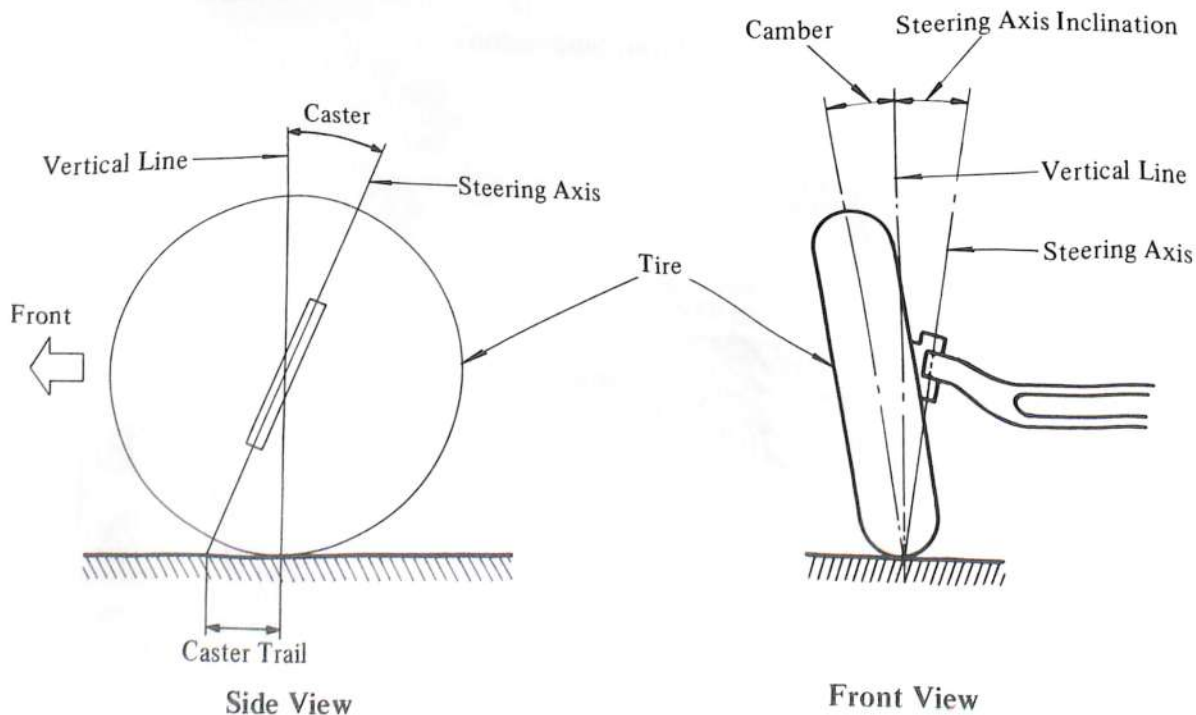
1. Good Directional Stability

- The lower arms on both the front and the rear suspensions are of sufficient length, so the tread changes very little during bound and rebound. This makes for better directional stability.
- By adopting a large front suspension caster of 8 degrees, directional stability has been further improved. On the other hand, since the caster trail has been optimized at 0.98 in. (25 mm), a natural steering feeling is assured.

Item \ Model	New	Previous
Tread	58.50 in. (1486 mm)	57.72 in. (1466 mm)
Camber	-15'	30'
Caster	8°	4°30'
Caster Trail	0.98 in. (25 mm)	0.94 in. (24 mm)
Steering Axis Inclination	11°	10°30'

— REFERENCE —

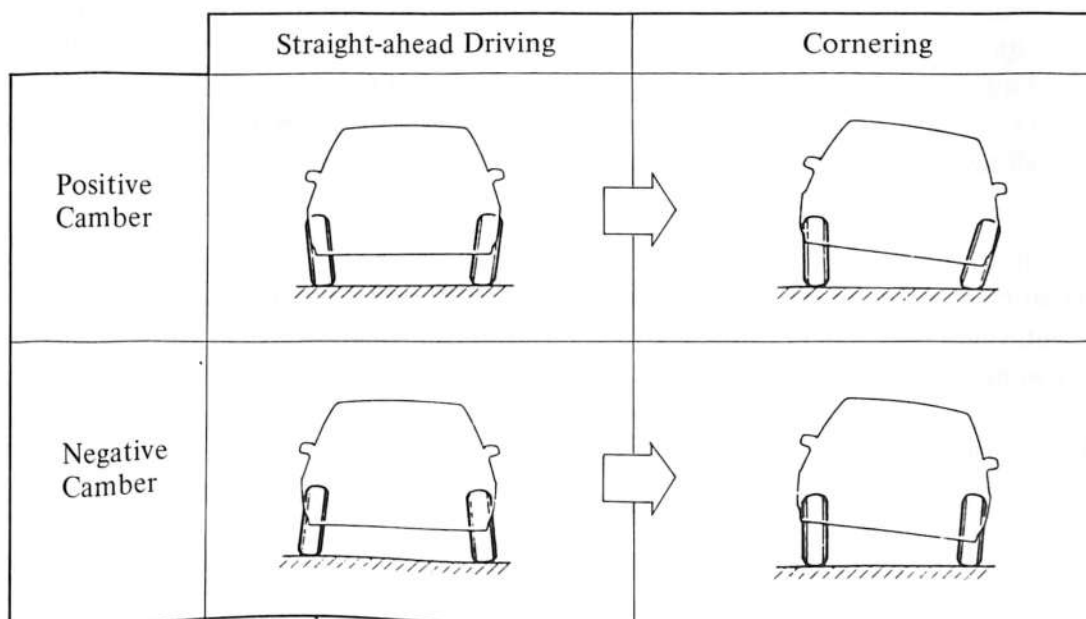
The axis around which the wheel rotates as it turns to the left or right is called the steering axis. The steering axis centerline as viewed from the side is generally tilted backward from the vertical as shown in the left figure below. The angle formed by this line and the vertical is called caster, and the distance from the intersection of the steering axis centerline with the ground, to the center of the tire-to-road contact area is called caster trail. These ensure both straight-ahead driving stability and wheel recovery after turning.



High-performance Chassis

The steering axis is also tilted inward as viewed from the front as shown in the right figure in the previous page. This is called *steering axis inclination*, and is measured in degrees of tilt from the vertical.

The wheels of the car are installed with their tops tilted outward or inward as shown in the right figure in the previous page. This is called *camber*, and is measured in degrees of tilt from the vertical. When the top is tilted outward, it is called *positive camber*. Conversely, inward tilt is called *negative camber*. Slightly negative camber provides better cornering performance by reducing the positive camber that occurs when the body of the car tilts during cornering, as shown in the figure below.



2. Good Cornering Performance

- Ball joints have been adopted for attaching the stabilizer bar in both the front and rear suspensions. Compared to the previous bushing type, linkage rigidity is high and it is effective for even minute rolls, so outstanding cornering performance is achieved.
- Since the camber of the front suspension is slightly negative, better cornering performance can be attained.

High-performance Chassis

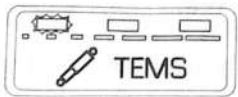
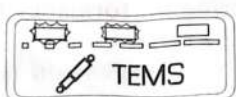
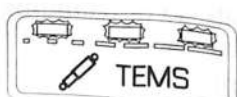
3. High Performance Combined with Good Riding Comfort

- Generally, during braking, the front of the body dives and the rear of the body rises, and during acceleration, the reverse, with the front of the body floating up and the rear of the body squatting, occurs. On the new Supra, the upper and lower arms of the front and rear suspension are placed in the optimum locations to reduce this phenomenon to the minimum.
- The front and rear suspension upper arms are made of aluminum and the front and rear stabilizer bars are hollow to reduce the unsprung weight. As a result, riding comfort is further improved.
- Generally, compared to the Macpherson strut type or the semi-trailing arm type, the double wish-bone suspension has a larger number of bushings and ball joints, so there is a tendency for a great deal of friction to develop and for the riding comfort to suffer. In the new Supra, the use of bushings with built-in metal ring for the upper arm bushings of the front and rear suspensions, for the lower bushings of the front and rear shock absorbers and for the front side bushings of the front suspension lower arms, has kept friction in the suspension at an acceptably low level. These bushings feature high rigidity in the perpendicular direction to the axis and soft characteristics in the axial direction.
- All the arms of the front and rear suspensions are mounted on the suspension members via bushings and the suspension members are mounted on the body via anti-vibration mounts. Through this double anti-vibration system, vibration and noise transmitted from the suspension to the body is kept to a minimum.

4. TEMS (Optional)

 TD-57

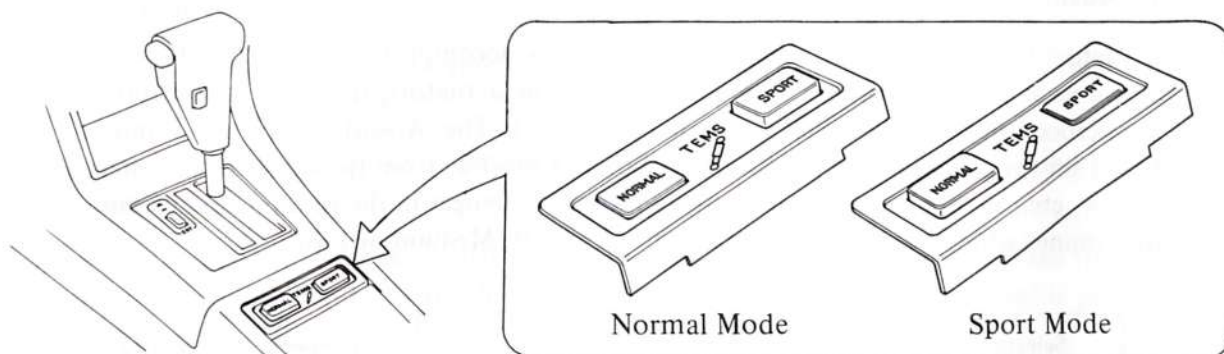
- TEMS stands for the Toyota Electronic Modulated Suspension.
- The damping force of the front and rear shock absorbers is automatically switched to one of 3 stages, Soft, Medium and Firm, according to the car's driving conditions. Also, in order to inform the driver of which of the 3 stages the damping force is currently set at, a TEMS indicator with the following type of display is provided in the combination meter.

Damping Force	Soft	Medium	Firm
TEMS Indicator	 TEMS	 TEMS	 TEMS

High-performance Chassis

- The driver can select either of the 2 modes shown below by operating the selector switch located just in back of the shift lever.

- ▶ Emphasis on riding comfort —————> Normal Mode
- ▶ Enjoying a sporty ride —————> Sport Mode



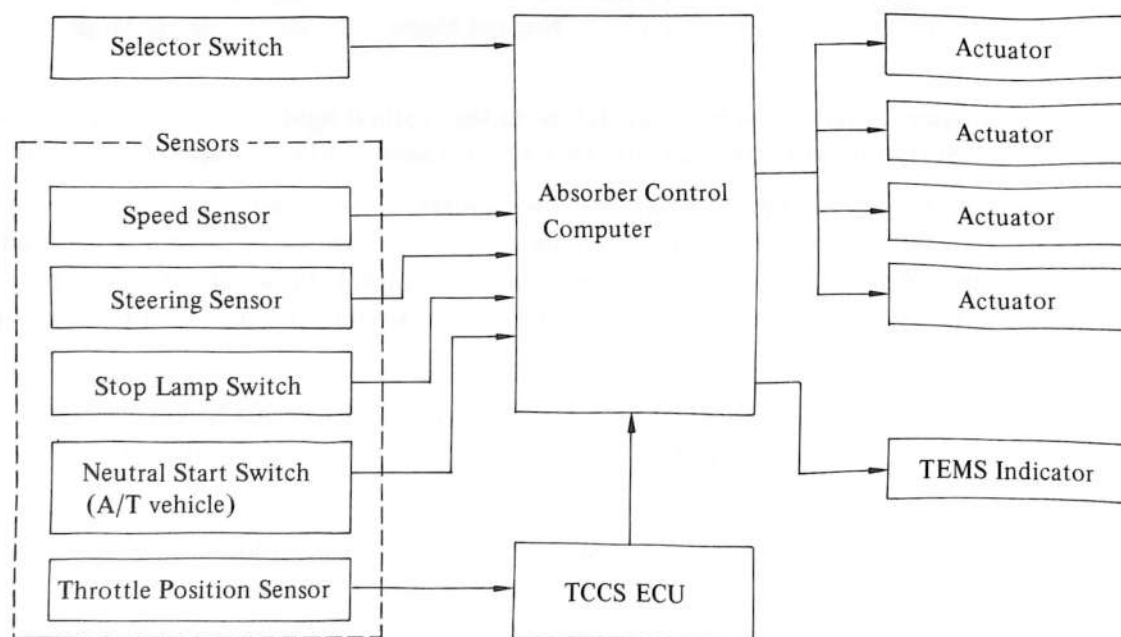
- During ordinary driving, when the selector switch is on the Normal mode, the damping force of the shock absorbers is Soft, and when the selector switch is on Sport mode, damping force is Medium.
- When vehicle speed exceeds 75 mph (120 km/h), for example on a closed circuit track, even if the selector switch is on the Normal mode, the damping force of the shock absorbers is automatically changed to Medium. (When the speed drops down below 62 mph (100 km/h), the damping force automatically returns to Soft.) Therefore, during high speed driving, the damping force cannot be changed using the selector switch.
- When the new Supra is accelerated suddenly from a speed below 12 mph (20 km/h), the damping force is temporarily changed to Firm. This prevents the front of the body from floating up and the rear of the body from squatting.
- If the brakes are applied when the vehicle speed is 37 mph (60 km/h) or higher, the damping force is temporarily changed to Firm. In this way, body nose dive during braking is kept to a minimum.
- In a sudden turn, the damping force temporarily becomes Firm, thus limiting body roll. Judgment of whether the vehicle is making a sudden turn is based on the turning angle of the steering wheel and the vehicle's speed at that time.
- On vehicles equipped with automatic transmission, while the shift lever is in the "N" or "P" range with the vehicle speed less than 6 mph (10 km/h), and for 5 seconds after the shift lever is then changed to any other range from that condition, the damping force is maintained on Firm. In this way, sudden squatting of the rear of the body when the shift lever is changed from "N" or "P" into any other range, is reduced.

High-performance Chassis

How does the TEMS work?

In the TEMS (Toyota Electronic Modulated Suspension), as described earlier, the damping force of the shock absorbers is automatically changed to one of three stages in accordance with the car's driving condition.

In actuality, changing of the damping force is accomplished by actuators installed above each shock absorber. The operation of the actuators, however, is controlled by a microcomputer (Absorber Control Computer). The Absorber Control Computer, based on various kinds of information which it receives from the speed sensor, steering sensor, etc., recognizes the moment-by-moment changes in the running conditions and determines what the damping force should be Soft, Medium or Firm.



Then how is the damping force of the shock absorbers changed to 3 different stages? As is generally well known, the damping force of shock absorbers is obtained by the resistive force of a shock absorber fluid passing through narrow passages. If the passages are widened, the damping force will decrease and if they are constricted, the damping force will become greater. In the TEMS, this fluid passage is made narrower or wider in 3 stages, varying the damping force.

The fluid channel is changed by an electric actuator mounted on top of each shock absorber that drives a vertical rod to control a valve inside the shock absorber body.

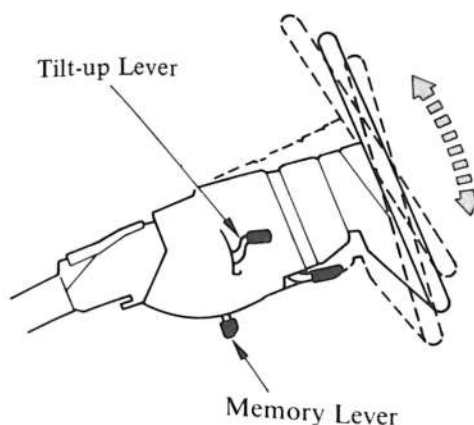
Luxury Equipment

Memory Tilt and Telescopic Steering

- In addition to the previous tilt mechanism, a telescopic mechanism has been also adopted, making it possible to adjust the steering wheel to a more suitable position.

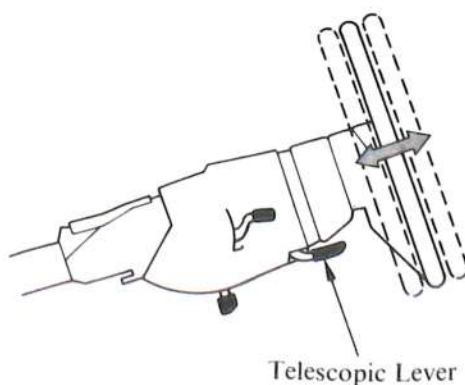
1. Memory Tilt Function

- By operating the memory lever, the steering wheel can be set at the desired angle within an $11^{\circ}15'$ range, in 6 steps (1 step is $2^{\circ}15'$).
- When the steering wheel is set at a certain angle, the device automatically and mechanically remembers that angle.
- This memory tilt mechanism makes getting into and out of the car easier. When the tilt-up lever is pulled, the steering wheel tilts to the highest step, and when the steering wheel is pushed down afterward, it is reset at the previous angle.



2. Telescopic Function

- By operating the telescopic lever, the steering wheel's longitudinal position can be adjusted to the desired position within a 1.58 in. (40 mm) range.



Luxury Equipment

Sports Seat

 TD-80

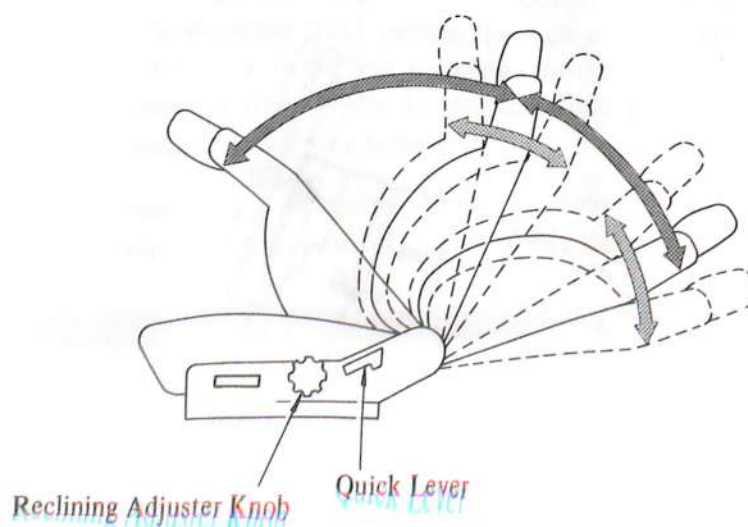
- An 8-way adjustable sports seat has been adopted for the U.S. and a 9-way adjustable sports seat has been adopted for Canada and as an option for the U.S.
- In the new 9-way adjustable sports seat, all adjustments except for the reclining and headrest adjustments, are power adjustments, making adjustment extremely easy.

Adjustment Function		Type of Seat	8-way Adjustable	9-way Adjustable
①	Forward-backward Slide		Manual	Power
②	Quick Reclining		Manual	Manual
③	Stepless Reclining		Manual	Manual
④	Front Vertical Adjuster		Manual	Power
⑤	Rear Vertical Adjuster		—	Power
⑥	Lumbar Support		Power	Power
⑦	Side Support		Power	Power
⑧	Headrest Vertical Adjustment		Manual	Manual
⑨	Headrest Forward-backward Adjustment		Manual	Manual



1. Reclining Function

- By operating the quick lever or the release pedal (passenger's seat only), the seat back can be reclined forward or backward.
- When the seat back is in the normal position or when it is reclined back, stepless adjustment within a 20° range can be carried out by turning the reclining adjuster knob.



Luxury Equipment

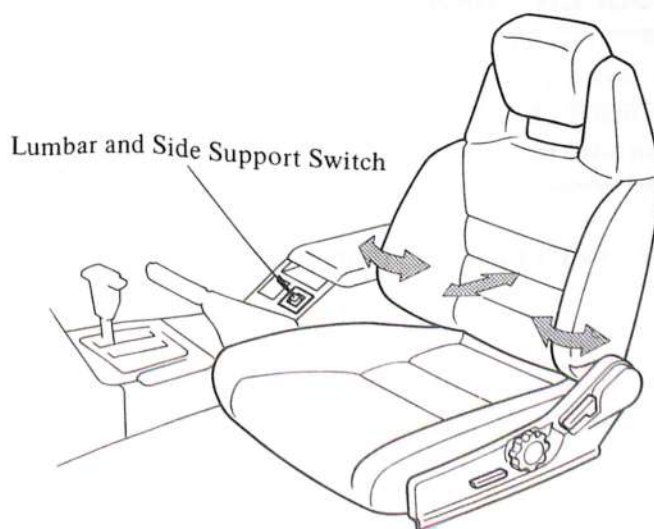
2. Power Slide and Power Vertical Adjuster (9-way Adjustable Sports Seat)

- If the power seat switch on the side of the seat cushion is moved forward or backward, the seat slides steplessly forward or backward.
- If the front end of the power seat switch is moved up or down, the front portion of the seat cushion can be adjusted up or down.
- By moving the rear end of the power seat switch up or down, the rear portion of the seat cushion can be adjusted up or down.



3. Power Lumbar Support and Power Side Support

- The lumbar support and the side support can be steplessly adjusted by means of motors incorporated into the seat back.
- The lumbar and side support switch is located just in front of the console box where the driver can reach it in the normal driving posture, so adjustments can be made easily.



Luxury Equipment

Cruise Control System

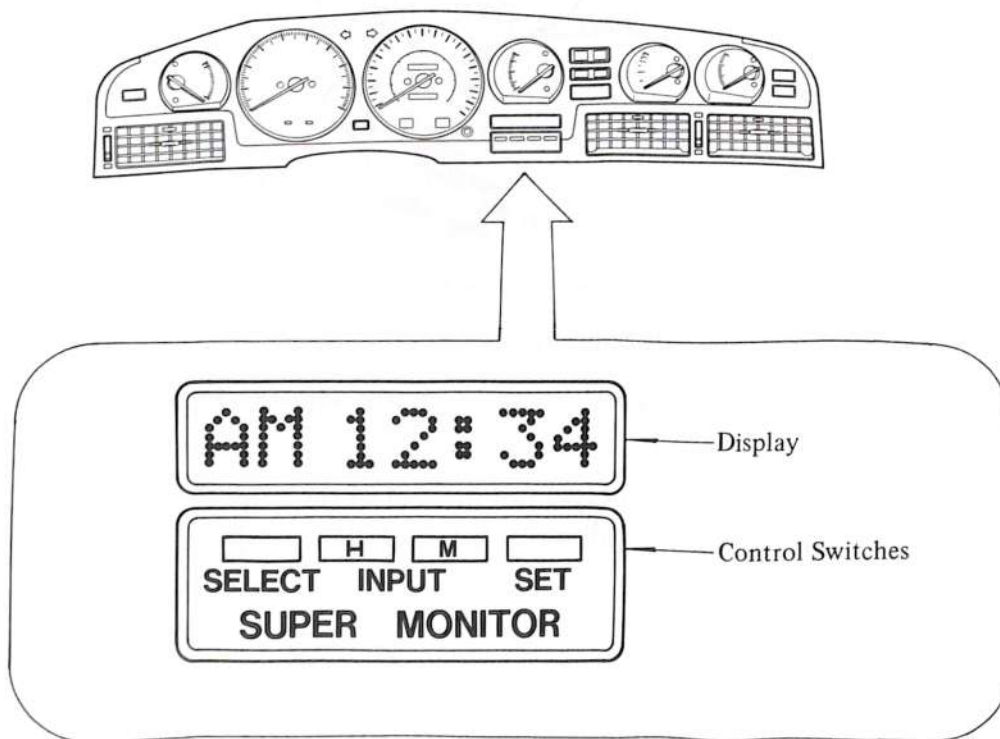
TD-87

- The cruise control system, which is extremely convenient when driving long distance, is now standard equipment.
- The control switch is located on the steering wheel (see page MH-5) for outstanding ease of operation.

Super Monitor (Optional for the U.S.)

TD-90

- The Super Monitor, which can display various types of information, is incorporated into the combination meter.



Luxury Equipment

- If the select button is pressed, the following information is displayed in this order. However, about 15 seconds after the display of item 8, the distance remaining until maintenance, the display automatically returns to item No. 1, the time display.

No.	Item	Display Content
1	Time	The current time is displayed by the 12 hour system with AM of PM indications.
2	Calendar	The current year, month and day are displayed.
3	Stopwatch	The monitor operates as a stopwatch displaying elapsed time in 1 second units. During operation, the stopwatch continues to operate even if the select button is pressed and other functions are displayed, or the ignition switch is turned off.
4	Timer	The monitor operates as a timer in 1 minute units up to a maximum of 24 hours and 59 minutes. The monitor displays the time remaining, and when that time reaches 0, an alarm sounds. During operation, the timer continues to operate even if the select button is pressed and another function is displayed, or the ignition switch is turned off.
5	Present Average Gas Mileage	The average fuel consumption after resetting, is displayed in 0.1 mile/gallon units.
6	Calculated Normally Possible Travel Distance	If the monitor is reset when the tank is filled with fuel, the normal distance it is possible to travel on the remaining fuel is displayed.
7	Amount of Gas Used	The amount of fuel used after resetting, up to 999 US gallons, is displayed in 1 gallon units.
8	Distance, Remaining Until Normal Maintenance	If the monitor is reset when the engine oil is changed, the number of normal miles of travel remaining until the oil is to be changed is displayed. When this distance reaches 0, a warning display and an alarm inform the driver.

- With proper operation, the diagnosis code for the TCCS and ECT can be displayed on the monitor.

Luxury Equipment

Audio System

 TD-102

- Through the use of 2-liter Bass-reflex type front speakers and 3-liter Bass-reflex type rear speakers, full bass sounds are reproduced and sound with the feel of a concert hall can be enjoyed.
- The Diversity Antenna System has been newly adopted as an option. This is a receiving system which selects either the glass antenna for FM reception mounted in the back door glass or the pole antenna mounted in the rear quarter panel to always have the best receiving conditions. The use of this system greatly improves FM receiving sensitivity.

Theft Deterrent System

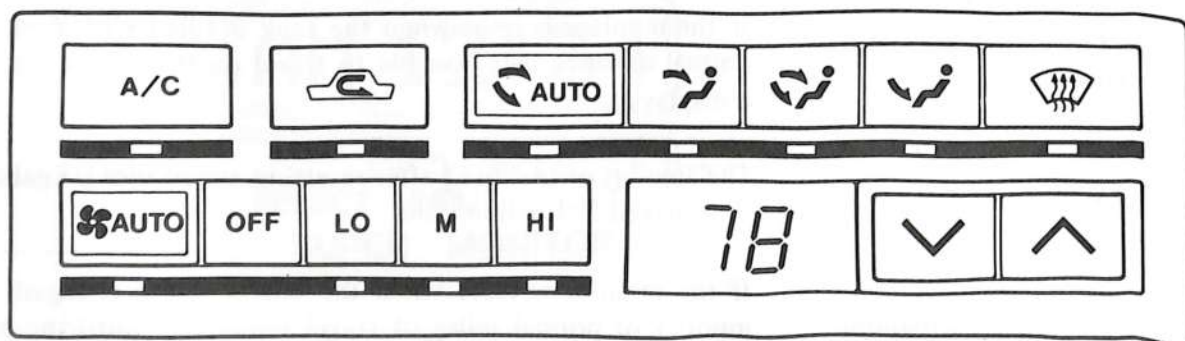
 TD-100

- In the new Supra, in addition to the 2 doors and the back door, if the hood is opened improperly, it is detected and the system emits an alarm.
- If forced entry is detected, the horn and headlights give an alarm and the starter relay also is turned off, making it impossible to start the engine.
- When the theft deterrent system is set, an indicator lamp in the combination meter blinks to signal that the system is set.

Air Conditioning System

 TD-105

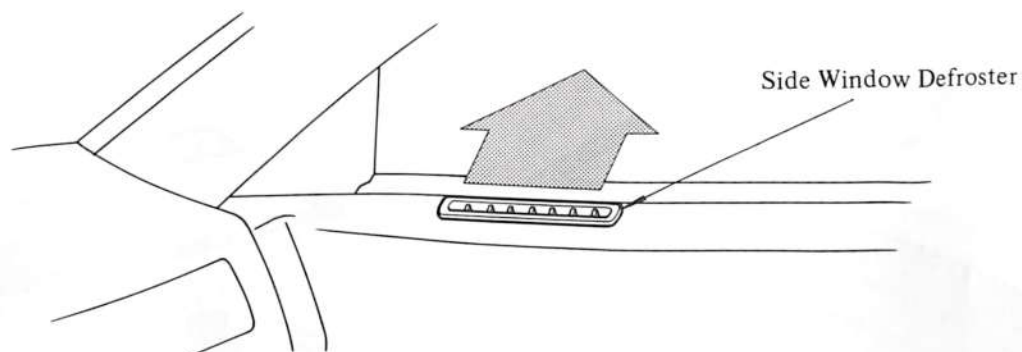
- A push button type control switch is used, improving ease of operation. The mode position, now indicated by graphic symbols, is easier to identify at a glance.



- The mode control switches now include an Auto mode, in which vents are automatically changed according to the set temperature and the temperature of the passenger compartment.
- When the Defroster mode is set, in order to improve the defrosting efficiency, the system will automatically switch to Fresh even if the Recirc switch is on.
- The desired temperature can be set in 1°F (1°C in Canada) units. The set temperature is also indicated on a large digital display, so it is extremely easy to see.

Luxury Equipment

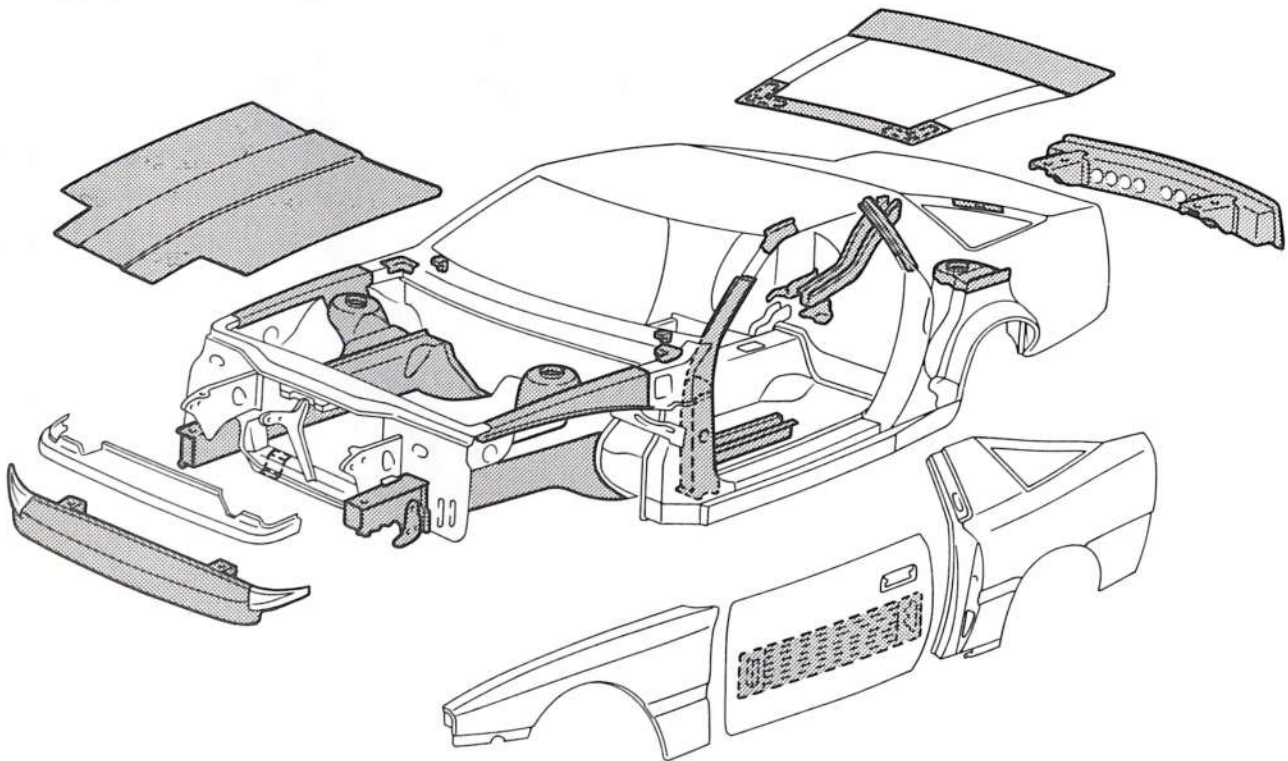
- Even when the blower switch is off, if the setting is on Fresh, outside air will be brought in by dynamic pressure while the car is moving. At such a time, the outlet temperature and the vents can be controlled as usual.
- As shown in the figure below, side window defrosters are built into the door trim. This increases the window defrosting capacity.



Lightweight and Durable Body

Lightweight Body

- High Strength Steel has been used extensively, making the body lighter while retaining its high strength. Generally, High Strength Steel is steel which has an intensity value of at least 35 kgf/mm².

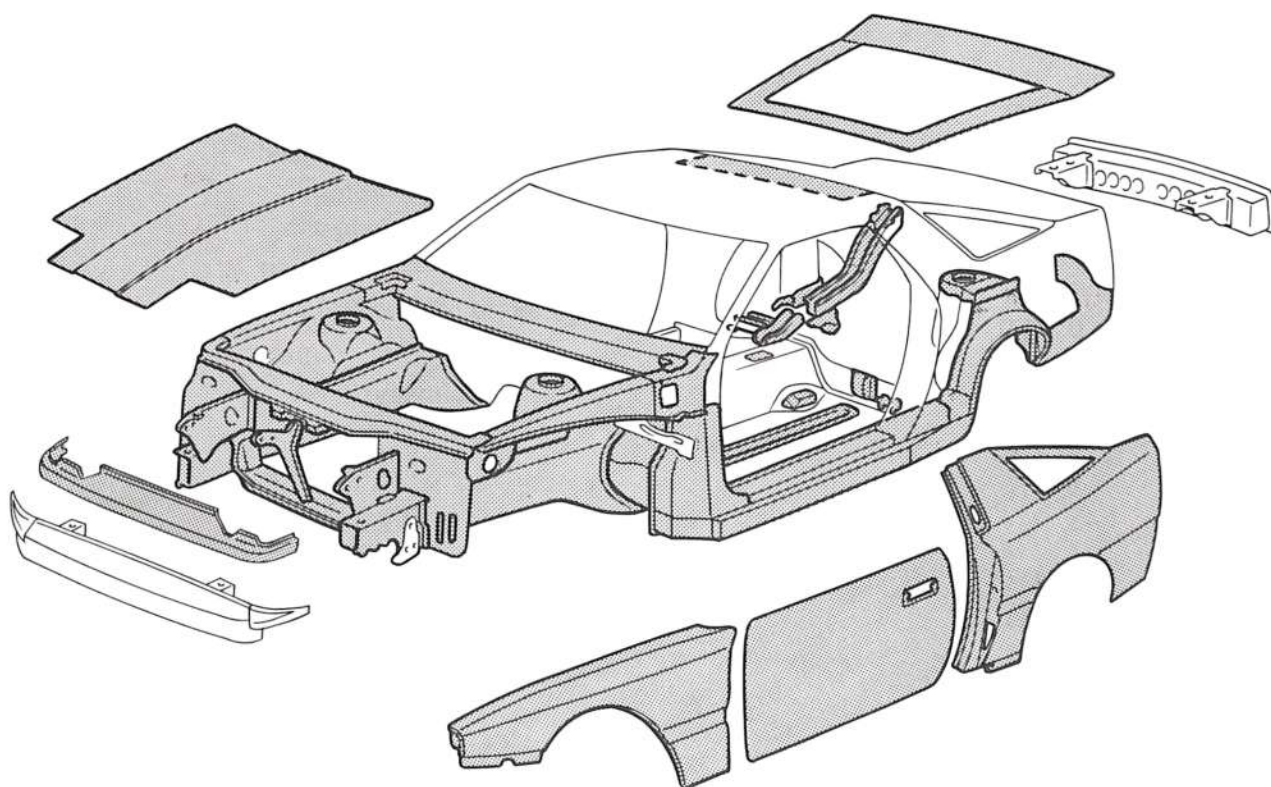


NOTE: The illustration shows only the main components. There are other components for which High Strength Steel is used. Total weight of High Strength Steel used is approximately 249 lbs. (113 kg).

Lightweight and Durable Body

Rust-resistant Body

- Rust-resistant Steel has been used extensively. 2 types of Rust-resistant Steel are used; Galvanized Steel Sheet and Electro Galvanized Steel Sheet.



NOTE: The illustration shows only the main components. There are other components for which Rust-resistant Steel is used.

Copy 1 Body

1. The first part of the report is a summary of the work done during the last year.

2. The second part is a detailed account of the experiments carried out.

3. The third part is a discussion of the results.

4. The fourth part is a conclusion.

5. The fifth part is a list of references.

6. The sixth part is a list of figures.



Technical Description

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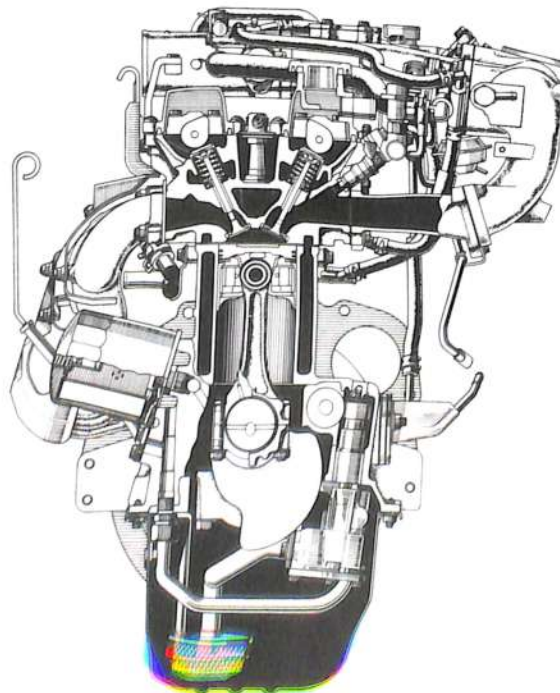
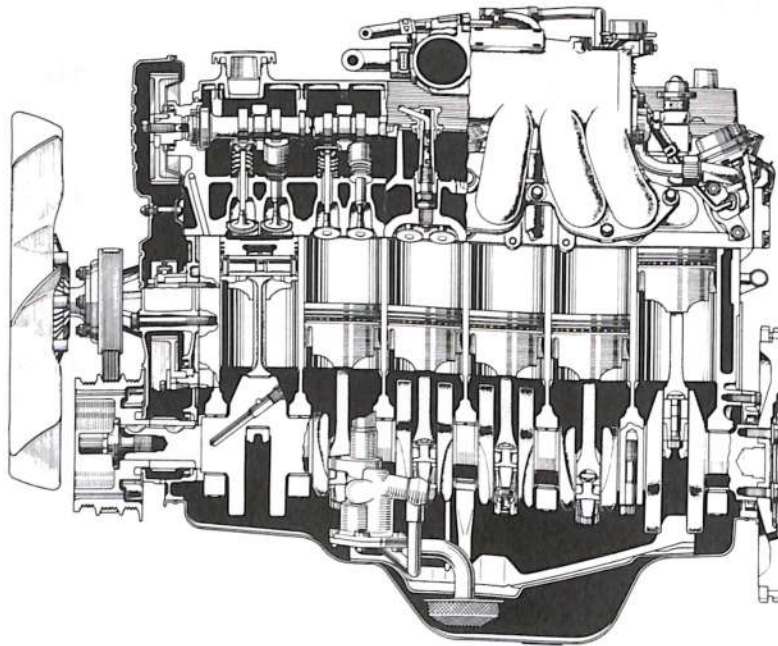
ENGINE

7M-GE ENGINE

DESCRIPTION

The 7M-GE engine is a 3.0 liter 4 valve DOHC engine that has been designed based on the 5M-GE engine (2.8 liter 2 valve DOHC engine).

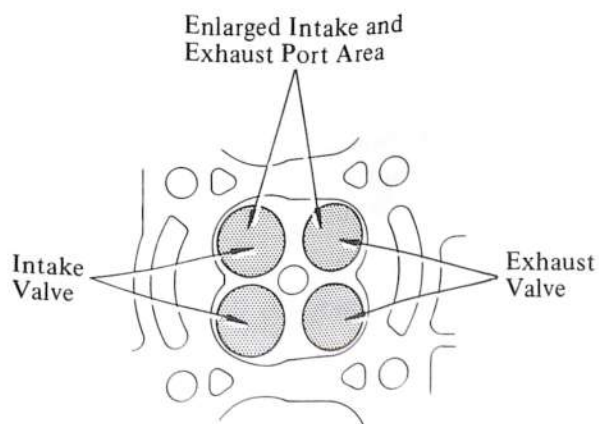
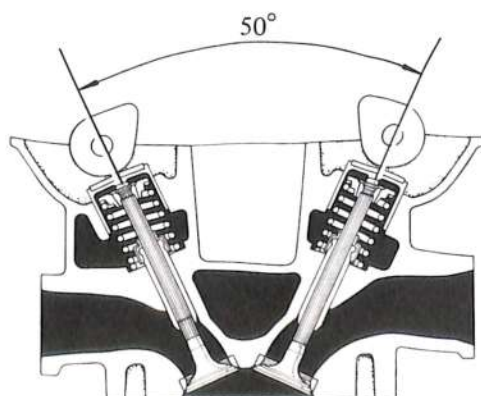
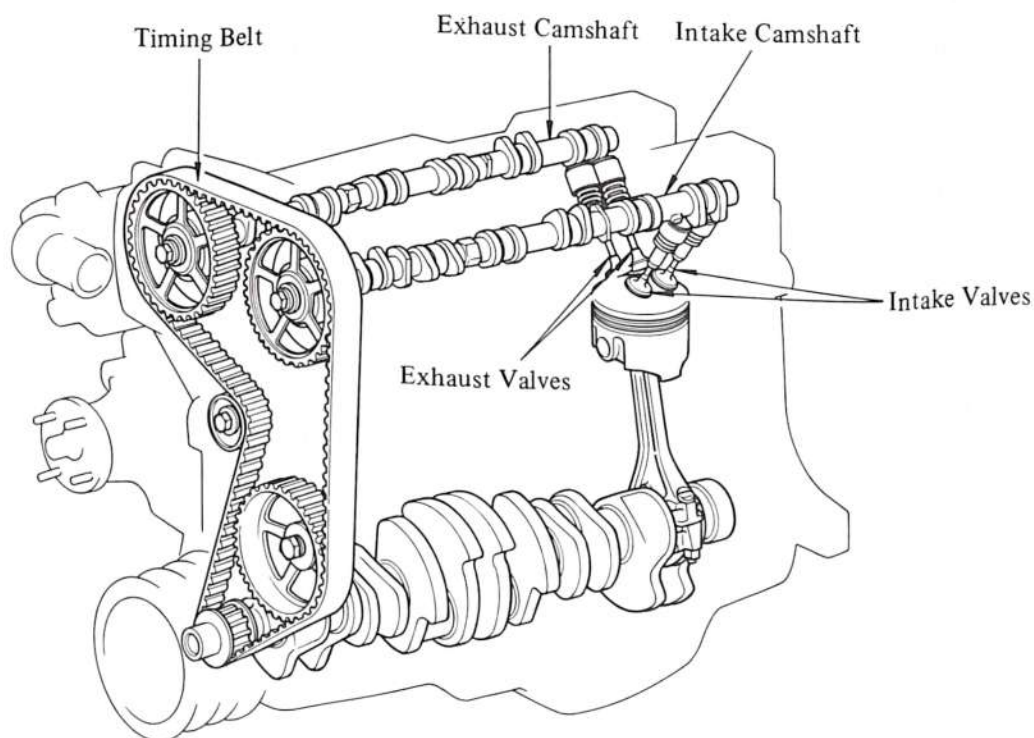
Fuel economy, maintainability, performance and reliability have all been improved by the use of four valves for each cylinder and the Intake Air Control System, as well as by the use of the TCCS (Toyota Computer Controlled System).



VALVE MECHANISM

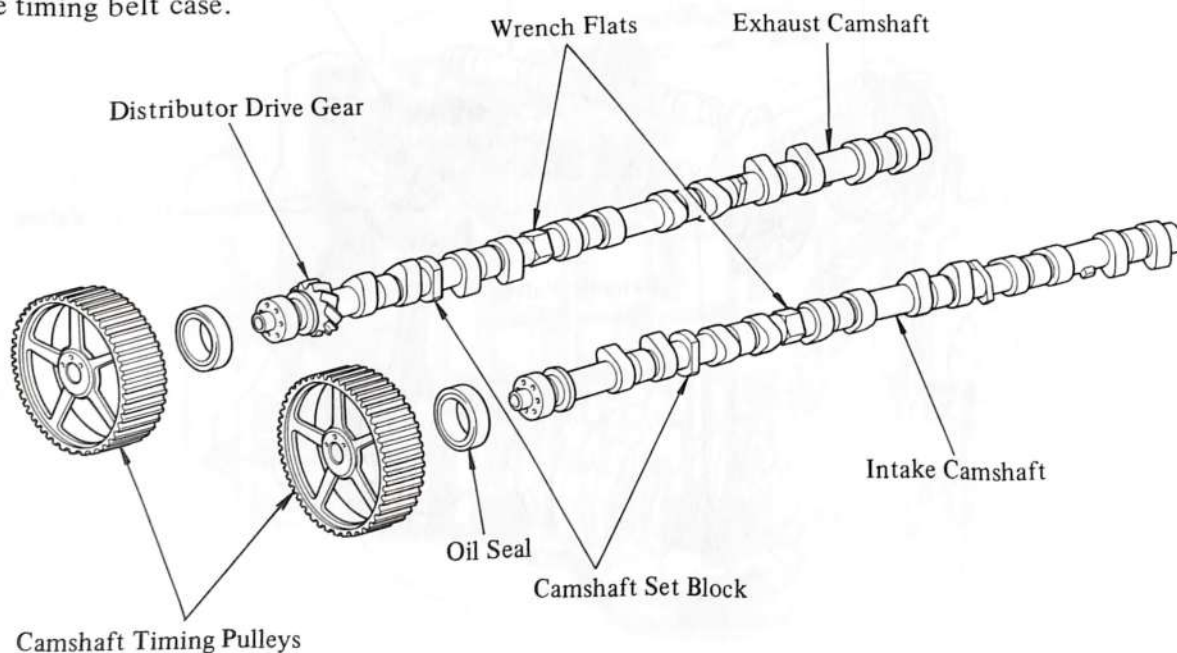
1. General

- Each cylinder is equipped with two intake valves and two exhaust valves so that the size and weight of each valve can be reduced. At the same time, intake and exhaust efficiency has been increased due to an overall increase in port area.
- The valves are directly opened and closed by the two belt-driven camshafts, even at high engine speeds.



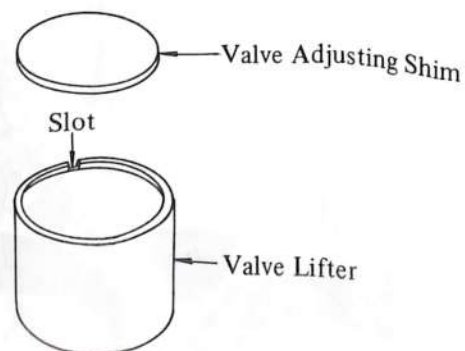
2. Camshafts

- Each camshaft has seven journals, six of which are located between the valve lifters. The thrust is taken up by the thrust surface of the No. 1 journal.
- The distributor is driven by a gear installed on the front of the exhaust camshaft.
- The two exhaust valves of each cylinder open and close together, as do the two intake valves.
- Each camshaft has been provided with hexagonal wrench flats so that the camshaft can be held immobile while the camshaft timing pulley is removed or installed.
- A block has been designed in for setting the camshaft at the No. 1 cylinder TDC compression.
- “T” type oil seals, which have superior sealing properties, are used to prevent oil from leaking into the timing belt case.



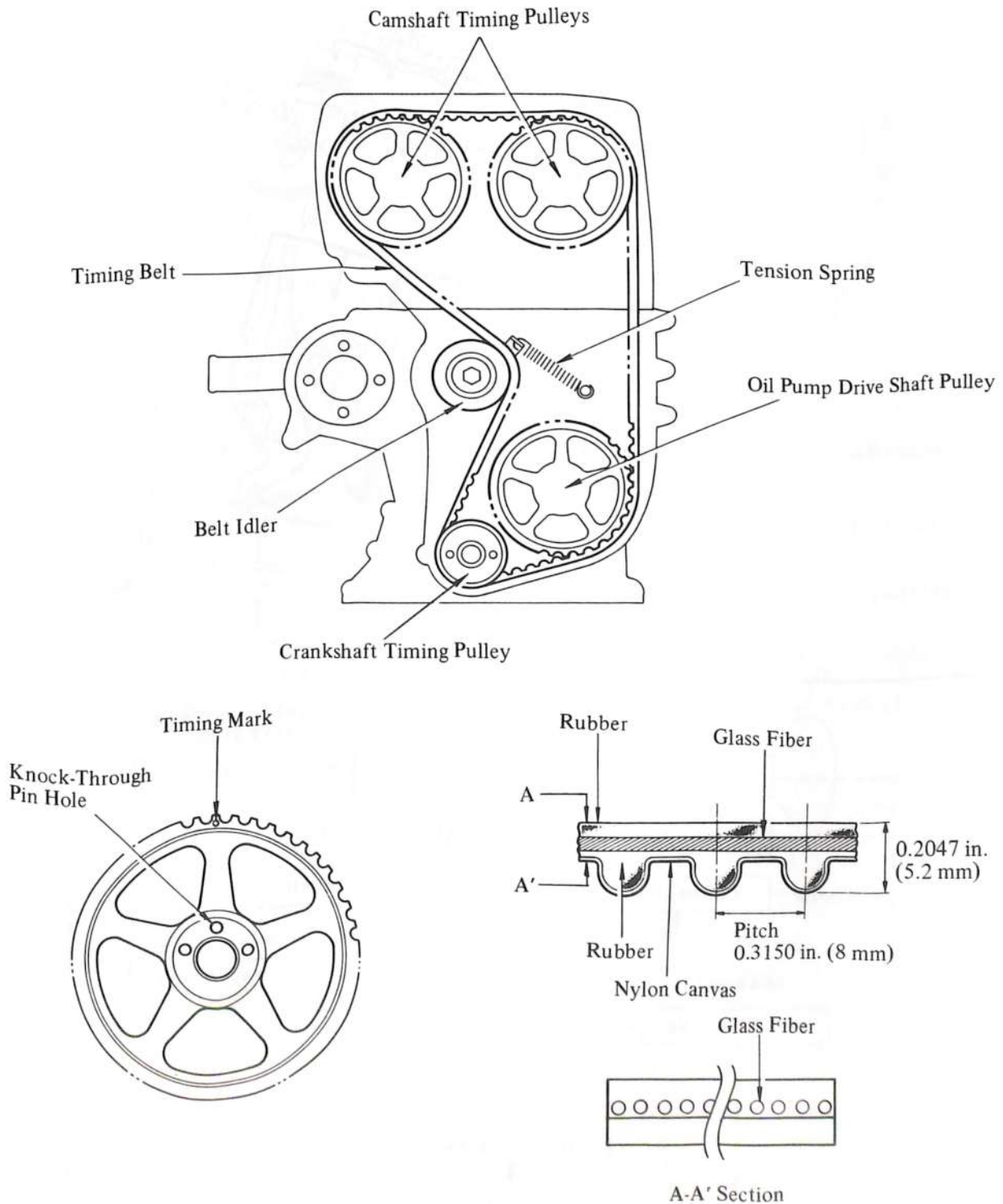
3. Valve Lifter and Valve Adjusting Shims

- The valve adjusting shims used are outer shim type and are located on top of the valve lifters. It is unnecessary to remove the camshafts in order to replace the shims when the valve clearance is adjusted.
- Shims are available in thirty-nine sizes from 0.0984 in. (2.500 mm) to 0.1299 in. (3.300 mm).



4. Timing Pulleys, Belt Idler and Timing Belt

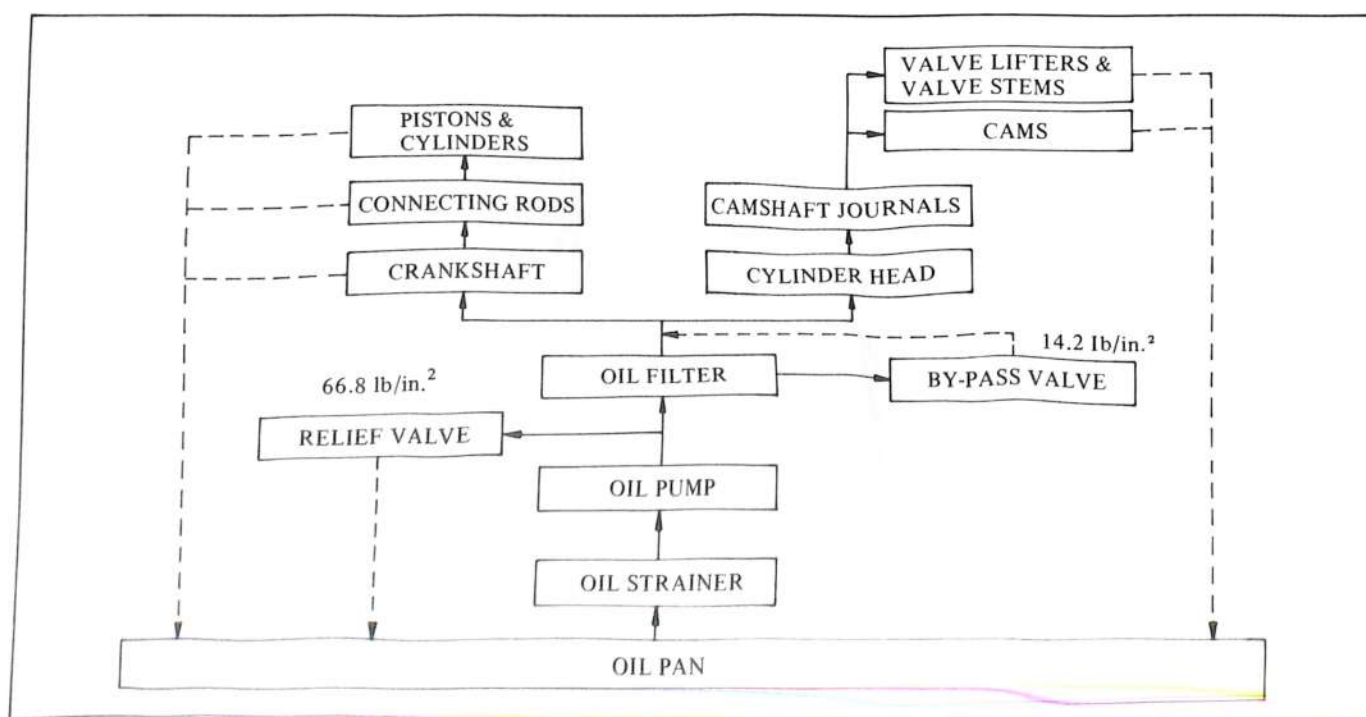
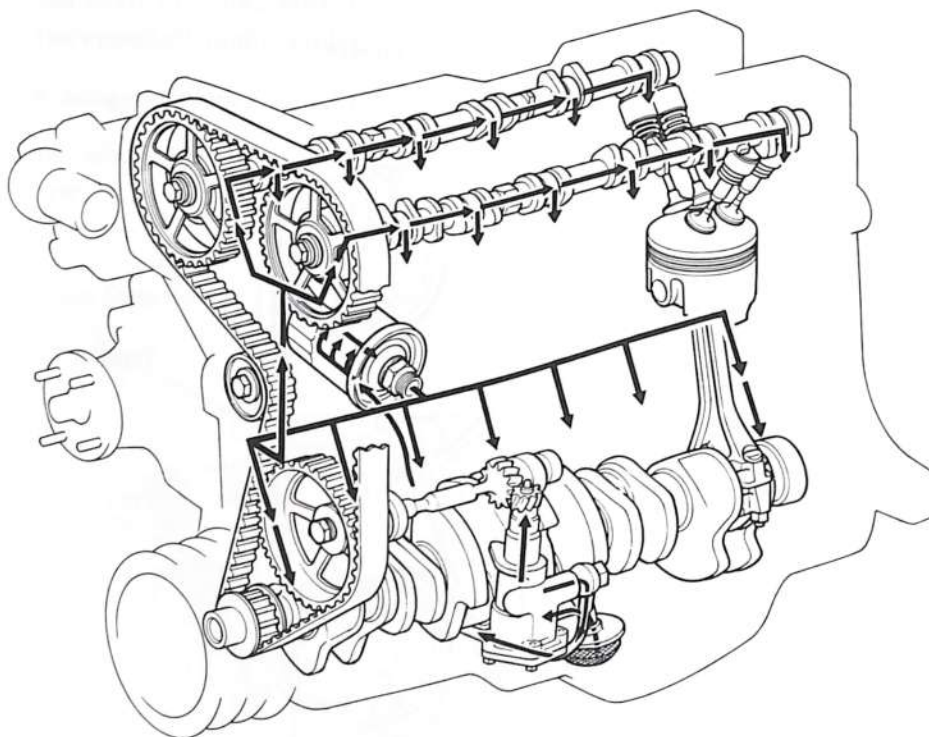
- The timing pulleys can be used interchangeably on either the exhaust or intake side.
- The timing belt idler is provided with a sealed-in-grease type ball bearing.
- A timing belt with rounded teeth is used to reduce noise.



LUBRICATION SYSTEM

Lubrication Circuit

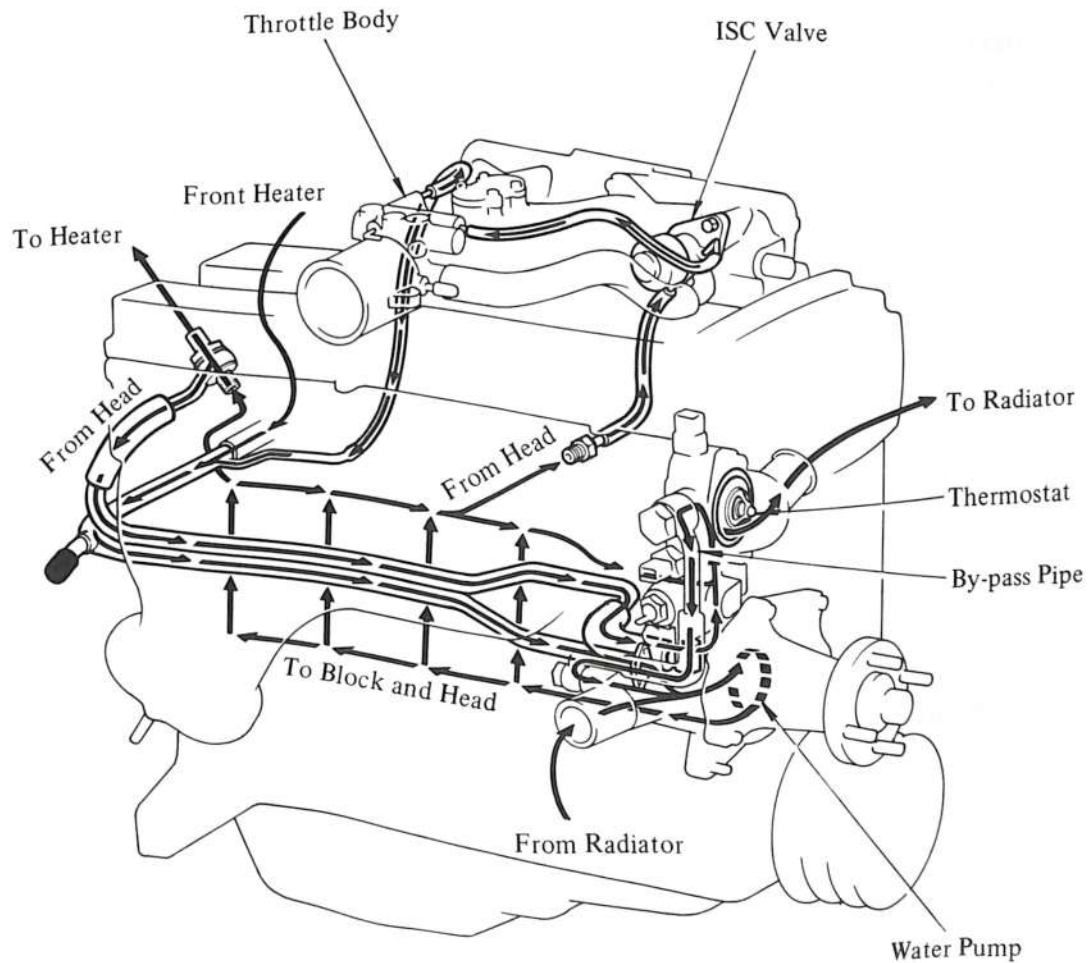
The lubrication circuit is fully pressurized and oil passes through an oil filter.



COOLING SYSTEM

Cooling Circuit

A pressurized, forced-circulation cooling system has been adopted. The water pump is driven by the belt and the thermostat is located at the water pump outlet side of the cooling circuit. Coolant not only cools the cylinder block and cylinder head, but also warms the ISC valve and throttle body, preventing icing.



TCCS (TOYOTA Computer-Controlled System)

1. General

The TCCS uses an ECU (Electronic Control Unit) with a built-in microprocessor. Stored inside the ECU is the data for fuel injection duration, ignition timing and idling speed, etc. which are matched with the various engine conditions as well as programs for calculation. The ECU utilizes these data and signals from the various sensors in the vehicle and makes calculations with the stored programs to determine fuel injection duration, ignition timing and idling speed, etc., and outputs control signals to the respective actuators which control operation.

The TCCS for the 7M-GE engine has the functions shown below:

EFI (Electronic Fuel Injection)

The ECU determines the fuel injection duration according to intake air volume, engine speed, coolant temperature and other signals and sends control signals to the fuel injectors. Also, this fuel injection duration is the basis for deciding the fuel injection timing. The fuel injection system in the 7M-GE engine is a 3 Group Injection System which injects fuel simultaneously into 2 cylinders once every 2 engine revolutions.

ESA (Electronic Spark Advance)

The ECU determines the amount of ignition advance over the initial set timing of the distributor by the intake air volume, engine speed, coolant temperature and other signals and sends control signals to the igniter. Also, based on signals from the knock sensor, the ECU controls the ignition timing at the optimum in accordance with the gasoline's octane value.

ISC (Idle Speed Control)

By means of engine speed signals, the ECU sends control signals to the ISC valve so that the actual idling speed becomes the same as the target idling speed stored in the ECU. Also, while the engine is warming up, the ECU, based on coolant temperature signals, sends control signals to the ISC valve corresponding to the coolant temperature to increase engine speed to fast idle.

EGR CUT CONTROL

Based on coolant temperature, throttle position or intake air volume signals, the ECU sends signals to the EGR VSV to cut the EGR. That is, when the water temperature is low, when the accelerator pedal released, or when the intake air volume is lower than a certain level, the EGR is cut.

INTAKE AIR CONTROL

Depending upon throttle position and engine speed signals, the ECU sends control signals to the VSV of the intake air control valve and controls the intake air inertia in the intake manifold. By this system, the engine's output is improved in the medium speed range and fuel consumption can be improved when the load on the engine is light.

FUEL PRESSURE CONTROL

Based on coolant temperature, intake air temperature and starting signals, the ECU sends control signals to the pressure regulator VSV and raises the fuel pressure. Through this system, restartability is improved when the engine is hot.

FUEL PUMP SPEED CONTROL

The ECU, based on intake air volume and engine speed signals, sends control signals to the fuel pump control relay to control the fuel pump speed. That is, to say, when the engine requires a large volume of fuel, the fuel pump turns at high speeds and when only a small volume of fuel is required, the pump turns at low speeds.

DIAGNOSIS

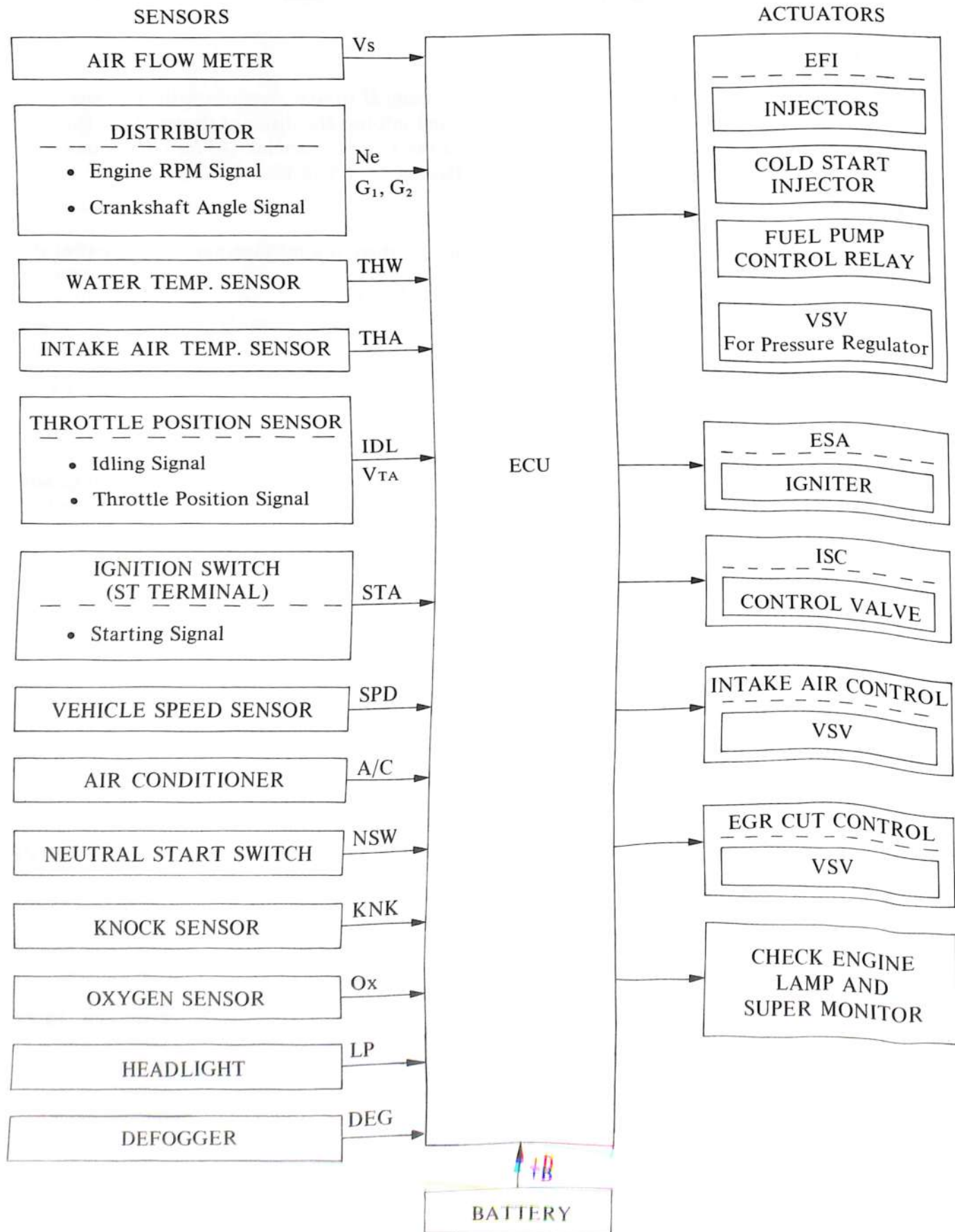
The ECU is constantly monitoring signals from each sensor. If trouble develops with the signals, the Check Engine Lamp inside the meter panel lights up and informs the driver of the trouble. The content of the trouble is stored in code in the ECU and if the T and E₁ terminals of the check connector are connected, the ECU outputs the trouble code by flashing the Check Engine Lamp.

FAIL SAFE

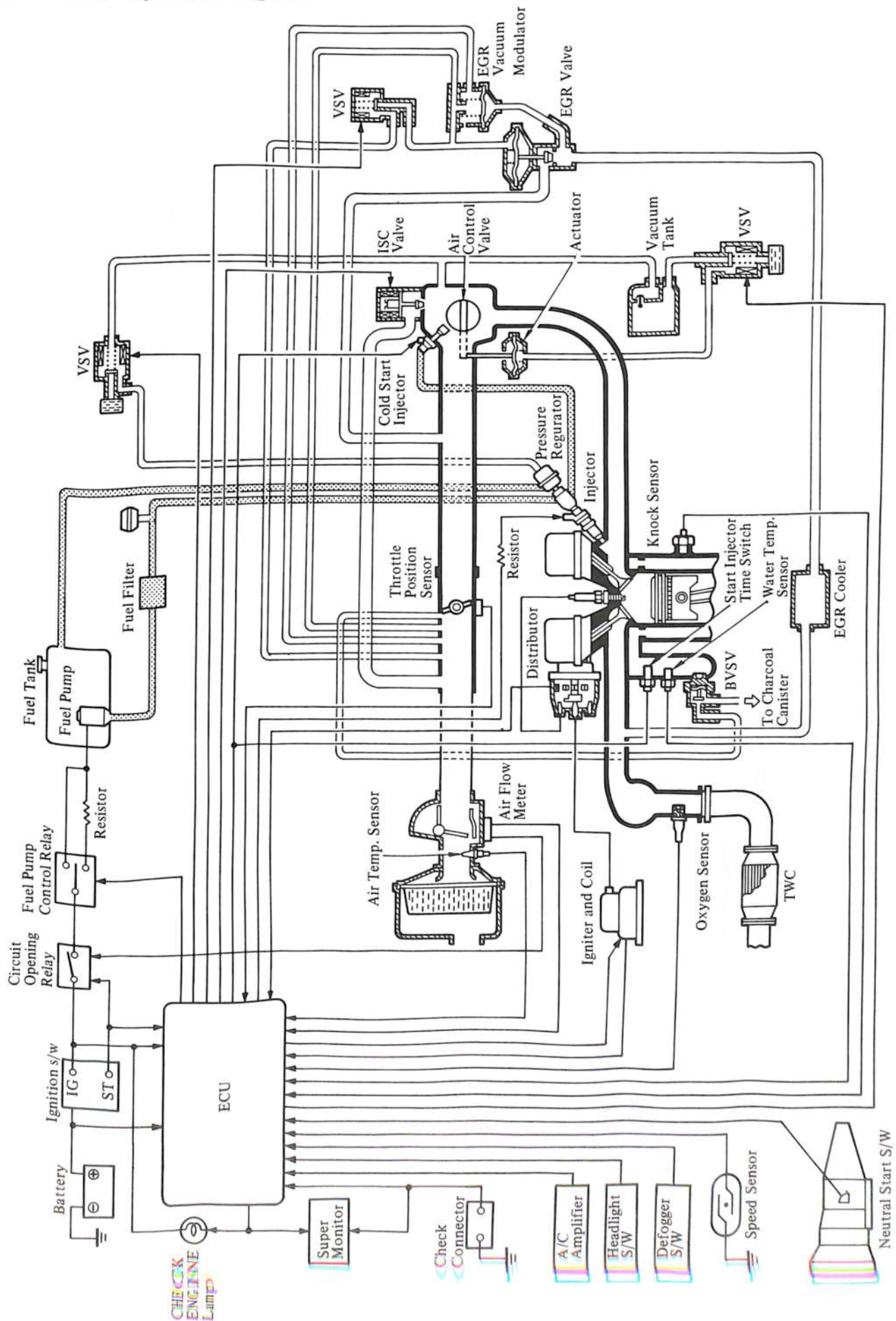
If the ECU judges from the signals from each sensor that there is a malfunction, it will control the engine using its own data or it will stop the engine.

2. Construction

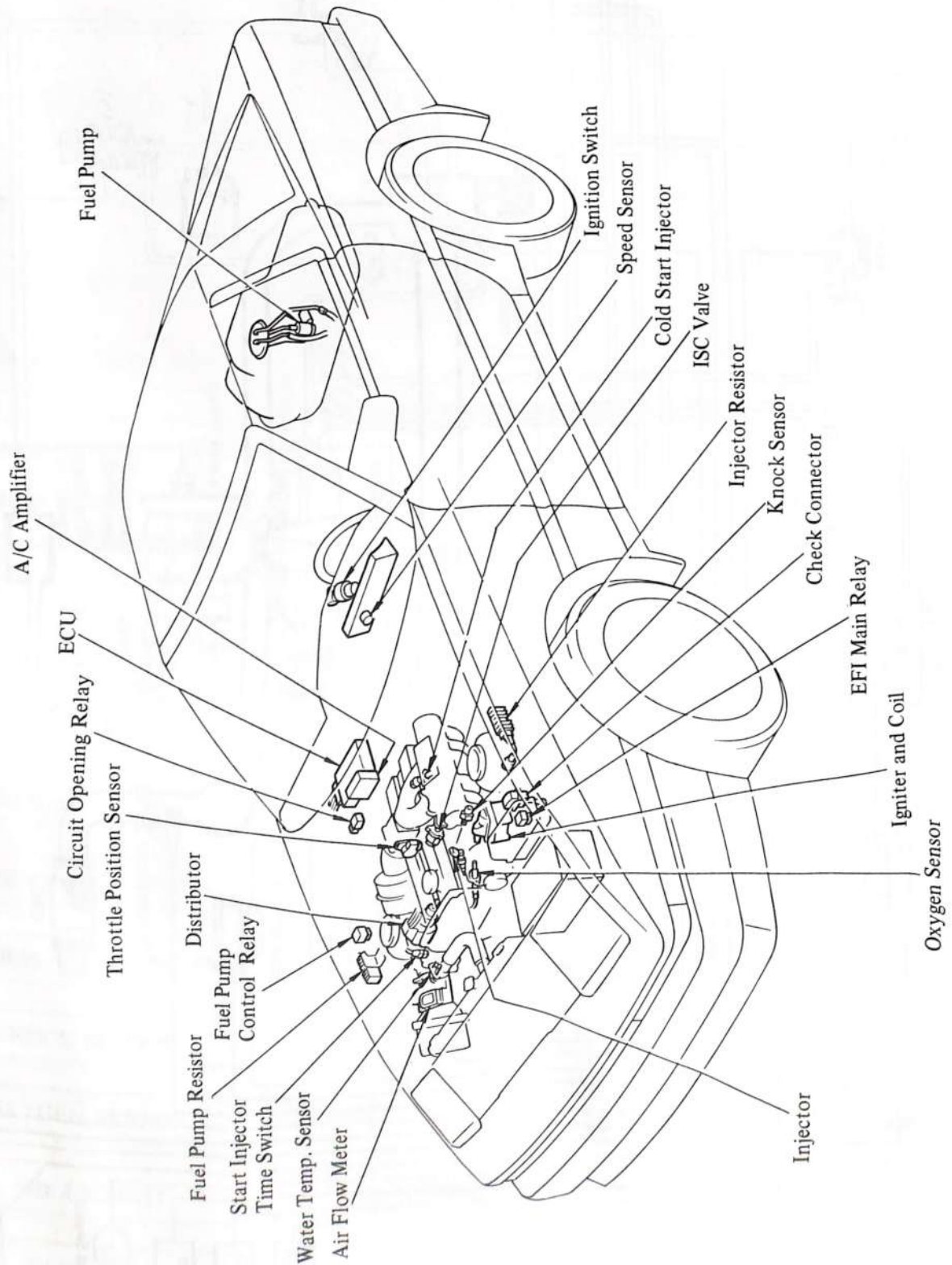
The TCCS can be broadly divided into three groups: the ECU, the sensors, and the actuators.



3. TCCS System Diagram



4. Arrangement of TCCS Components



5. ECU Connectors

IGSW	+B ₁
Batt	+B
Vcc	✕
Vs	LP
THA	ECT
Fp	DEG
SPD	W
EGR	A/C
M-REL	L ₃
VSV ₂	L ₂
VSV ₁	L ₁
Ox	E ₂
THW	KNK
IGf	✕
IGt	✕
Ne	IDL
G ₂	VTA
G ₁	T
G _⊖	V _F
ISC ₂	ISC ₄
ISC ₁	ISC ₃
NSW	✕
STJ	E ₁
STA	#30
#10	#20
E ₀₁	E ₀₂

	Symbol	Connection	Symbol	Connection
24 Pin	IGSW	Ignition Switch	+B ₁	Battery
	Batt	Battery	+B	Battery
	Vcc	Air Flow Meter		
	Vs	Air Flow Meter	LP	Headlight Switch
	THA	Intake Air Temp. Sensor	ECT	ECT ECU
	Fp	Fuel Pump Control Relay	DEG	Defogger Switch
	SPD	Speed Sensor	W	Warning Lamp
	EGR	EGR VSV	A/C	A/C Amplifier
	M-REL	Main Relay	L ₃	ECT and TEMS ECUs
	VSV ₂	Pressure Regulator VSV	L ₂	ECT and TEMS ECUs
	VSV ₁	Intake Air Control Valve VSV	L ₁	ECT and TEMS ECUs
	Ox	Oxygen Sensor	E ₂	Sensor Ground

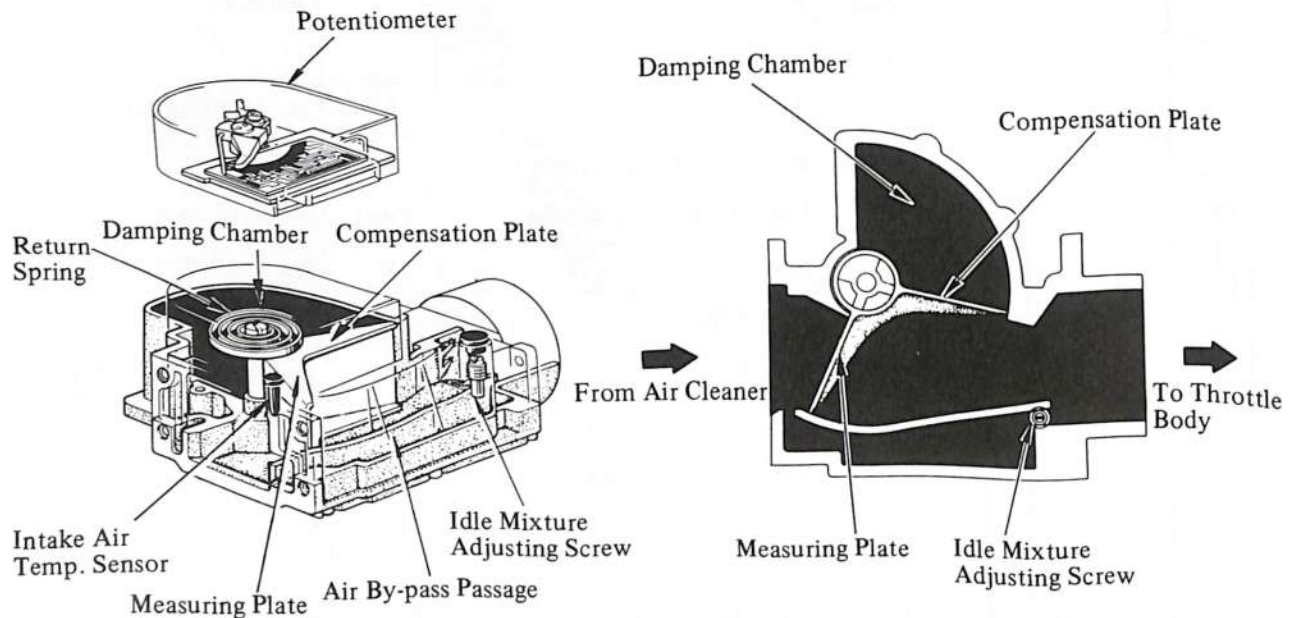
18 Pin	THW	Water Temp. Sensor	KNK	Knock Sensor
	IGf	Igniter		
	IGt	Igniter		
	Ne	Engine Revolution Sensor	IDL	Throttle Position Sensor
	G ₂	Engine Revolution Sensor	VTA	Throttle Position Sensor
	G ₁	Engine Revolution Sensor	T	Check Connector
	G _⊖	Engine Revolution Sensor	V _F	Check Connector
	ISC ₂	ISC Valve	ISC ₄	ISC Valve
	ISC ₁	ISC Valve	ISC ₃	ISC Valve

10 Pin	NSW	Neutral Start Switch		
	STJ	Start Injector	E ₁	CPU Ground
	STA	Starter Switch	#30	No.3 and No.5 Injectors
	#10	No.1 and No.4 Injectors	#20	No.2 and No.6 Injectors
	E ₀₁	Engine Ground	E ₀₂	Engine Ground

6. Construction and Operation of Main Components

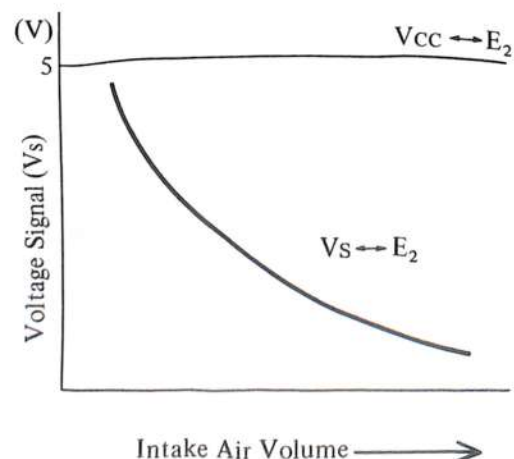
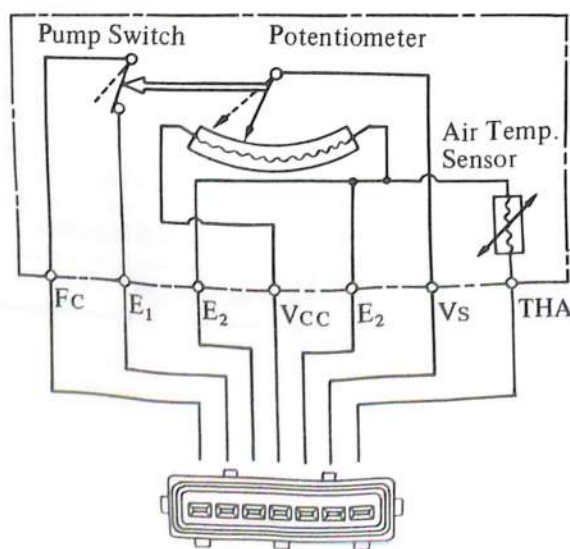
AIR FLOW METER

Using a potentiometer, the air flow meter translates intake air volume into varying voltage. The ECU determines the basic injection duration and basic ignition advance angle on the basis of this voltage.



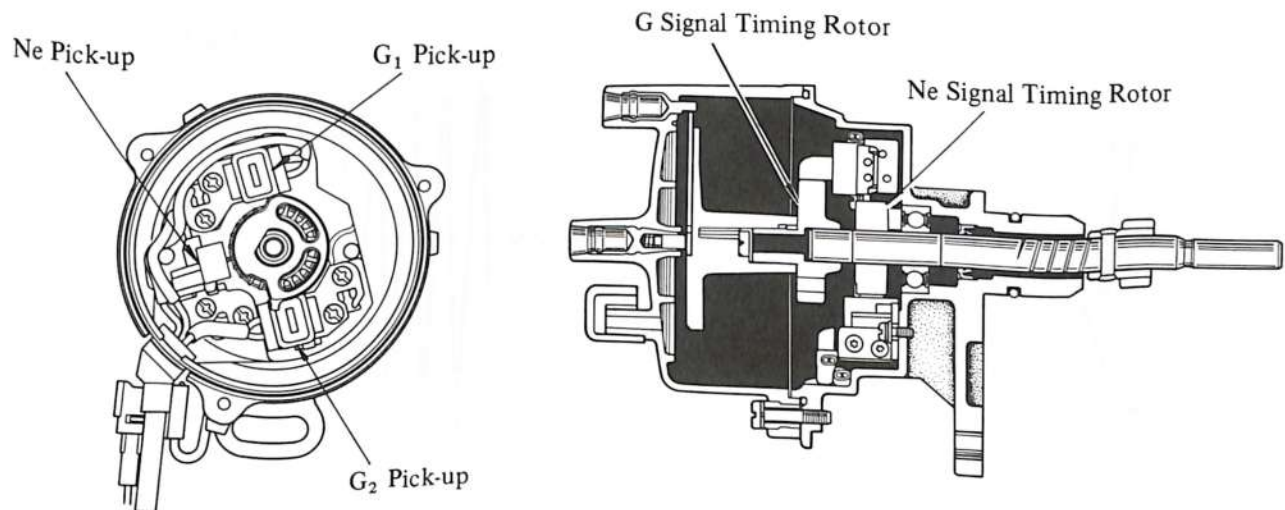
The ECU has a built-in constant-voltage circuit, which supplies a constant 5 volts to the V_{CC} terminal. Consequently, the output voltage at the V_s terminal will always indicate the exact opening angle of the measuring plate, and therefore, the exact intake air volume. The ECU memorizes the specific values which are premeasured at the connection between intake air volume and voltage, so that the exact intake air volume is detected by only the V_s output voltage.

The V_s output voltage decreases when the intake air volume increases, as shown in the graph.



DISTRIBUTOR

The conventional governor advance and vacuum advance mechanisms have been eliminated in the TCCS distributor since spark advance is electronically controlled by the ECU. The distributor in the TCCS contains three pick-up coils (G_1 , G_2 and Ne), which are similar to those of the conventional fully-transistorized ignition unit. These coils are important sensors for the ECU, allowing it to detect engine rpm and crankshaft angle.



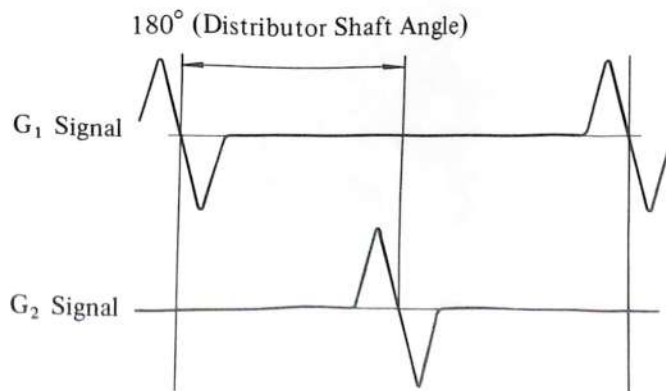
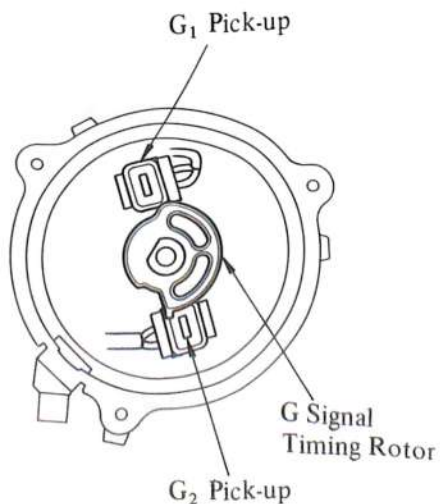
Crankshaft Angle Sensor (G_1 and G_2 Signal)

The G_1 signal informs the ECU of the standard crankshaft angle, which is used to determine injection timing and ignition timing in relation to No. 6 cylinder TDC; G_2 conveys the same information for No. 1 cylinder.

The components of the distributor that are used to generate these signals are:

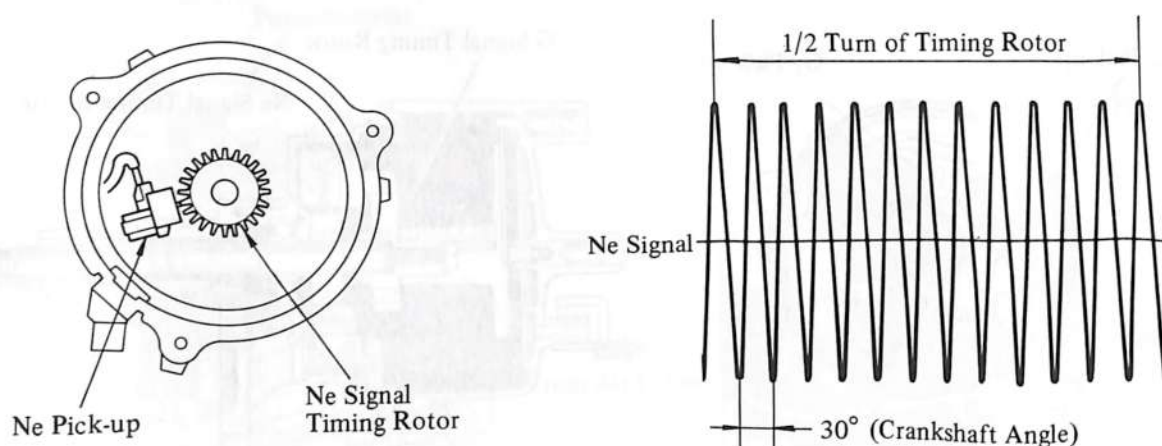
(1) the timing rotor, which is fixed to the distributor shaft and turns once for every two revolutions of the crankshaft; and (2) the two pick-up coils (the G_1 pick-up coil and the G_2 pick-up coil), which are mounted on the inside of the distributor housing.

The G_1 , G_2 timing rotor is provided with a projection or tooth which activates the G_1 and G_2 pick-up coils once each revolution of the distributor shaft, generating the waveforms shown in the chart. From these signals, the ECU detects when the No. 6 and No. 1 pistons are near their TDC.



Engine RPM Sensor (Ne Signal)

The Ne signal is used by the ECU to detect the crankshaft angle and the engine speed. Ne signals are generated in the pick-up coil by the timing rotor the same as with the G signal. The only difference is that the timing rotor for the Ne signal has 24 teeth. Therefore, 24 Ne signals are generated per engine cycle or once each turn of the distributor shaft. From these signals, the ECU detects the engine speed as well as each 30° change in the engine crankshaft angle.

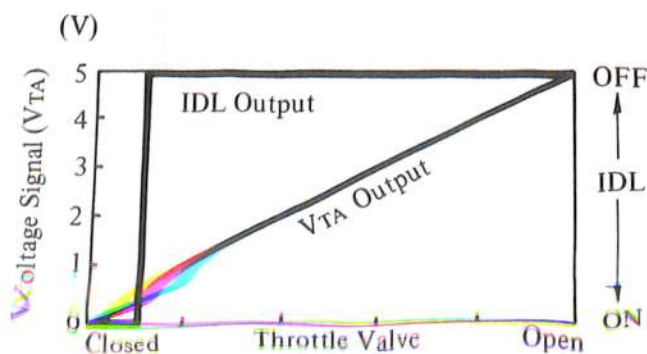
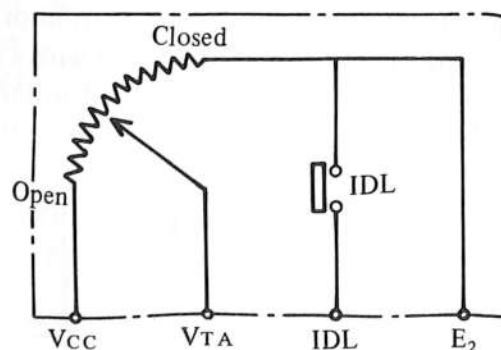
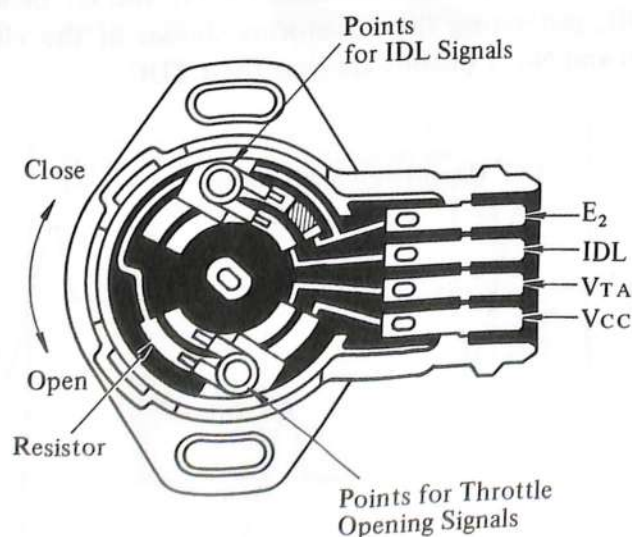


THROTTLE POSITION SENSOR

The throttle position sensor is mounted on the throttle body. It converts the throttle opening angle into voltage and sends it as the throttle position signal to the ECU.

A 5V constant voltage is applied to the Vcc terminal from the ECU. As the contact point slides along the resistor in accordance with the throttle valve opening angle, voltage is applied to the VTA terminal in proportion to this angle.

When the throttle valve is closed completely, the contact points for the IDL signal connect between the IDL and E₂ terminals.



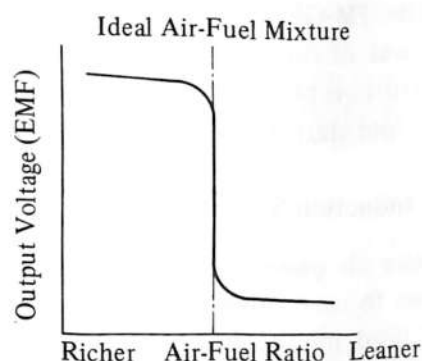
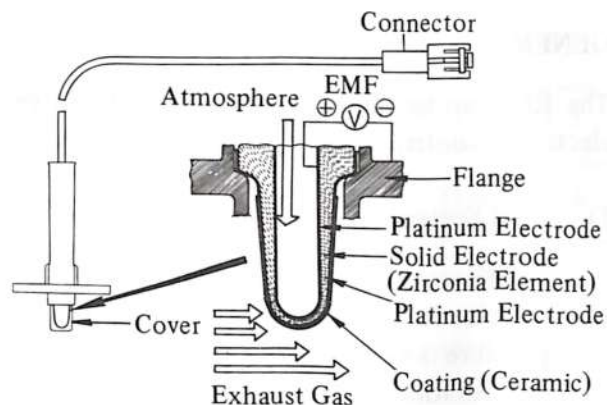
OXYGEN SENSOR

The O_2 sensor is composed of a test tube shaped zirconia element with a thin layer of platinum bonded to both sides. This sensor is mounted in the exhaust manifold and senses the oxygen concentration (air-fuel ratio) in the exhaust gas. If there is a difference in the oxygen concentration on the two sides of the zirconia element, an electromotive force is generated, or, if the temperature of the O_2 sensor becomes high, the platinum is activated and through its catalytic action, the zirconia element's electromotive force changes suddenly at the boundary near the ideal air-fuel ratio.

Using these properties, exhaust gas is passed over the outer surface of the O_2 sensor and atmospheric air is introduced to the inside surface. The sensor accurately detects whether the oxygen concentration, that is, the air-fuel ratio, is higher (rich) or lower (lean) than the ideal air-fuel ratio.

If the air-fuel ratio is more concentrated than the ideal air-fuel ratio, (rich), the electromotive force of the O_2 sensor becomes high and "rich" signals are sent to the computer.

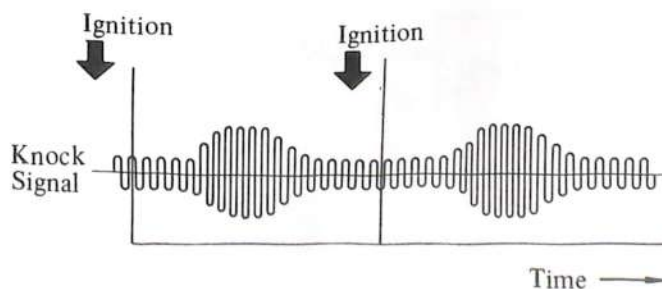
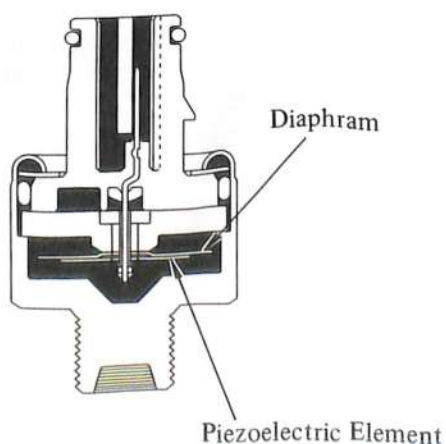
On the other hand, if the concentration of O_2 is low, the electromotive force of the O_2 sensor is low, and "lean" signals are sent to the computer.



KNOCK SENSOR

The knock sensor is mounted on the left side of the cylinder block. A piezoelectric ceramic element is incorporated into the sensor.

If knocking develops in the engine, this piezoelectric element, by resonating with the knocking vibration, generates a voltage which corresponds with the knocking strength and sends a signal to the ECU.



7. EFI (Electronic Fuel Injection)

GENERAL

The EFI can be broadly separated into three systems; the fuel system, the air induction system and electronic control system.

1) Fuel System

Fuel is pressurized by an electric pump, then flows through the filter to the injector. There is one injector for each cylinder and it injects fuel whenever its solenoid valve opens. Because the fuel pressure is kept constant by the pressure regulator, the injection volume is controlled by changing the duration of each injection.

The fuel system also has a cold start injector located on the air intake chamber to assist in cold engine starting.

In the 7M-GE TCCS, the ECU controls the fuel pump speed in 2 stages corresponding to the amount of fuel required by the engine. Also, the fuel pressure when the engine is at high temperatures is made higher than when the engine is at normal temperatures at starting time.

The cold start injector is controlled by the start injector time switch and the ECU.

2) Air Induction System

Intake air passes in order through the air flow meter, throttle body and intake manifold and flows to each intake port. The intake air volume is measured by the air flow meter and its signals are used by the ECU to determine the basic injection duration. In the 7M-GE TCCS, the ISC valve, by adjusting the intake air volume which bypasses the throttle, automatically adjusts the engine idling speed and engine fast idle. By opening and closing the air control valve in the intake manifold, the intake air intake efficiency is improved and the engine's output is increased.

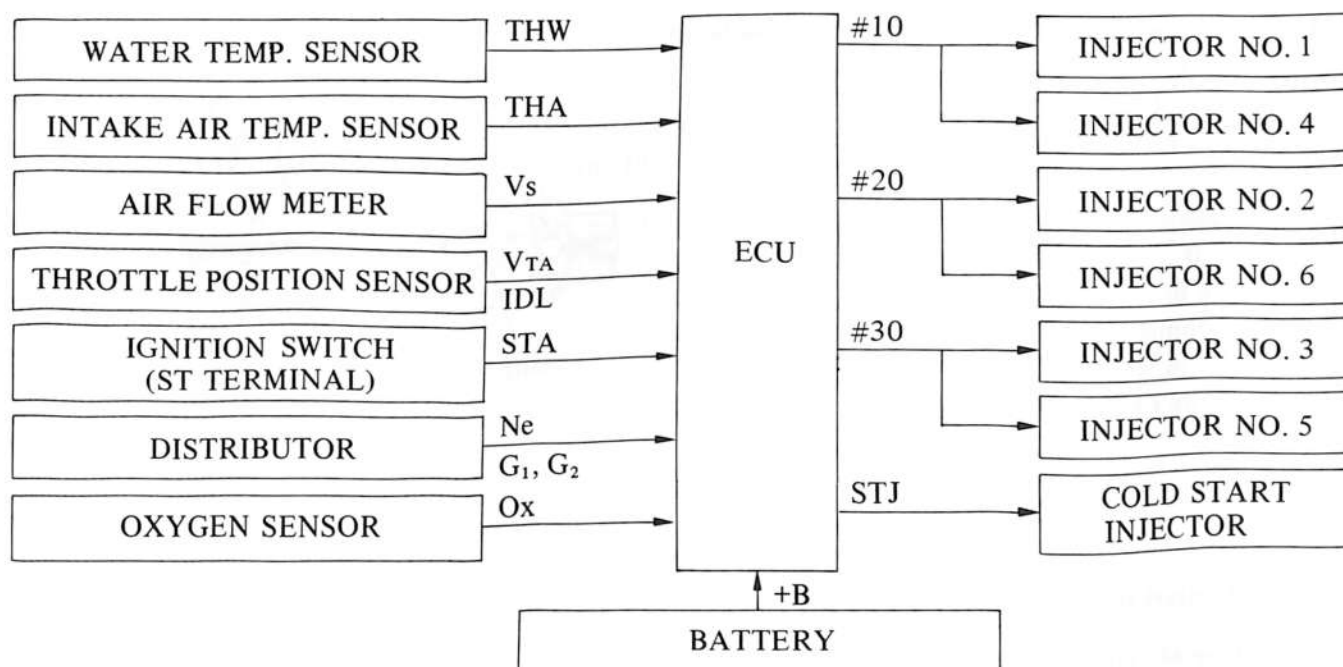
3) Electronic Control System

The ECU includes a built-in microprocessor. It controls injection duration precisely based on data stored in its memory and signals from each sensor.

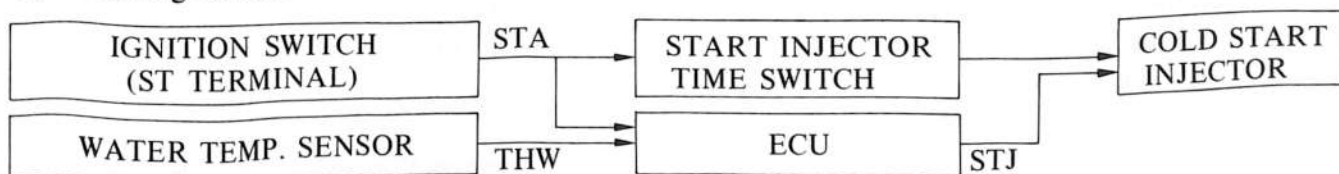
Also, the ECU, based on this injection duration, controls the injection timing. Further, the fuel injection system is a 3 group injection system which injects fuel into 2 cylinders simultaneously once every 2 engine revolutions.

EFI BLOCK DIAGRAM

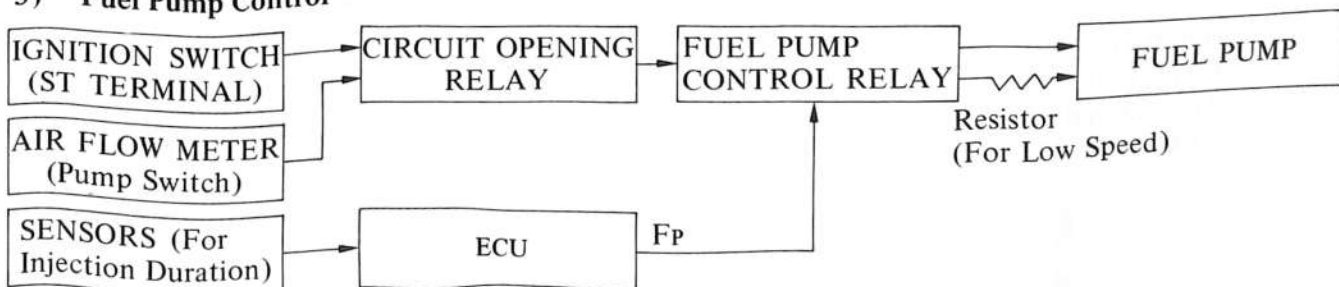
1) Fuel Injection Duration Control



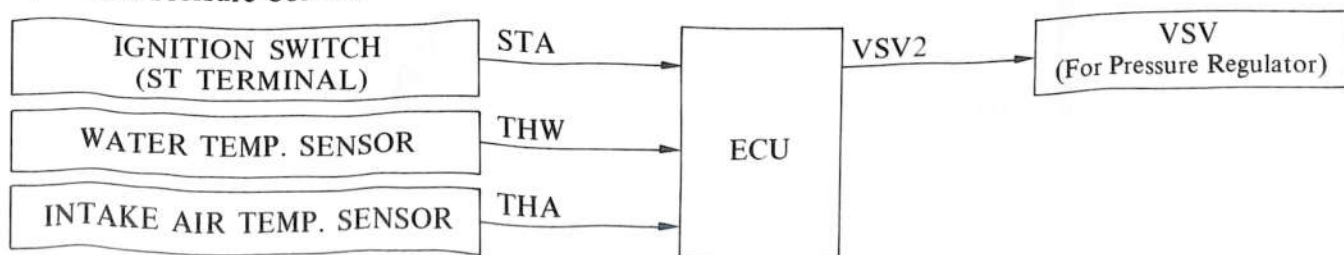
2) Starting Control



3) Fuel Pump Control



4) Fuel Pressure Control



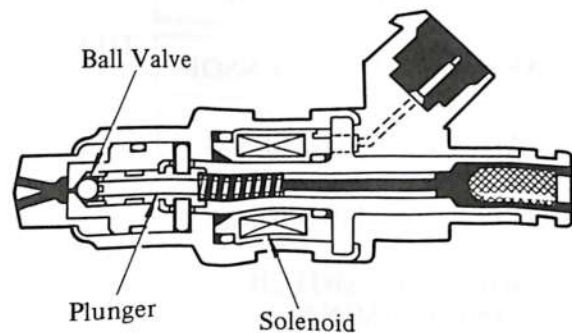
FUEL SYSTEM

1) Fuel Injector

Fuel is injected into the intake port of each cylinder in accordance with injection signals from the ECU.

In the end of the injector, there are 2 injection holes which match the 2 intake ports. The shape of the valve has been changed from the pintle type to the ball type to reduce the possibility of valve sticking.

The plunger has been made smaller and lighter in weight, and its response to signals from the ECU has been raised.

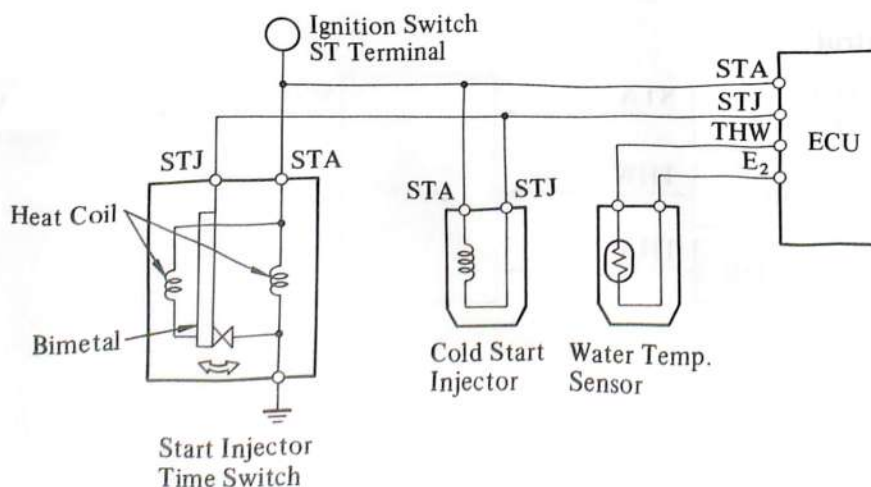
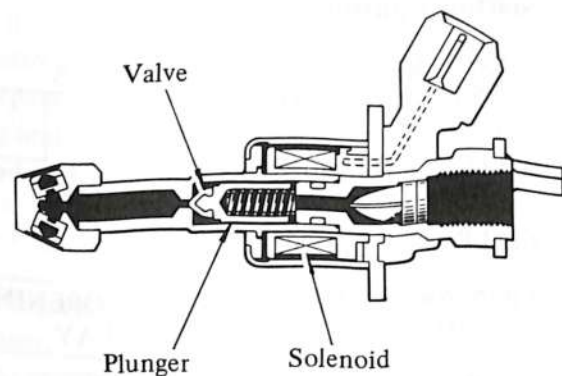


2) Cold Start Injector

The cold start injector injects fuel into the intake air chamber during engine cranking to improve startability.

In starting the engine when the engine coolant temperature is 76°F (22°C) or lower, the cold start injector's operation time is controlled by the start injector time switch.

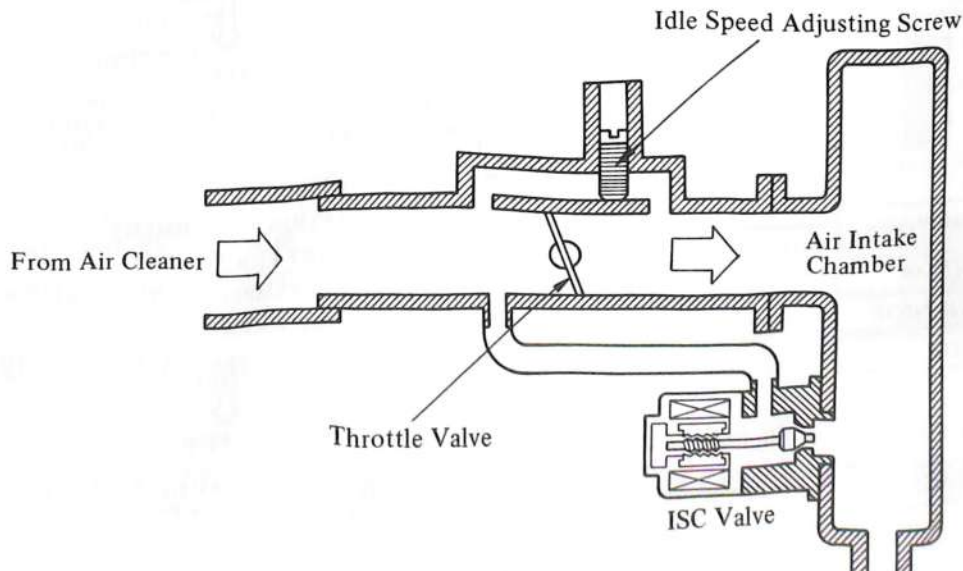
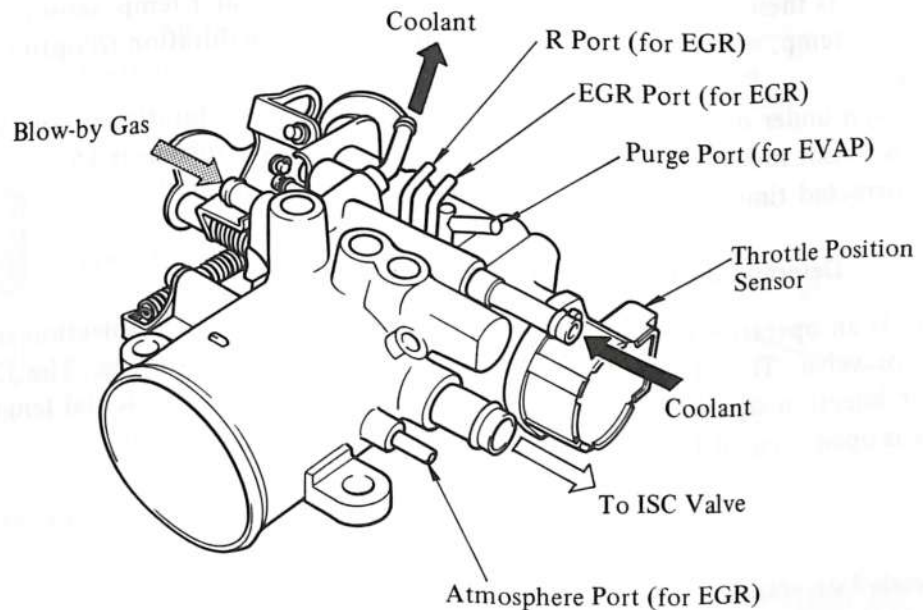
However, starting the engine when engine coolant temperature is between 76°F and 95°F (22°C and 35°C), the operation time of the cold start injector is controlled by the ECU.



AIR INDUCTION SYSTEM

Throttle Body

- A throttle valve is incorporated into the throttle body. By controlling the intake air volume with the throttle valve, the engine's output is controlled.
- A throttle position sensor is mounted on the throttle valve shaft. This sensor senses the throttle valve opening angle and sends signals to the ECU.
- Also, for the ISC system, a passage is provided for intake air to bypass the throttle valve. This ISC valve automatically controls the engine idling speed and causes the engine to fast idle when it is cold.
- Engine coolant passes through the throttle body to prevent icing of the throttle valve.



PRINCIPLE OF INJECTION DURATION CONTROL

The ECU determines the duration of each injection in the following steps:

Step 1: Determination of Duration of Basic Injection

The ECU selects, from the data stored in its memory, an injection duration that is suitable for the intake air volume (as detected by the air flow meter) and the engine rpm (as detected by the distributor). This injection duration is called the "basic injection duration."

Step 2: Determination of Adjusted Duration of Injection

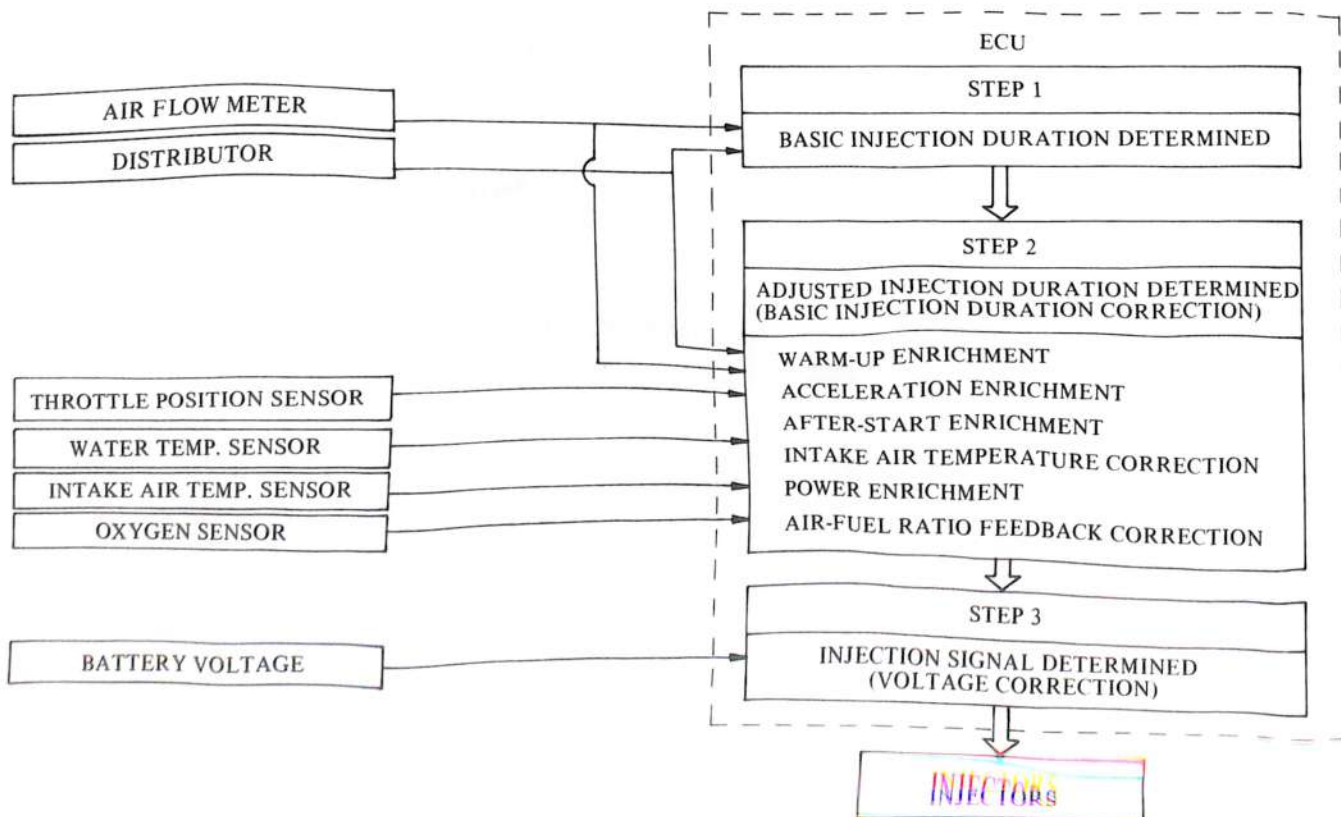
Under most engine conditions, the engine runs smoothly at an air-fuel mixture ratio of approximately 15 (this is called the "ideal air-fuel ratio"). However, when the engine is still cold, or when an extra load is applied to the engine, the air-fuel ratio is reduced to below 15 (i.e., it becomes richer). The ECU detects these engine conditions by means of the water temp. sensor, throttle position sensor and intake air temp. sensor, and corrects the basic injection duration to optimize it for the existing engine conditions.

Also, even under normal engine conditions, the injection duration is corrected by the signals from the oxygen sensor to keep the air-fuel ratio within a narrow range near 15.

The corrected time is called the "adjusted injection duration".

Step 3: Determination of Length of Injection Signal

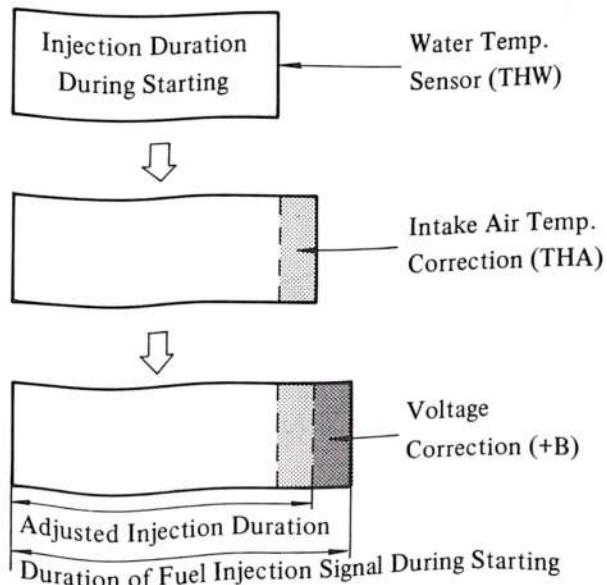
There is an operational delay between the sending of the ECU injection signal and the opening of the injector valve. This delay is greater the lower the battery voltage. The ECU accounts for this delay in the injection signal that it sends to the injector so that the actual length of time that the injector valve is open is equal to the calculated adjusted injection duration.



STARTING INJECTION CONTROL

During engine starting, it is difficult for the air flow meter to accurately sense the amount of air being taken in due to large fluctuations in rpm.

For this reason, the ECU selects from its memory an injection duration that is suitable for the coolant temperature, regardless of intake air volume or engine rpm. It then adds to this an intake air temperature correction and a voltage correction, to obtain the injection duration.

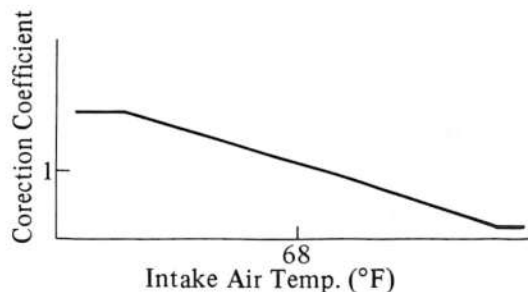


RELEVANT SIGNALS

- Engine speed (Ne)
- Coolant temperature (THW)
- Intake air temperature (THA)

CONDITIONS

Engine speed below 400 rpm.

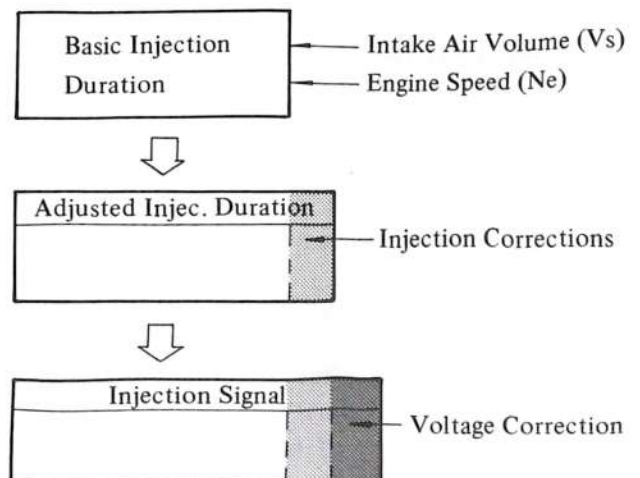


AFTER-START INJECTION CONTROL

When the engine is running more-or-less steadily above 400 rpm, the ECU determines the injection signal duration as explained below;

$$\begin{aligned} \text{Injection Signal Duration} &= \text{Basic Injection Duration} \\ &\times \text{Injection Correction Coefficient*} \\ &+ \text{Voltage Correction} \end{aligned}$$

* Injection correction coefficient is calculated by the sum and product of various correction coefficients.



1) Basic Injection Duration

This is the most basic injection duration, and is determined by the volume of air being taken in (Vs signal) and the engine speed (Ne signal). The basic injection duration can be expressed as follows:

$$\text{Basic Injection Duration} = K \frac{\text{Intake Air Volume}}{\text{Engine Speed}}$$

where K: Coefficient

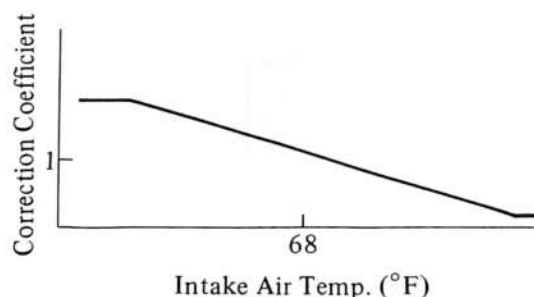
2) Injection Corrections

The ECU is kept informed of the moment-by-moment engine running conditions by signals from various sensors, and makes various corrections in the basic injection duration based on these signals.

a) Corrections Based on Intake Air Temperature

The density of the intake air will change depending upon its temperature. For this reason, the ECU must be kept accurately informed of both the intake air volume (by means of the air flow meter) and the intake air temperature (by means of the intake air temp. sensor) so that it can adjust the injection duration to maintain the air fuel ratio currently required by the engine. For this purpose, the ECU considers 68°F (20°C) to be the "standard temperature" and increases or decreases the amount of fuel injected, depending upon whether intake air temperature falls below or rises above this standard.

RELEVANT SIGNAL —
Intake air temperature (THA)



b) Warm-up Enrichment

As fuel vaporization is poor when the engine is cold, if a rich fuel mixture is not supplied, drivability will deteriorate.

For this reason, when the coolant temperature is low, the water temp. sensor informs the ECU, which increases the amount of fuel injected to compensate.

As the coolant warms up, the amount of warm-up enrichment decreases, reaching zero (correction coefficient = 1.0) when the coolant reaches 140°F (60°C).

RELEVANT SIGNAL —
Coolant temperature (THW)

c) After-start Enrichment

Immediately after starting (engine speed above 400 rpm), the ECU supplies an extra amount of fuel for a certain period to aid in stabilizing engine operation.

The correction volume is the highest immediately after the engine is started and gradually decreases. The maximum correction volume value (starting value) is determined according to the coolant temperature.

RELEVANT SIGNALS —
• Engine speed (Ne)
• Coolant temperature (THW)

CONDITION —
Engine speed above 400 rpm

d) Acceleration Enrichment During Warm-up

The ECU injects extra fuel during acceleration when the engine is still warming up in order to aid driveability.

Through calculation of the amount of change in the intake air volume per engine revolution, the ECU detects the engine's acceleration or deceleration condition. The correction volume is determined according to the coolant temperature and the strength of acceleration or deceleration.

RELEVANT SIGNALS

- Air flow meter (Vs)
- Engine speed (Ne)
- Coolant temperature (THW)

CONDITIONS

Intake air volume per engine revolution changes (acceleration or deceleration) with coolant temperature below 176°F (80°C).

However, if any of the following occurs the ECU stops calculating this change, and halts the injection of extra fuel:

- Engine speed falls below 400 rpm
- Fuel cut-off occurs
- Intake air volume becomes smaller than a certain level

e) Power Enrichment

When the engine is operating under heavy load conditions, the injection volume is supplemented by a certain volume to maintain good driveability.

The correction volume is determined according to the intake air volume.

RELEVANT SIGNALS

- Throttle position (V_{TA})
- Air flow meter (Vs)

CONDITIONS

Throttle valve opening angle above 60° or intake air volume larger than a certain level.

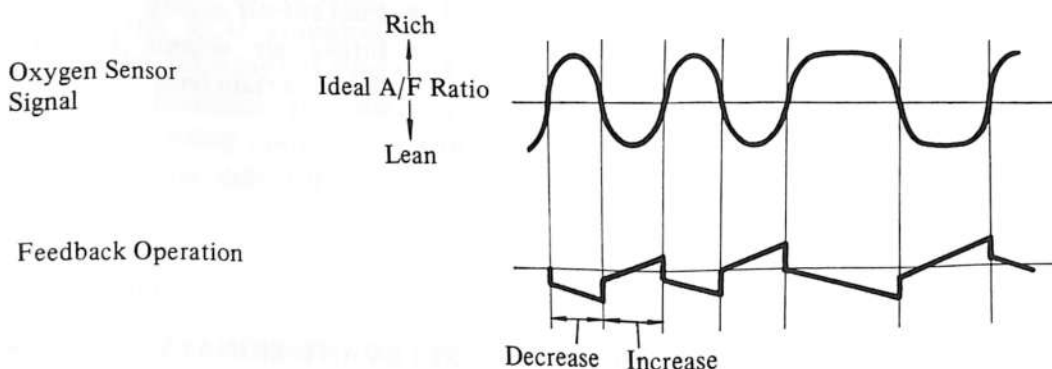
f) Air-fuel Ratio Feedback Correction

The ECU corrects the injection duration by the signals from the oxygen sensor to keep the air-fuel ratio within a narrow range near the ideal air-fuel ratio. (Closed loop operation)

Further, in order to prevent over heating of the catalyst and assure driveability, under the following conditions, the air-fuel ratio feedback operation does not work. (Open loop operation)

- During engine starting
- During power enrichment
- Fuel cut-off occurs

The ECU compares the voltage of the signals sent from the oxygen sensor with a reference voltage. As a result, if the voltage of the signal is higher, the air fuel ratio is judged to be richer than the ideal air-fuel ratio and the amount of fuel injected is reduced at a constant rate. If the point where the voltage of the signal is lower, it is judged that the air-fuel ratio is leaner than the ideal so the amount of fuel injected is increased.

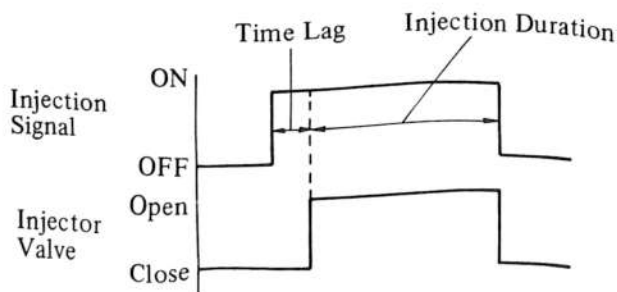


3) Voltage Correction

There is a slight delay between the time the ECU sends an injection signal to the injectors and the time the injectors actually open. This delay becomes longer the more the voltage of the battery drops (as, for example, when it becomes over-discharged, or "run down").

This means that the length of time that the injector valves remain open would become shorter than that calculated by the ECU, causing the actual air-fuel ratio to become higher (i.e., leaner) than that required by the engine, if this were not prevented by voltage correction.

In voltage correction, the ECU compensates for this delay by lengthening the injection signal by a period corresponding to the length of the delay. This corrects the actual injection period so that it corresponds with that calculated by the ECU.



RELEVANT SIGNAL
Battery voltage (+B)

FUEL CUT-OFF

1) Fuel Cut-off During Deceleration

During deceleration at high engine speed with the throttle valve completely closed, in order to prevent overheating of the catalyst due to misfiring and to improve fuel economy, the ECU cuts off fuel injection. When the engine speed becomes low or the throttle valve is opened, fuel injection is resumed.

RELEVANT SIGNALS

- Throttle position (IDL)
- Engine speed (Ne)
- Coolant temperature (THW)

CONDITIONS

IDL contacts closed with engine speed above fuel cut-off speed (NB).

CONDITIONS FOR RESUMPTION OF FUEL INJECTION

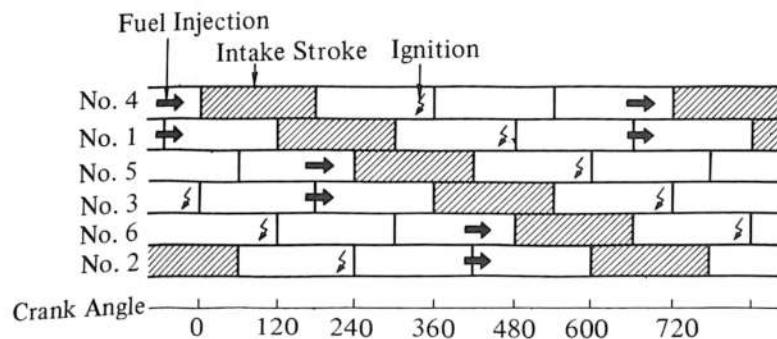
Engine speed drops below fuel injection resumption speed (NA), or IDL contacts open.

2) Fuel Cut-off Due to High Engine Speed

To prevent engine over-run, fuel injection is halted if the engine speed rises above 6,800 rpm. Fuel injection is resumed when the engine speed falls below this value.

FUEL INJECTION TIMING

The fuel injection system is a 3 group injection system which injects fuel simultaneously into 2 cylinders once every 2 engine revolutions.



START INJECTOR CONTROL

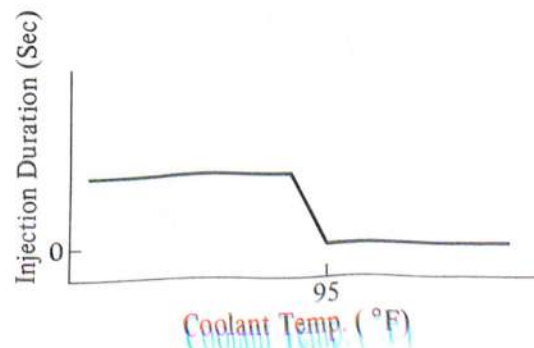
To improve startability when the engine is cold, the injection duration of the cold start injector is controlled not only by the start injector time switch but by the ECU in accordance with the coolant temperature. Once the engine has been started, current to the cold start injector is cut off and injection is terminated.

RELEVANT SIGNALS

- Coolant temperature (THW)
- Ignition switch (STA)
- Engine speed (Ne)

CONDITIONS

The engine is cranking and the coolant temperature is below 95°F (35°C)



8. ESA (Electronic Spark Advance)

GENERAL

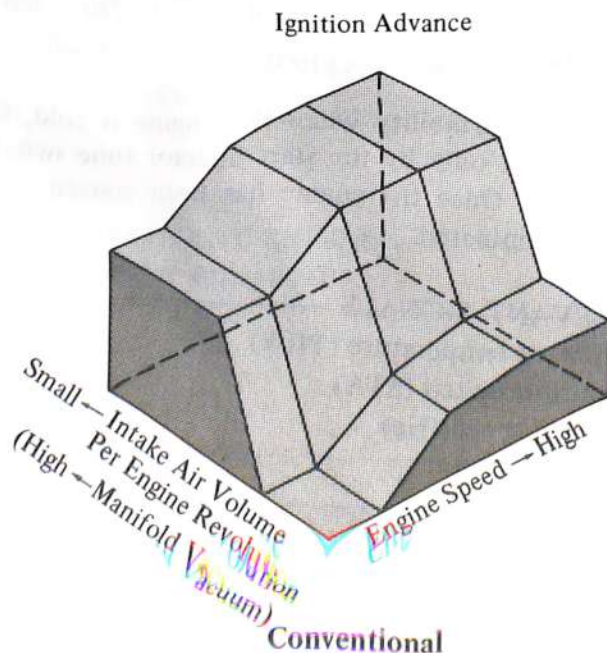
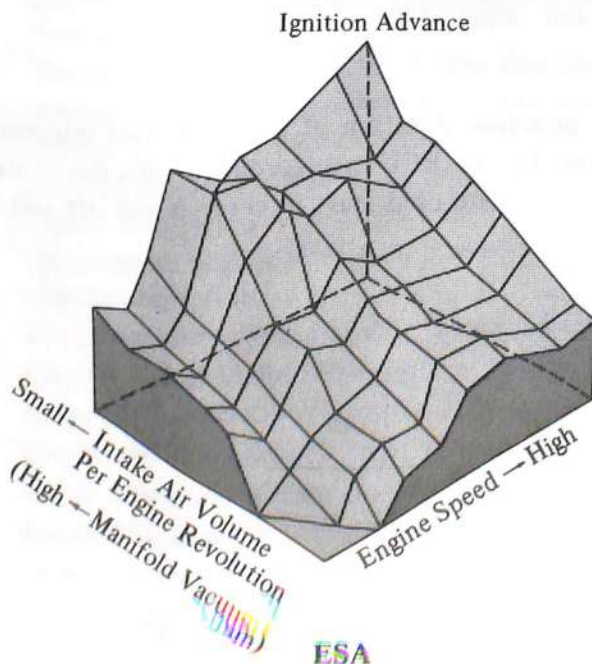
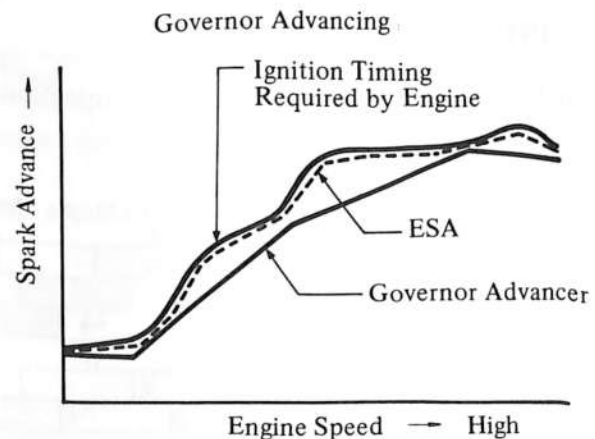
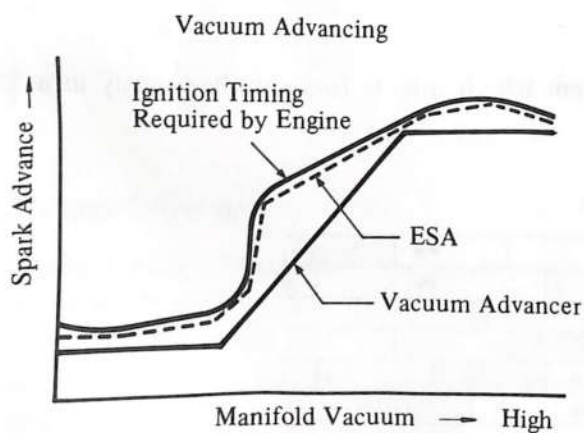
The air-fuel mixture must be ignited so that the combustion pressure will become maximum at 10° after TDC. However, the time from ignition of the air-fuel mixture to the maximum combustion pressure varies depending on the engine speed and the intake air volume. Ignition must occur earlier when the engine speed is faster. In the conventional system, the timing was advanced by the governor advancer. When the intake air volume per engine revolution is small (high vacuum), ignition must also be advanced, and this is achieved by the vacuum advancer in the conventional system.

Actually, optimum ignition timing is affected largely by a number of factors, such as the shape of the combustion chamber and the temperature inside the combustion chamber in addition to the engine speed and the intake air volume. Therefore the governor and vacuum advance do not provide ideal ignition timing for the engine.

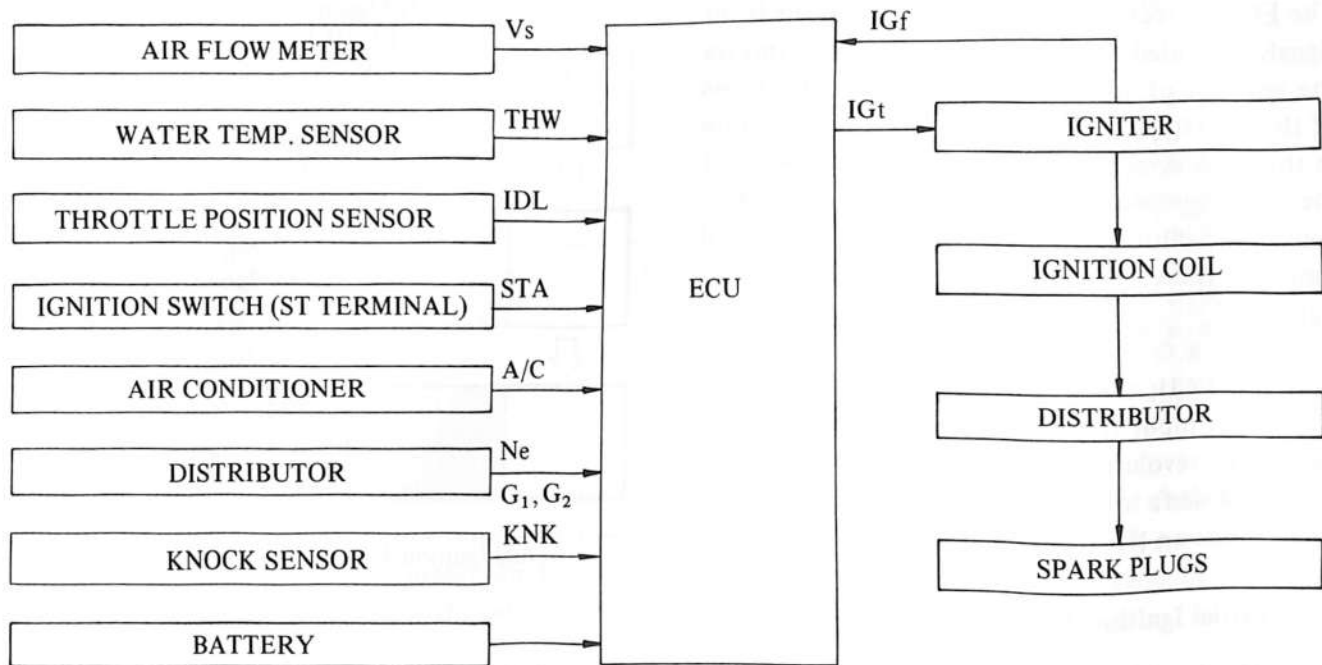
With the ESA (Electronic Spark Advance) system, the engine is provided with nearly ideal ignition timing characteristics.

The ECU determines ignition timing from its internal memory containing optimum ignition timing data for each engine condition, based on signals detected by various sensors, and then sends signals to the igniter accordingly.

Since the ESA always ensures optimum ignition timing, both fuel efficiency and engine power output are improved.



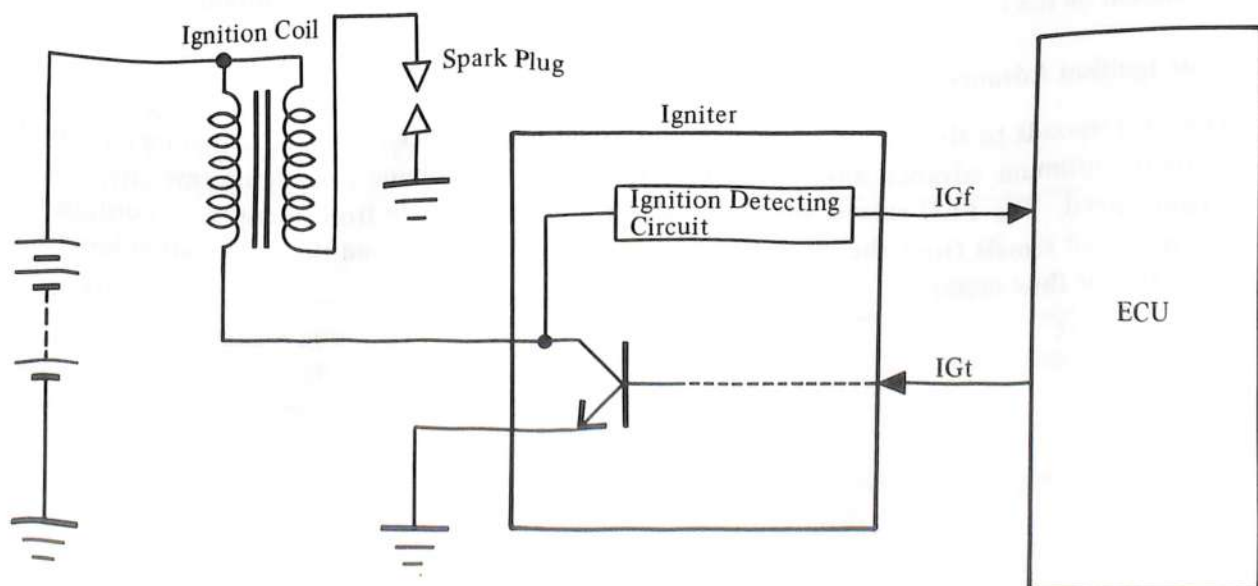
ESA BLOCK DIAGRAM



IGNITER

The ignition in the TCCS is basically the same as that in a conventional system, with the following exceptions.

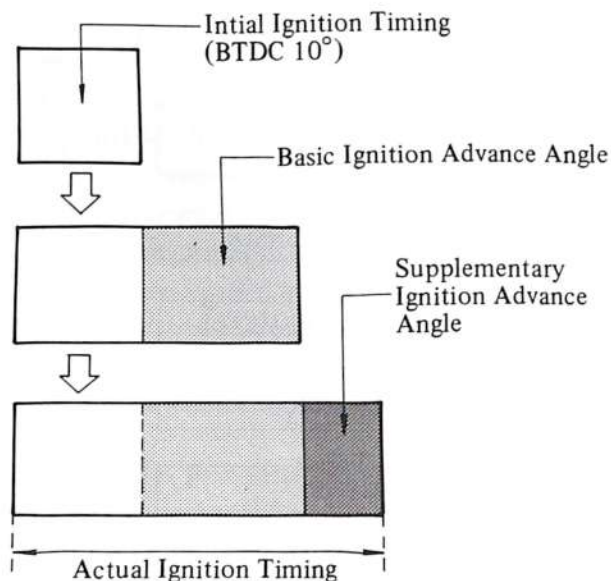
The power transistor in the conventional type is turned on and off by signals generated by the pick-up coil of the signal generator that is built into the distributor. These signals in the TCCS are replaced by IGt signals (ignition signal), which are sent by the ECU. When the primary ignition signal occurs in the primary coil, the igniter sends IGf signals (ignition confirmation signal) to the ECU, which detects, by such signals, whether there actually was ignition or not. If no IGf is supplied, it is interpreted by the ECU as a malfunction in the ignition system, and the ECU stops fuel injection accordingly.



FUNCTIONS OF ECU

The ECU detects various engine conditions from signals provided by the sensors, and determines the amount of advance angle required in excess of the initial ignition timing. The ignition timing in the ESA system is determined by the sum of the basic ignition advance angle and the supplementary ignition advance angles. The actual timing is therefore as shown in the chart on the right.

Whenever a G signal (either G_1 or G_2) is input into the ECU, the ECU counts the number of Ne signals input (One Ne signal is generated for each 30° revolution of the crankshaft). When the crankshaft rotates to the specified angle, the ECU sends an IGt (ignition) signal to the igniter.



1) Initial Ignition Timing

The initial ignition timing is the basic crankshaft angle at which ignition takes place when the electronic advance is not in operation. This initial timing is set at 10° BTDC in the ESA system.

Advancing Control During Starting

Since engine speed is unstable during and immediately after starting, the ECU cannot accurately determine the correct ignition timing. For this reason, it does not advance the ignition timing beyond the initial ignition angle of 10° BTDC until engine operation is stabilized.

RELEVANT SIGNALS

- Engine speed (Ne)
- Ignition switch (STA)

CONDITIONS

Engine speed below 400 rpm, or STA on.

NOTE: At engine adjustment time, etc., with the vehicle stopped, confirm the ignition timing by connecting the T and E_1 terminals in the check connector with the throttle valve closed.

Under the above conditions, ignition advance should not be occurring and the ignition timing should be the initial ignition timing (10° BTDC)

2) Basic Ignition Advance Angle

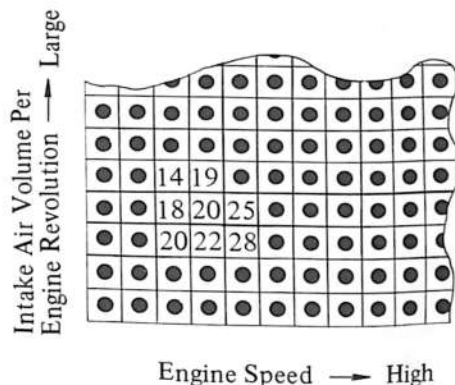
This corresponds to the vacuum advance and governor advance angles. The memory in the ECU contains optimum advance angle data for the intake air volume per engine revolution and the engine speed. The ECU selects the basic ignition advance angle from memory according to the engine speed signals from the Ne pick-up coil in the distributor and the intake air volume signals from the air flow meter.

a) IDL Contacts Open (OFF)

When the IDL contacts open, the ECU determines the basic ignition advance angle based upon data stored in its memory. This data might be shown in the form of a table, as shown in the chart.

RELEVANT SIGNALS

- Air flow meter (Vs)
- Engine speed (Ne)
- Throttle position (IDL)

Basic Ignition Advance Angle Data**– REFERENCE –**

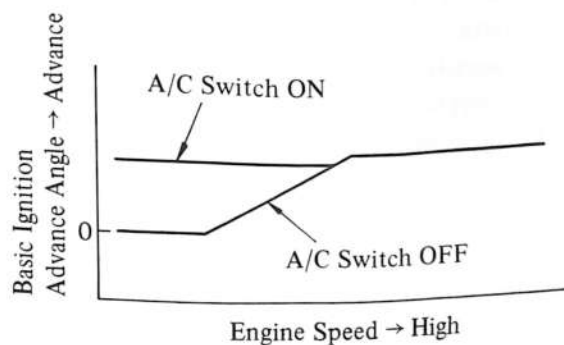
Since the capacity of the ECU's memory is limited, it cannot hold all possible advance angle data. For this reason, the ECU selects the value that is the closest to the required value for each particular combination of engine speed and intake air volume. It then carries out proportional calculations to find the optimum ignition timing for the given engine speed and the intake air volume.

b) IDL Contacts Closed (ON)

When the IDL contacts close, the ignition timing is advanced as shown in the graph.

RELEVANT SIGNALS

- Throttle position (IDL)
- A/C switch (A/C)
- Engine Speed (SPD)

**3) Supplementary Ignition Advance Angle for Overheat Prevention**

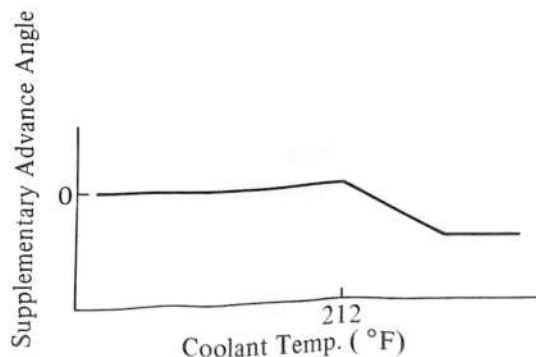
In order to prevent overheating, ignition timing is retarded when the coolant temperature rises above 212°F (100°C).

RELEVANT SIGNALS

- Coolant temperature (THW)
- Air flow meter (Vs)
- Engine speed (Ne)

CONDITIONS

Coolant temperature above 212°F (100°C) and the intake air volume per engine revolution above a certain level.



4) Supplementary Ignition Advance Angle for Stable Idling

When the engine speed changes at idle because of engine load changes, the ECU adjusts the ignition timing to stable engine speed.

The ECU is always calculating the average engine speed value. If the engine speed goes below a certain fixed speed, the ECU advances the ignition timing by a certain angle only. If the engine speed goes above the average engine speed, the ECU retards the ignition timing by a fixed angle only.

Furthermore this supplementary ignition angle varies within 0° and 3° .

RELEVANT SIGNALS

- Engine speed (Ne)
- Throttle position (IDL)
- Vehicle speed (SPD)

CONDITIONS

Vehicle speed zero, engine speed below 1,000 rpm and IDL contacts closed.

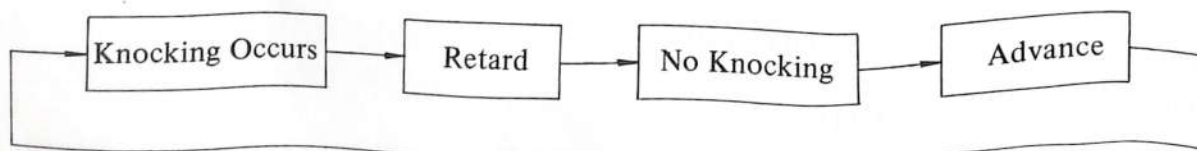
5) Supplementary Ignition Advance Angle for Knock Prevention

The ignition timing, at which engine knocking occurs, differs according to the gasoline's octane value. The ECU controls the ignition timing at the optimum timing to correspond to the gasoline octane value.

If engine knocking occurs, the knock sensor converts the vibration from the knocking into voltage signals and sends them to the ECU. The ECU judges whether the knocking strength is at one of 3 levels, strong, medium or weak, according to the strength of the knock signals and changes the supplementary ignition advance angle according to the strength. That is, if knocking is strong, the ignition timing is retarded a lot, and if it is weak, it is retarded a little.

When engine knocking stops, the ECU stops retarding the ignition timing and advances the ignition timing by fixed angles a little at a time.

If ignition timing advance continues and engine knocking recurs, ignition timing is again retarded. The ECU feeds back signals from the knock sensor to correct ignition timing as shown below.

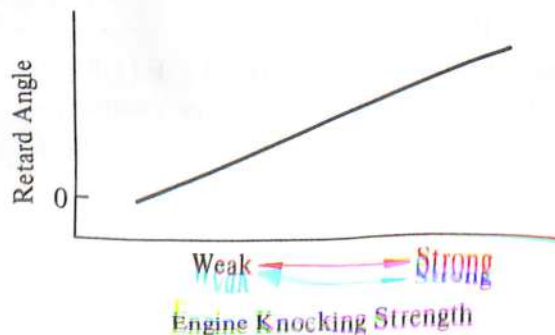


RELEVANT SIGNALS

- Engine speed (Ne)
- Intake air volume (Vs)
- Coolant temperature (THW)
- Engine knocking (KNK)

CONDITIONS

- Intake air volume per engine revolution larger than a certain level.
- Ignition timing not advanced with coolant temperature below 140°F (60°C).



7) Maximum and Minimum Advance Angle Control

If the actual ignition timing (initial ignition timing + basic ignition advance angle + supplementary ignition advance angle) becomes abnormal, the engine will be adversely affected. To prevent this, the ECU controls the actual ignition timing so that the sum of the basic ignition and supplementary ignition advance angles cannot be greater than a certain maximum value, nor less than a certain minimum value. These values are:

Maximum advance angle: 47° BTDC

Minimum advance angle: 5° BTDC

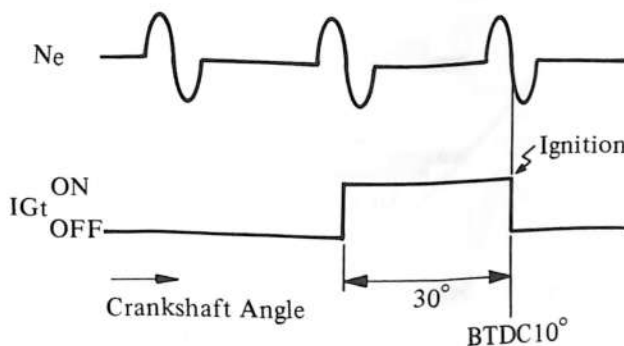
8) Igniter Control

a) During Engine Starting and Immediately After Starting

During engine starting and immediately after starting, the ECU begins sending the IGt signal to the igniter 30° crank shaft angle before the initial ignition timing angle (10° BTDC).

CONDITIONS

- STA on or engine speed below 400 rpm.
- IDL on and service terminals E_1 and T shorted.

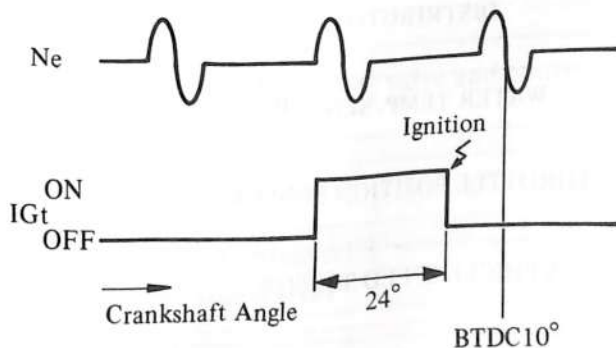


b) During Engine Running

During engine running, the ECU begins sending the IGt signal to the igniter 24° crank angle before the ignition point that it has just calculated.

CONDITION

- Engine speed above 400 rpm.



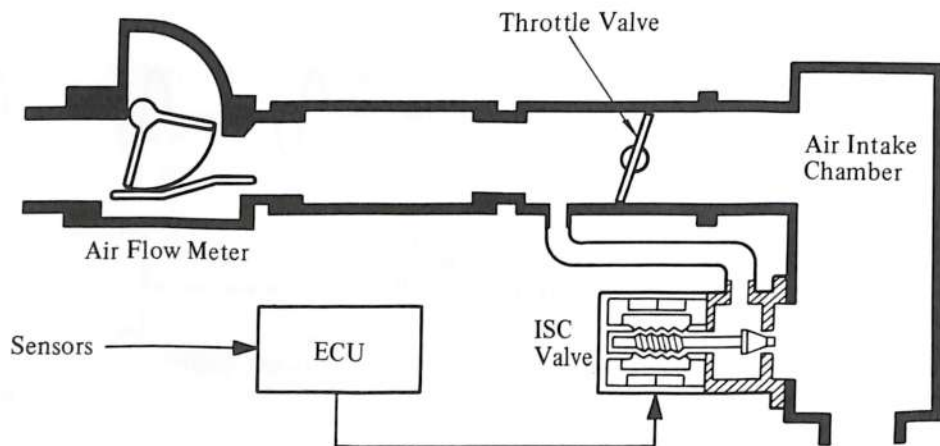
9. ISC (Idle Speed Control)

GENERAL

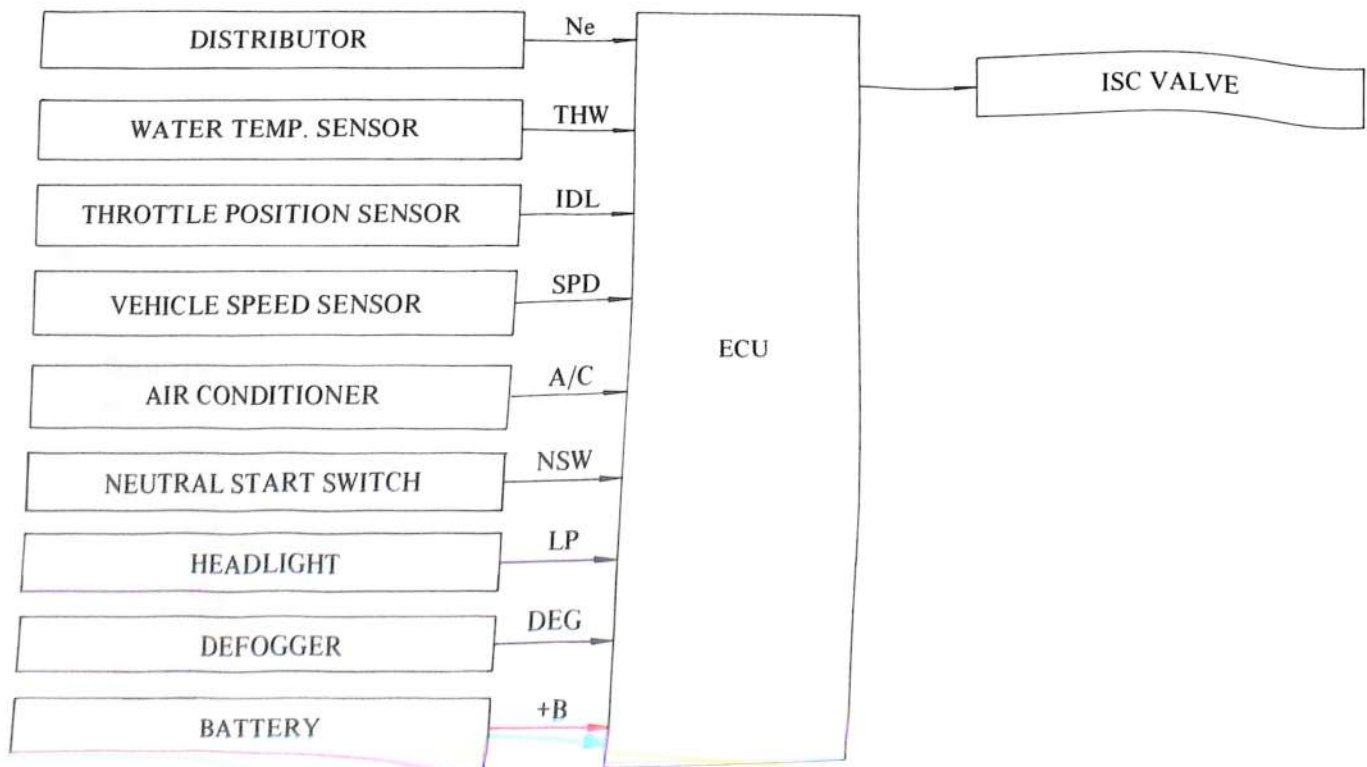
In previous engines, the volume of intake air bypassing the throttle valve is adjusted by the idle speed adjusting screw to adjust the idling speed. Afterward, as the idling speed changes over a period of time, it is readjusted by turning the idle speed adjusting screw.

Also, when the engine is cold, intake air bypasses the throttle valve through an air valve and the engine speed increases, causing fast idle. In addition, when the air conditioner is operated, the throttle valve is opened by a diaphragm and the idle speed is increased.

In the 7M-GE TCCS, a target idling speed for each engine condition is stored in the ECU and by adjusting the intake air volume bypassing the throttle valve according to each engine condition by the ISC valve, the idling speed is controlled so that it becomes the target idling speed. Also, when the engine is cold, the ISC valve is opened corresponding to the coolant temperature and the engine speed is increased, causing fast idle.



ISC BLOCK DIAGRAM

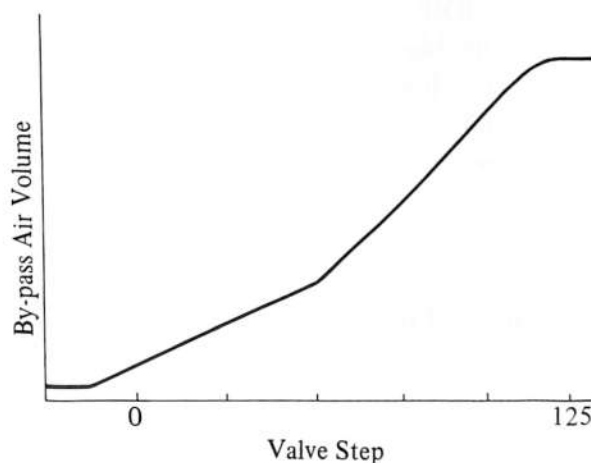
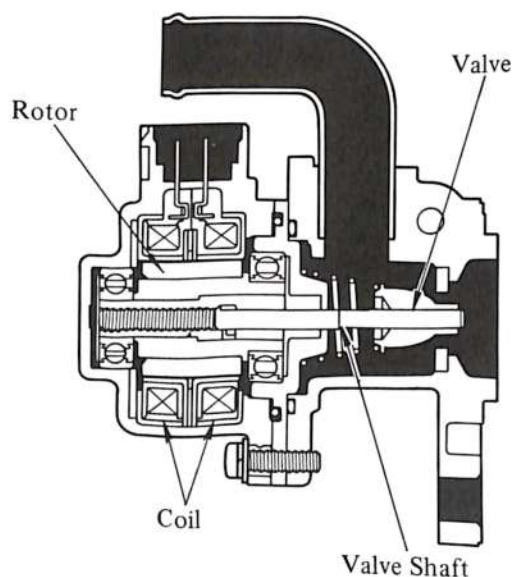


ISC VALVE

The ISC valve is mounted on the intake manifold and intake air bypassing the throttle valve is directed to the ISC valve through a hose.

The ISC valve operates according to signals from the ECU and controls the volume of intake air which bypasses the throttle valve.

The ISC valve is a step motor type. It consists of 4 coils, the magnetic rotor, valve shaft and valve. When current flows to the coils due to signals from the ECU, the rotor turns and moves the valve shaft forward or backward according to the signals, changing the gap between the valve and the valve body. In this way the intake air volume bypassing the throttle valve is changed, changing the engine speed. There are depending on the rotor stop position, 125 steps in the gap between the valve and the valve body.



FUNCTION OF ECU

Based on signals from various sensors, the ECU sends control signals to the ISC valve and controls the engine speed at the optimum speed for each respective engine condition.

1) Initial Set

When the engine is stopped, the ISC valve is fully open (125 steps), giving the engine good restartability.

The Main Relay goes off after the ignition switch is turned off and initial set is completed.

RELEVANT SIGNALS

- Engine speed (Ne)

CONDITIONS

Engine speed is zero and main relay ON.

2) After-start Control

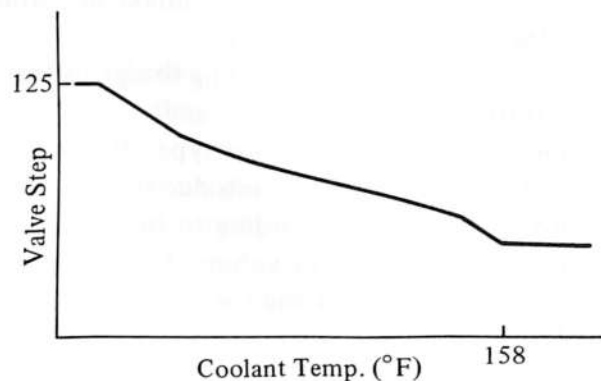
If the engine is started and the ISC valve is in the initial set (fully open) condition, the engine speed will become too high. Therefore, immediately after the engine is started, the ISC valve is adjusted to the step position which corresponds to the coolant temperature. This keeps the engine speed lower.

RELEVANT SIGNALS

- Engine speed (Ne)
- Coolant temperature (THW)

CONDITIONS

When the engine speed rises to a certain level. (The lower the coolant temperature, the higher this level becomes.)



3) Warm-up Control

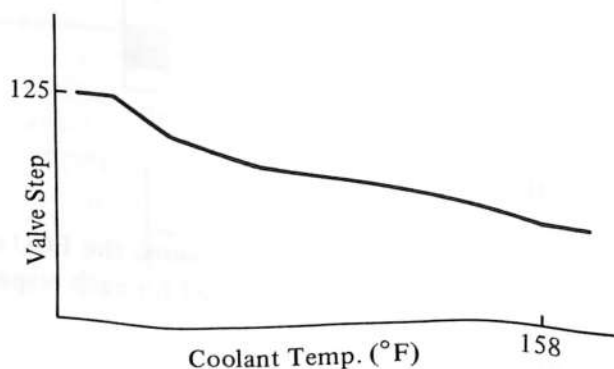
When after-start control is ended, the fast idle speed is controlled corresponding to the coolant temperature in order to warm up the engine. As the coolant temperature rises, the ISC valve gradually closes and when the coolant temperature reaches 158°F (70°C), warm-up control ends.

RELEVANT SIGNALS

- Engine speed (Ne)
- Coolant temperature (THW)

CONDITIONS

Engine speed above 300 rpm.



4) Feedback Control

After the engine is warmed up, the actual engine speed and the target idling speed stored in the ECU are compared. The ECU sends control signals to the ISC valve in order to adjust the actual engine speed to match the target idling speed.

That is, when the actual engine speed is lower than the target idling speed, the ECU sends signals to the ISC valve to open. Conversely, when the actual engine speed is higher than the target idling speed, control signals are sent to the valve to close.

RELEVANT SIGNALS

- Throttle position (IDL)
- Vehicle speed (SPD)
- Engine speed (Ne)
- Coolant temperature (THW)
- Air conditioner (A/C)
- Neutral start switch (NSW)

CONDITIONS

IDL contacts close, vehicle speed is zero, Engine speed above 300 rpm and coolant temperature above 158°F (70°C).

Target Idling Speed (Automatic Transmission)

Air Conditioner Switch	Neutral Start Switch	Engine Speed
ON	ON	900 rpm
	OFF	750 rpm
OFF	ON	700 rpm
	OFF	600 rpm

Target Idling Speed (Manual Transmission)

Air Conditioner Switch	Engine speed
ON	900 rpm
OFF	700 rpm

5) Engine Speed Change Estimate Control

Immediately after the air conditioner switch or automatic transmission shift position or headlight switch or defogger switch is changed, the engine load changes, causing the engine speed to change. To prevent the engine speed from changing, immediately after the air conditioner switch or automatic transmission shift position or headlight switch or defogger switch is changed, the ECU sends signals to the ISC valve to open or close by a fixed number of valve steps.

RELEVANT SIGNALS

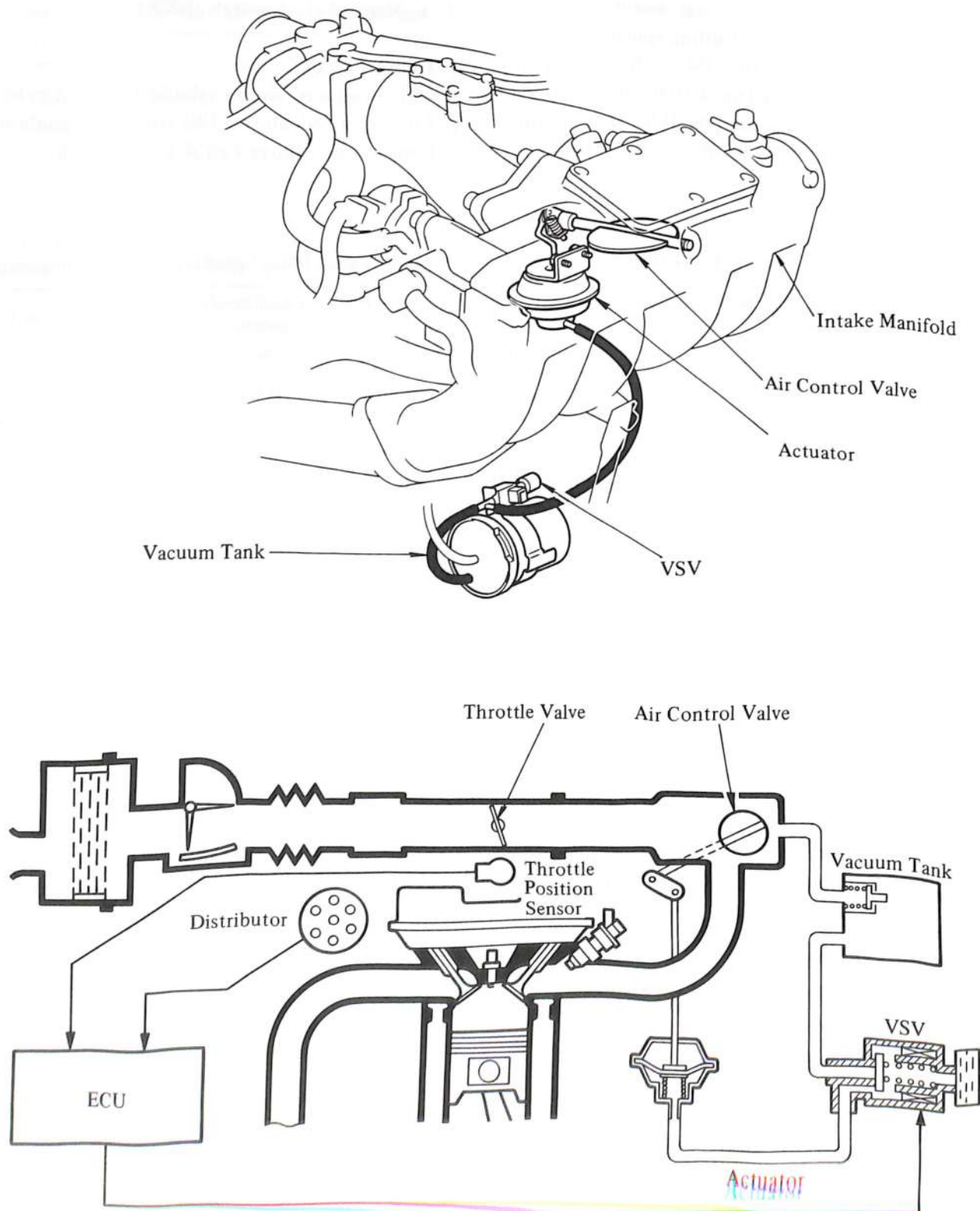
- Engine speed (Ne)
- Air conditioner (A/C)
- Neutral start switch (NSW)
- Headlight (LP)
- Defogger (DEG)

CONDITIONS

When air conditioner switch or neutral start switch or headlight switch or defogger switch turned on or off with engine speed above 300 rpm.

10. Intake Air Control System

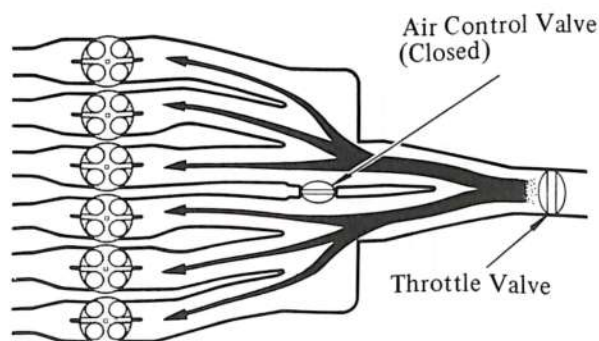
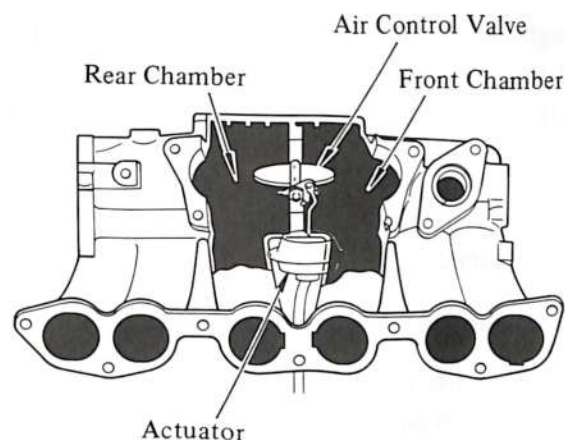
The intake air control system opens and closes an air control valve installed in the intake manifold corresponding to the engine speed and throttle valve opening angle to raise air intake efficiency.



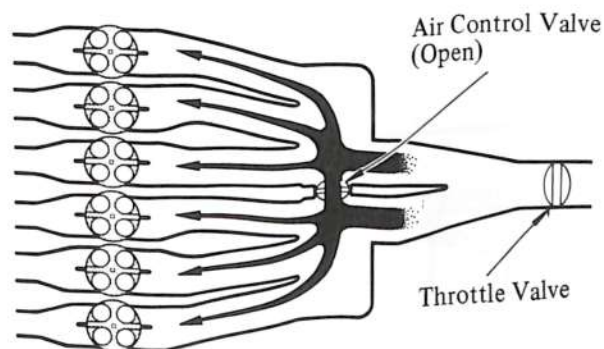
INTAKE MANIFOLD AND AIR CONTROL VALVE

An air control valve is built into the inside of the intake manifold, which divides the intake air chamber into two chambers, the front chamber and the rear chamber.

When this valve is closed, the same effect on intake efficiency can be obtained as when the intake manifold is long. That is, if high engine output is necessary at low engine speed, the valve closes and intake efficiency is increased by the intake air inertia effect. When engine speed is high, the valve is opened to reduce intake resistance and intake efficiency is kept from dropping.



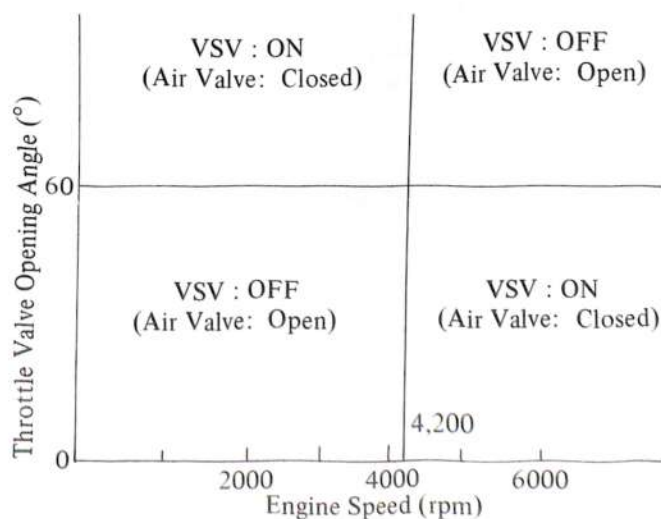
When air control valve is closed



When air control valve is open

OPERATION

As shown in the chart at right, the VSV is turned on or off depending upon engine speed and throttle valve opening angle. If the VSV is turned on, vacuum is directed from the intake manifold to the actuator and the air control valve is fully closed. If the VSV is turned off, atmospheric air is directed into the actuator and the air control valve is fully opened.



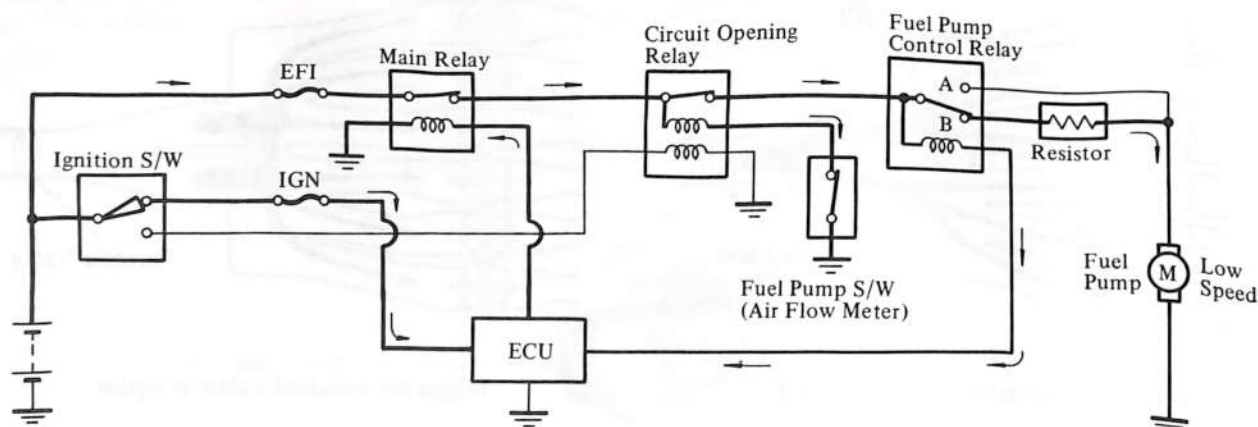
11. Fuel Pump Speed Control

A high output fuel pump has been adopted in the 7M-GE engine. The ECU changes the speed of the fuel pump in 2 stages corresponding to the amount of fuel required by the engine. With this system, electric power consumption and fuel pump durability are improved.

OPERATION

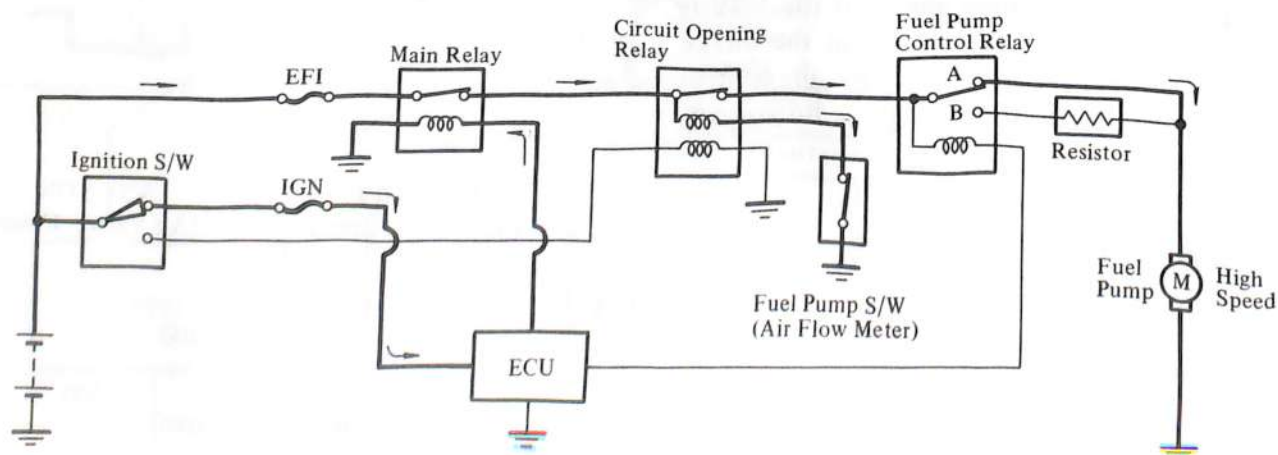
1) During Engine Idling or Cruising

The ECU is constantly calculating the fuel injection duration per fixed period of time. When the engine is idling, or under normal driving conditions, that is, when the fuel injection duration per fixed period of time is shorter than the reference value, the ECU turns on the fuel pump control relay coil. When the control relay coil is turned on, the point contacts side B and the current to the fuel pump flows through a resistor, causing the fuel pump turns at low speed.



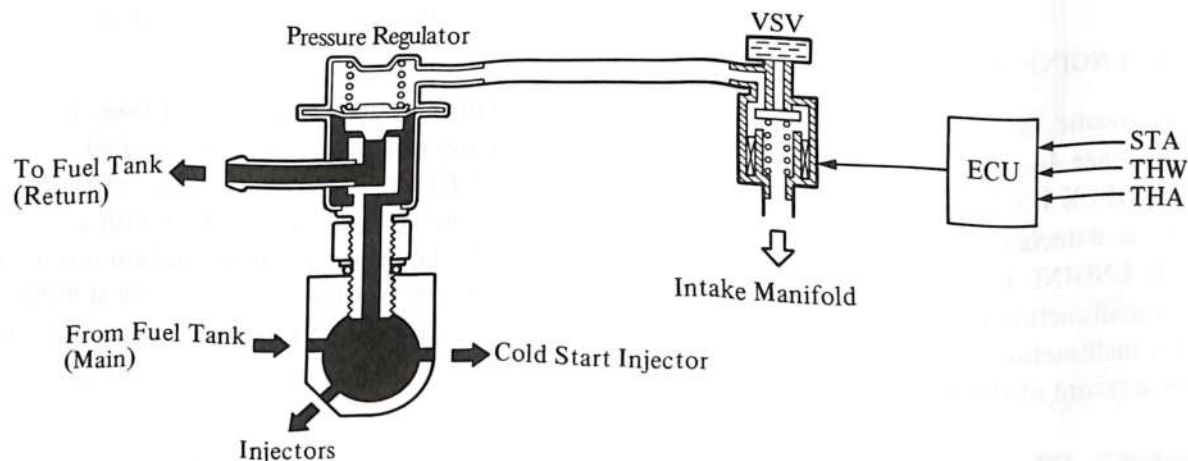
2) During High Engine Speed and High Load Operation

When the engine is operated at high speeds and under heavy loads, the fuel pump control relay coil is turned off. If the control relay coil is turned off, the point contacts with side A and the current to the fuel pump flows directly to the pump without passing through a resistor, causing the fuel pump turns at high speed.



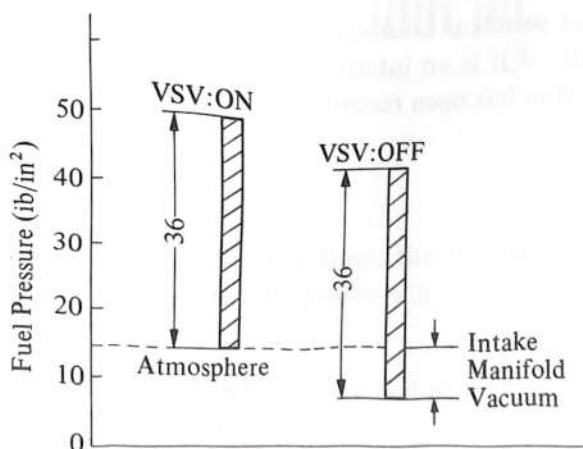
12. Fuel Pressure Control

When the engine is started with its temperature high, the fuel pressure is made higher than under normal driving conditions. When the fuel pressure is increased, the fuel's tendency to percolate is reduced, which improves engine restartability and idling stability.



OPERATION

When the coolant temperature is 212°F (100°C) or higher and the intake air temperature is 140°F (60°C) or higher, if the engine is cranked, the ECU turns on the VSV. As the VSV goes on, atmospheric air is introduced into the diaphragm chamber of the pressure regulator and the fuel pressure becomes higher than the fuel pressure under normal driving conditions by the amount of the intake manifold vacuum only. Even after the engine is started, the VSV remains on for scores of seconds.



13. Diagnosis

GENERAL

The ECU contains a built-in self-diagnostic system.

The ECU, which constantly monitors all sensors, lights the "CHECK ENGINE" lamp when it detects a problem in a sensor or its circuitry. At the same time, the ECU registers the system containing the malfunction in its memory. This information is retained in memory after the ignition switch is turned off, and even after the malfunction has been corrected. When the vehicle requires service because of a problem in the TCCS system, the contents of the memory may be checked to identify the malfunction. After the problem is repaired, the diagnostic system is cleared by removing the EFI fuse for more than 10 seconds with the ignition switch off.

CHECK ENGINE LAMP

The diagnostic system monitors sixteen conditions, including the normal condition, listed in the chart on page 44. Whenever a malfunction is detected in any one of the systems marked with a circle in the CHECK ENGINE lamp column, the ECU lights the CHECK ENGINE lamp to inform the driver that it has detected a malfunction in the engine. For all of the systems not marked with a circle in the CHECK ENGINE lamp column, the ECU does not light the lamp when a malfunction is detected because a malfunction in those systems would not cause any major trouble such as engine stalling.

After a malfunction is corrected, the ECU turns off the CHECK ENGINE lamp, but the ECU memory retains a record of the system that contained the malfunction.

Operation

- When the ignition switch is turned from off to on, the CHECK ENGINE lamp goes on. After the engine is started, the lamp goes out. This is to inform the driver that the CHECK ENGINE lamp circuitry is operating normally.
- The lamp lights immediately if a TCCS problem occurs while the engine is running.
- If the problem is rectified, the lamp goes out five seconds after the problem is corrected.
- If the problem no longer exists at the time the TCCS is being checked by a technician (as, for example, if it is an intermittent problem), the CHECK ENGINE lamp will not light, even if the malfunction has been recorded in the memory of the ECU.



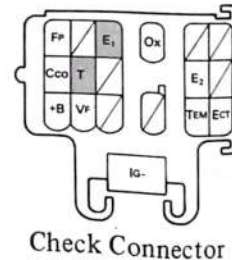
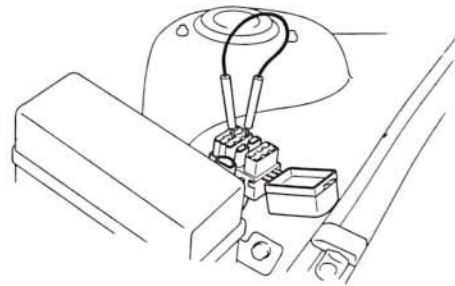
Check Engine Lamp

DIAGNOSTIC CODES

In the case of the 7M-GE engine, TCCS problems can be diagnosed by fulfilling the following three conditions, then counting the number of times the CHECK ENGINE lamp flashes (see the Table of Diagnostic Codes on the next page):

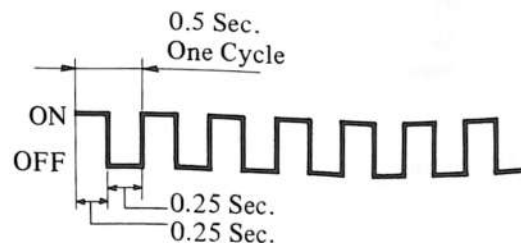
CONDITION

- Ignition switch on
- Check terminals E₁ and T connected
- IDL contacts on (throttle valve fully closed)



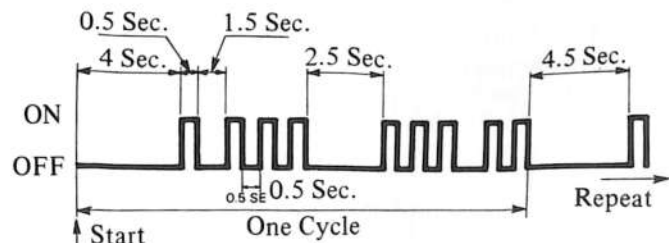
1) Normal

The lamp will flash 2 times per second as shown in the chart on the right.



2) Malfunction Present

The appropriate diagnostic code(s) will be indicated by the lamp as shown in the example on the right. In this case, codes 13 and 32 are indicated:



NOTE: • If two or more malfunctions are present at the same time, the lowest-numbered diagnostic code will be displayed first. However, no other code will appear along with code No. 11.

- All detected diagnostic codes, except 51 and 53, will be retained in memory by the ECU from the time of detection until cancelled out.
- Once the malfunction is cleared, the "CHECK ENGINE" warning lamp will go out but the diagnostic code(s) will remain stored in the ECU memory (except for code 51 and 53.)

Code No.	Item	Diagnosis	Trouble Area	"CHECK ENGINE" Diagnostic Light
	Normal			—
11	ECU (+B)	Momentary interruption in power supply to ECU.	• Ignition switch, main relay circuit • ECU	—
12	RPM Signal	No "Ne" or "G" signal to ECU within several seconds after engine is cranked.	• Distributor circuit • Crank position, starter signal circuit • Distributor • ECU	○
13	RPM Signal	No "Ne" signal to ECU when the engine speed is above 1,000 rpm.	↑	○
14	Ignition Signal	No "IGF" signal to ECU 6–8 times in succession	• Igniter circuit • Igniter • ECU	○
21	Oxygen Sensor Signal	Open circuit in oxygen sensor signal (Ox)	• Oxygen sensor circuit • Oxygen sensor • ECU	○
22	Water Temp. Sensor Signal	Open or short circuit in water temp. sensor signal (THW)	• Water temp. sensor circuit • Water temp. sensor • ECU	○
24	Intake Air Temp. Sensor Signal	Open or short circuit in intake air temp. sensor signal (THA)	• Intake air temp. sensor circuit • Intake air temp. sensor • ECU	—
31	Air Flow Meter Signal	Open circuit in Vcc signal or short circuit between Vs and E ₂ when idle contacts are closed	• Air flow meter circuit • Air flow meter • ECU	○
32	Air Flow Meter Signal	Open circuit in E ₂ signal or short circuit between Vcc and Vs	↑	○
41	Throttle Position Sensor Signal	Open or short circuit in throttle position sensor signal (V _{TA})	• Throttle position sensor circuit • Throttle position sensor • ECU	—
42	Vehicle Speed Sensor Signal	No "SPD" signal for several seconds when engine speed is between 2,000 rpm and 4,500 rpm except when racing the engine	• Vehicle speed sensor circuit • Vehicle speed sensor • ECU	—
43	Starter Signal	No "STA" signal to ECU until engine speed reaches 800 rpm with vehicle not moved	• Starter signal circuit • Ignition switch, main relay circuit • ECU	—
51	Switch Signal	No "IDL" signal or No "NSW" signal or "A/C" signal to ECU, with the check terminals E ₁ and T shorted.	• A/C amplifier • A/C switch circuit • Neutral start switch • Neutral start switch circuit • Accelerator pedal and cable • Throttle position sensor • Throttle position sensor circuit • ECU	—
52	Knock Sensor Signal	Open or short circuit in knock sensor signal (KNK)	• Knock sensor circuit • Knock sensor • ECU	○
53	Knock Control CPU (ECU)	Knock control CPU faulty	• ECU	○

14. Fail-Safe

FAIL-SAFE FUNCTION

When a malfunction is detected by any of the sensors, the fail-safe function of the ECU either relies on the data stored in its memory to allow the TCCS to continue operating or stops the engine.

1) Water Temp. Sensor and Air Temp. Sensor Malfunction

If an open circuit develops in the air or water temp. sensor, or in their circuitry, the affected sensor will send a signal informing the ECU that the temperature has fallen below -58°F (-50°C). On the other hand, if a short circuit develops, the sensor will send a signal informing the ECU that the temperature has risen above 284°F (140°C).

If the ECU receives either one of these abnormal signals, it ignores all input from the affected sensor and relies upon the standard air or coolant temperature value stored in memory.

These values are 68°F (20°C) for intake air temperature and 176°F (80°C) for coolant temperature. This is to prevent stalling and poor idle.

2) Ignition System Malfunction

The ECU will detect a malfunction in the ignition system if no IGf signal is supplied to the ECU 3–5 times consecutively after each IGt signal, and will discontinue fuel injection. This is to prevent TWC from overheating due to no ignition.

3) Throttle Position Sensor Malfunction

If the throttle position sensor circuit is open or if there is a short, the ECU judges that the signals indicate a malfunction and controls the engine as if the throttle valve opening angle were 0° . This prevents engine stall or engine overrun.

4) Knock Sensor and Knock CPU Malfunction

If the knock sensor circuit becomes open or is shorted, or if trouble develops in the knock CPU in the ECU, the ECU, without ignition timing feedback control corresponding to the knock strength, sets the supplementary ignition advance angle to the maximum retard condition to prevent knocking. By thus preventing the ignition timing from advancing too far, the engine knock is suppressed.

5) Back-up Function

If there is trouble with the CPU in the ECU and the ignition signals (IGt) are not output, the ECU controls fuel injection and ignition timing at predetermined levels as a back-up function to make it possible to continue to operate the vehicle.

Furthermore, the injection duration is calculated from the starting signal (STA) and the throttle position signal (IDL). Also, the ignition timing is fixed at the initial ignition timing, 10° BTDC, without relation to the engine speed.

NOTE: If the engine is controlled by the back-up function, the CHECK ENGINE lamp lights up to warn the driver of the malfunction but the diagnostic code is not output.

EMISSION CONTROL SYSTEM

1. System Purpose

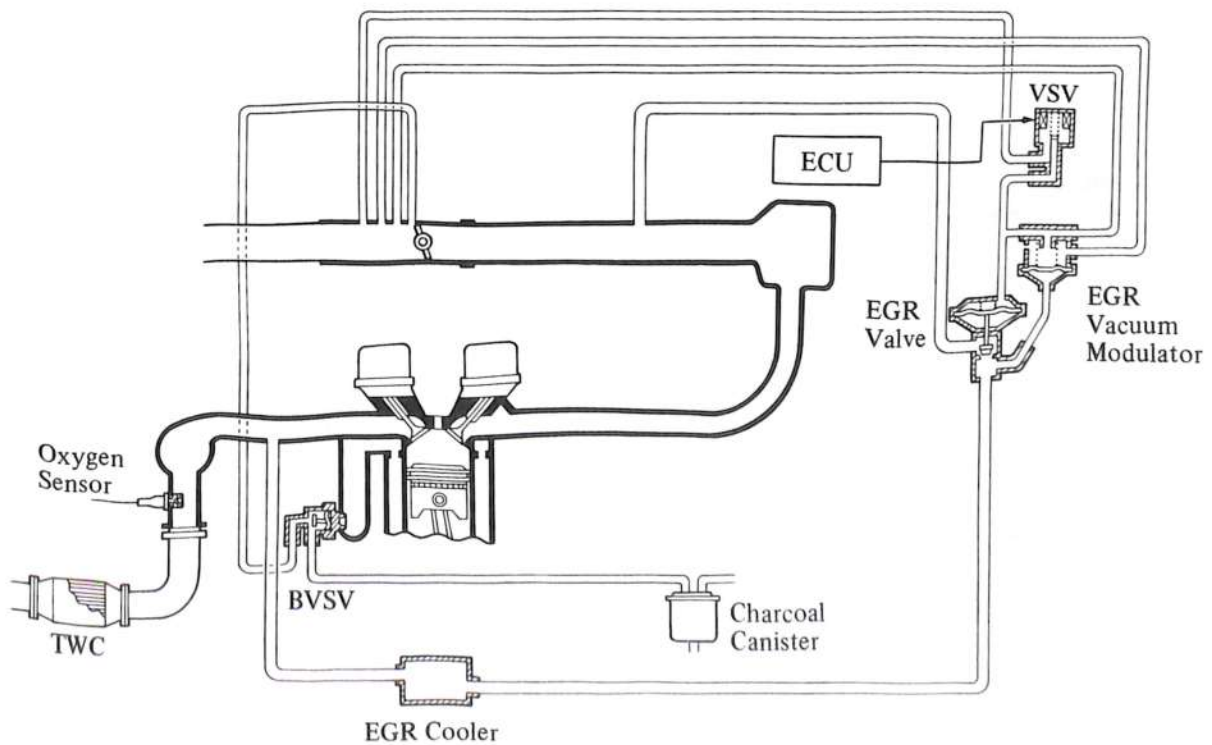
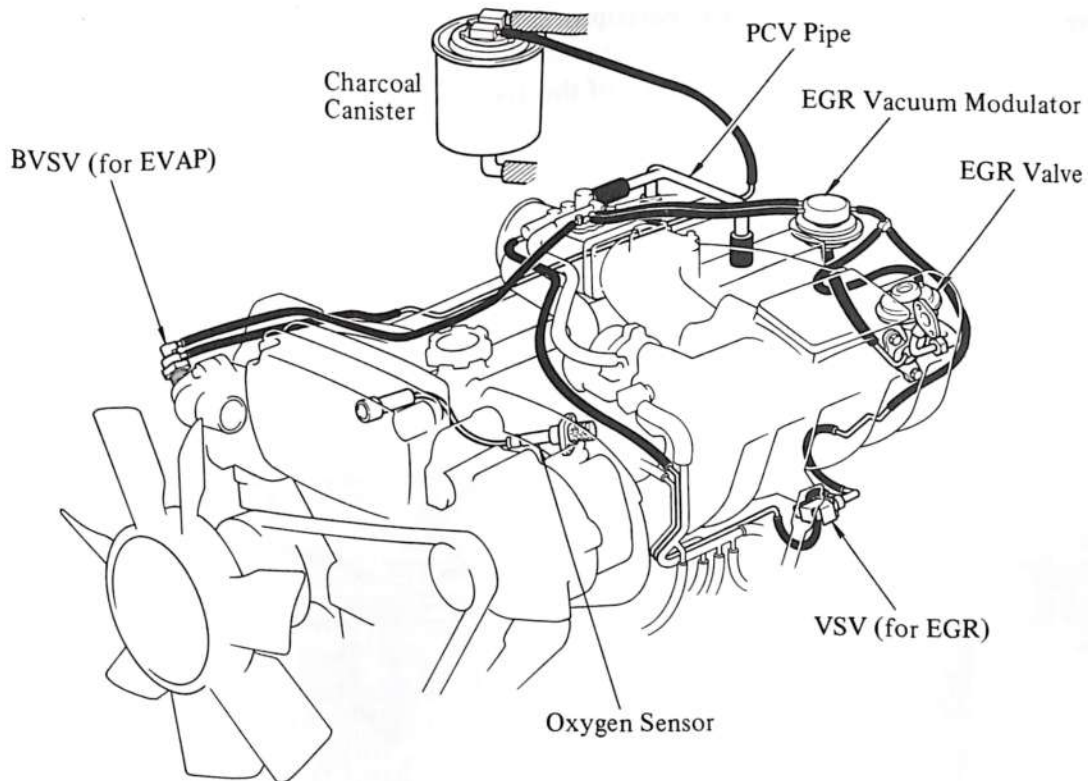
System	Abbreviation	Purpose
Positive crankcase ventilation	PCV	Reduces blow-by gas (HC)
Fuel evaporative emission control	EVAP	Reduces evaporative HC
Exhaust gas recirculation	EGR	Reduces NOx
Three-way catalyst	TWC	Reduces HC, CO and NOx
Electronic fuel injection	EFI	Regulates all engine conditions for reduction of exhaust emissions

NOTE: EGR Cut Control by ECU

Under the following engine conditions, the ECU sends signals to the VSV and the EGR is cut by bleeding atmospheric air from the EGR Valve pressure chamber.

- Coolant temperature below 140°F (60°C).
- Throttle valve opening angle decreases.
- Intake air volume smaller than a certain level.

2. Component Layout And Schematic Drawing

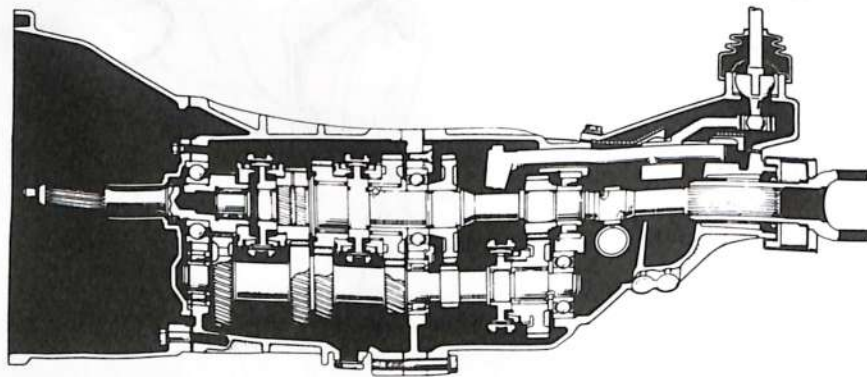


MANUAL TRANSMISSION

W58 MANUAL TRANSMISSION

The W58 manual transmission, which has been proven on previous models, is mounted in the new Supra.

The basic construction, operation and gear ratios of this transmission have not been changed.



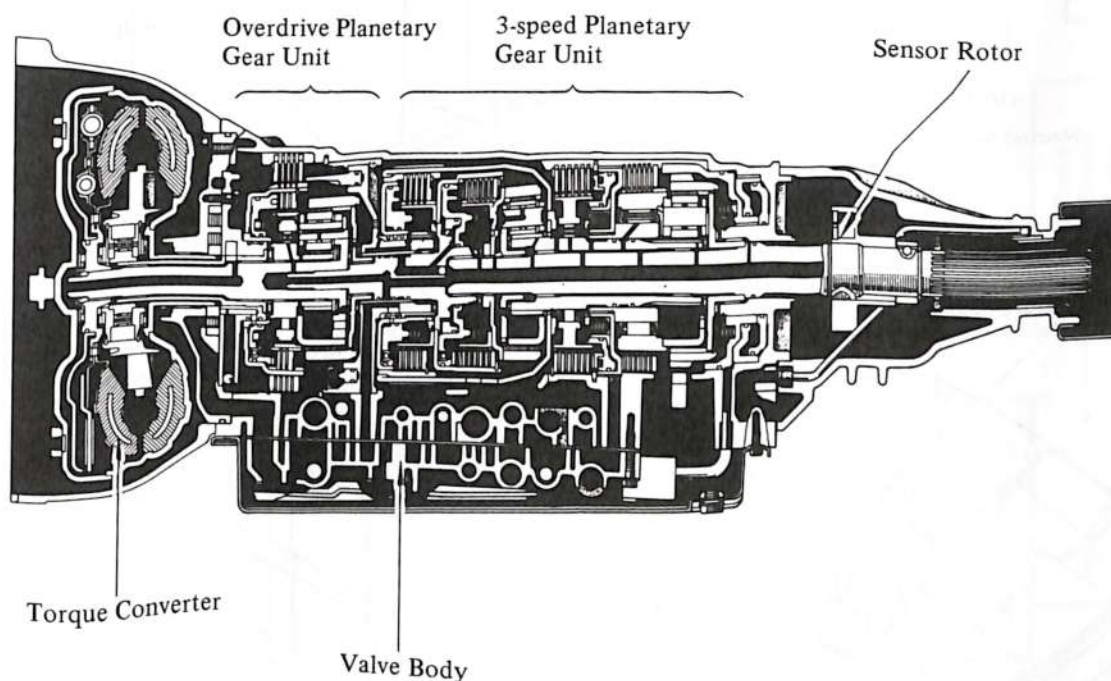
Specifications

Gear Ratio	1st	3.285
	2nd	1.894
	3rd	1.275
	4th	1.000
	5th	0.783
	Reverse	3.768
Fluid Volume		2.5 US qts. (2.4 liters, 2.1 Imp. qts.)
Type of Fluid		API GL-4 or GL-5 SAE 75W-90 or 80W-90

AUTOMATIC TRANSMISSION

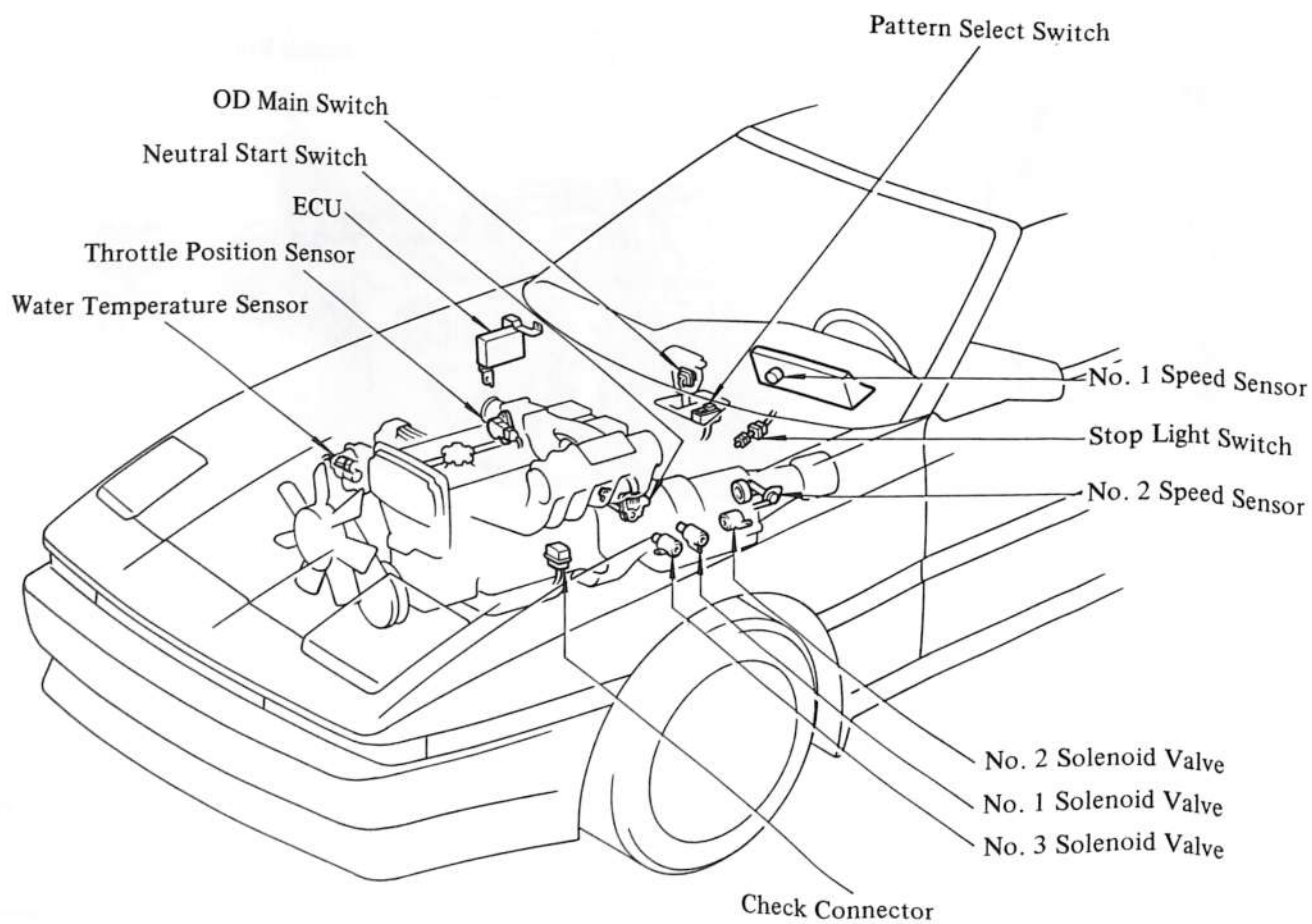
A340E AUTOMATIC TRANSMISSION

The basic construction and operation of this transmission is the same as that of the A340E Electronically-controlled Transmission (ECT) mounted the Truck.

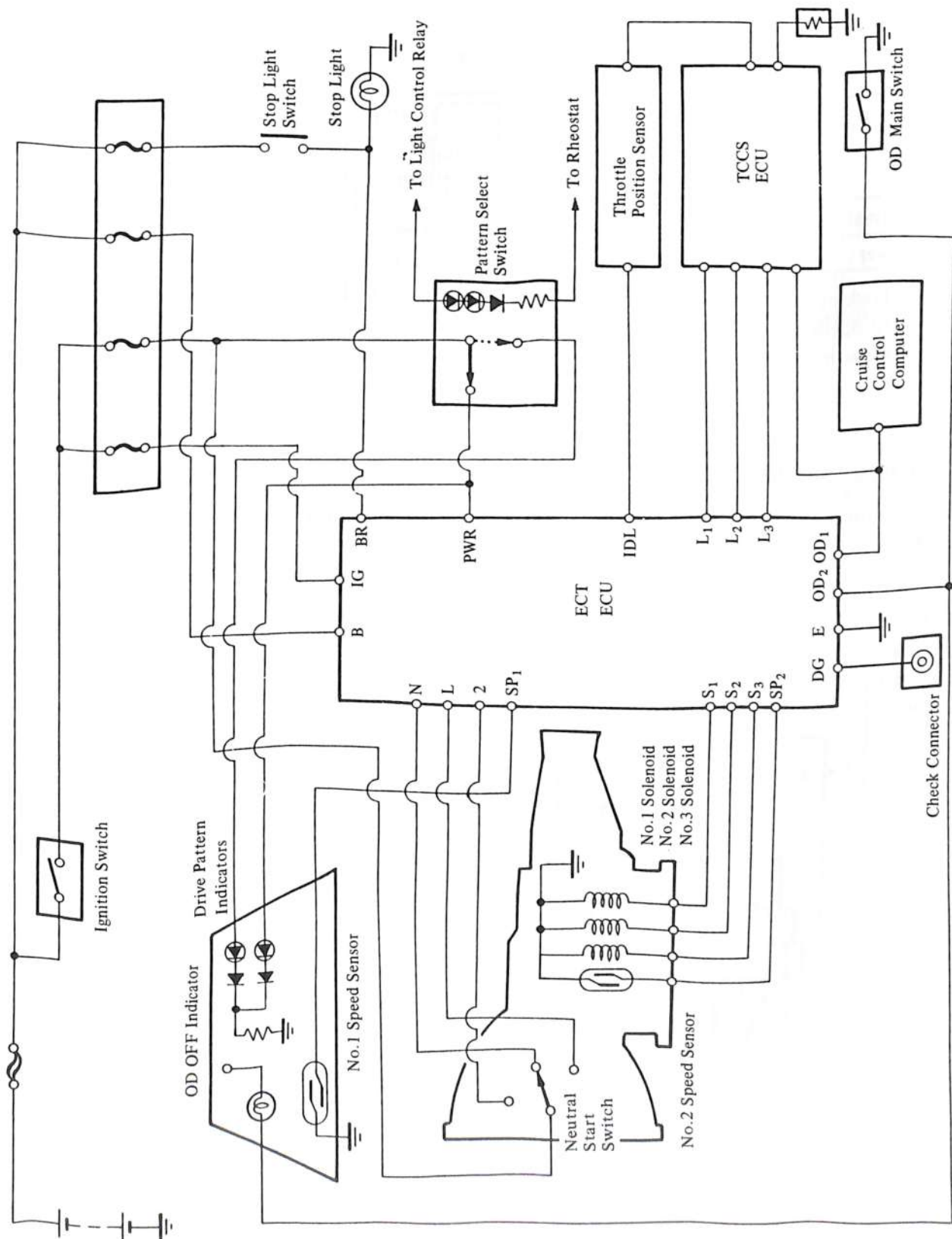


Specifications

Type of Transmission		A340E
Type of Engine		7M-GE
Gear Ratio	1st	2.804
	2nd	1.531
	3rd	1.000
	4th (Overdrive)	0.705
	Reverse	2.393
Fluid Volume		7.6 US qts. (7.2 liters, 6.3 Imp. qts.)
Type of Fluid		ATF type DEXRON® II

LOCATION OF ECT COMPONENTS

WIRING DIAGRAM



SHIFT AND LOCK-UP PATTERN

As shown in the chart below, the ECU is programmed to select the shift and lock-up pattern depending upon the driving mode and shift lever position (range).

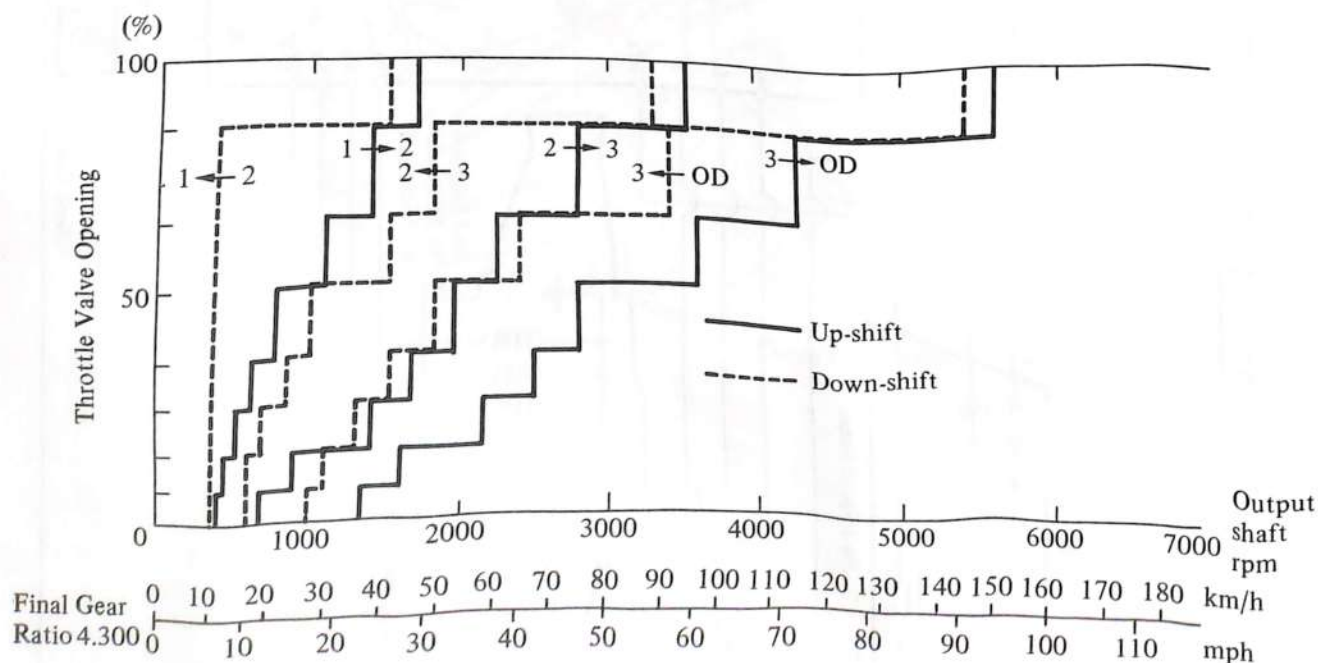
* See page TD-54

Driving Mode \ Range	"D" Range		"2" Range		"L" Range	
	Shift Pattern	* Lock-up Pattern	Shift Pattern	Lock-up Pattern	Shift Pattern	Lock-up Pattern
Normal	S-1	L-1	S-3	—	S-4	—
Power	S-2	L-2	↑	—	↑	—

NOTE: Lock-up is engaged in the 2nd, 3rd and OD gears in the D range. However, it will only begin to operate when the speed of the vehicle reaches the specified speed, which depends on the throttle opening.

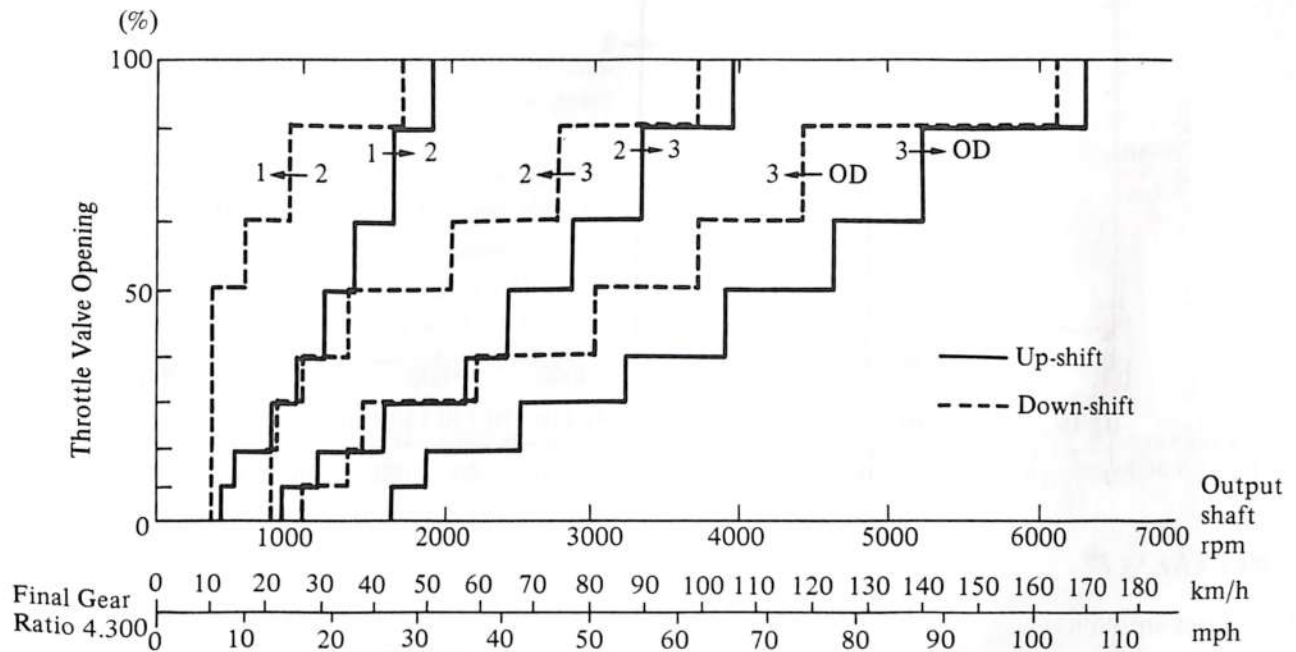
● "D" Range, Normal Mode (S-1 and L-1)

Suitable for city, suburban and highway driving, Providing both good fuel economy and good acceleration.



● “D” Range, Power Mode (S-2 and L-2)

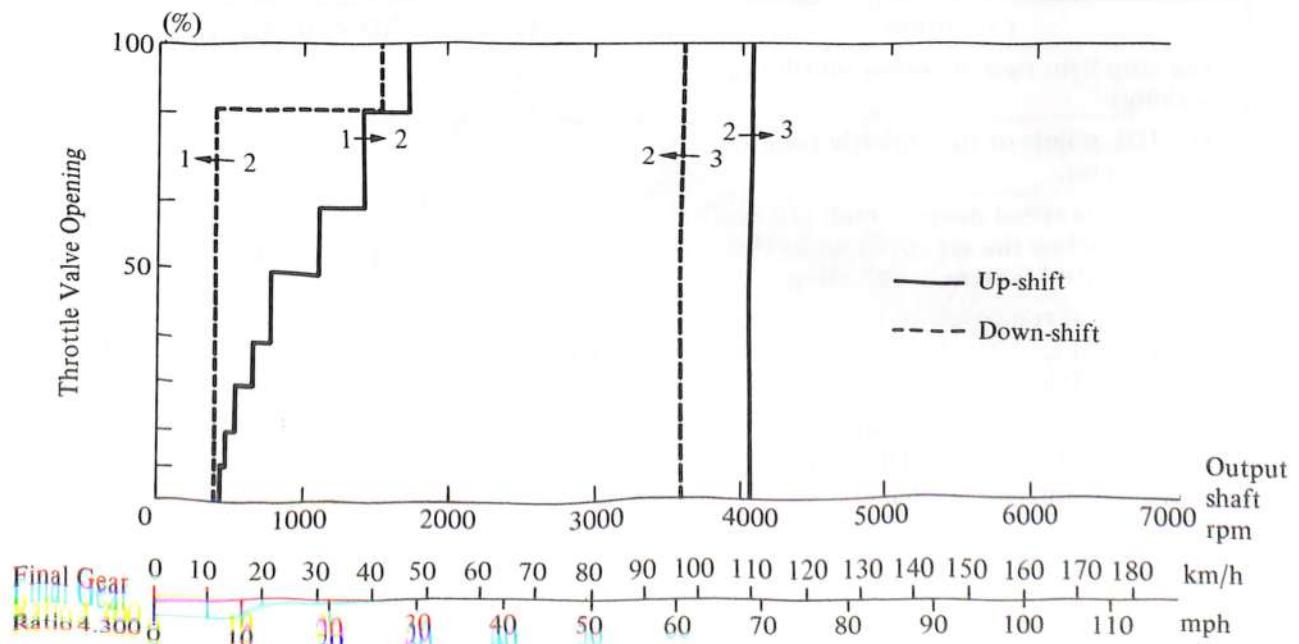
This is the best pattern for accelerating. For this reason, the speed at which the transmission up-shift or down-shift occurs is higher than in the Normal mode.



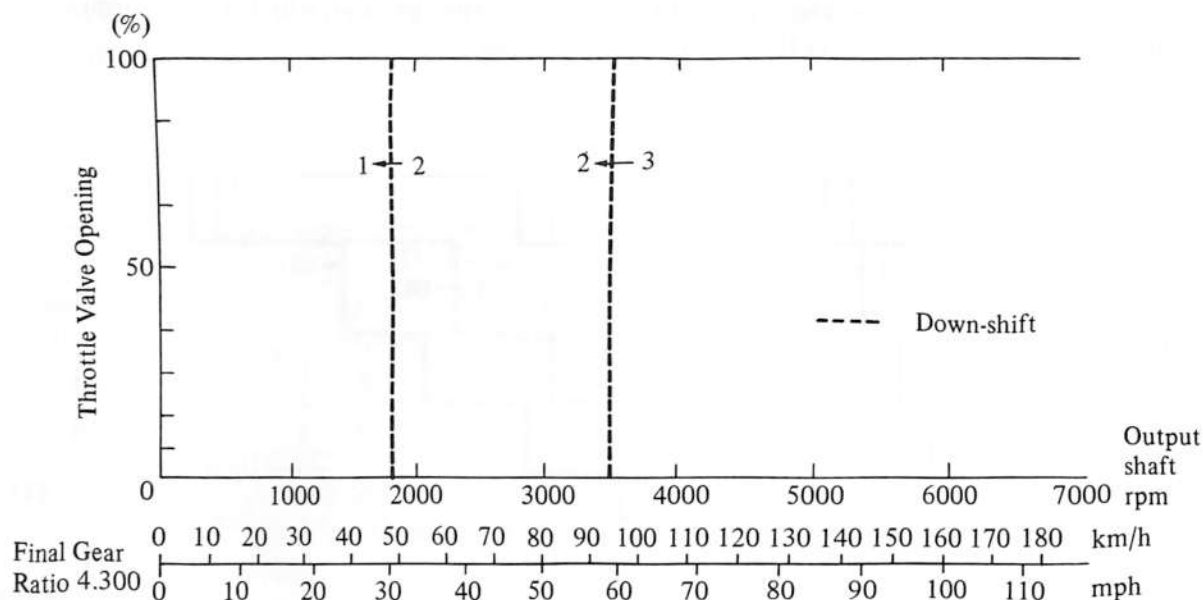
● “2” Range, Normal or Power Mode (S-3)

These are equivalent to 2 ranges in a conventional automatic transmission. The speed range covered is very wide, and this pattern has the added advantage of allowing engine braking when the vehicle is being driven on mountain roads.

However, to prevent the engine from over-running, the transmission automatically shifts into 3rd gear if the speed of the output shaft rises above 4,100 rpm.



● “L” Range, Normal or Power Mode (S-4)



– REFERENCE –

1. Lock-up Points

Gear	Driving Pattern	Lock-up Pattern	Lock-up mph (km/h)	
			Engaged	Disengaged
OD (D Range)	Normal	L-1	36 – 39 (58 – 62)	34 – 36 (55 – 58)
	Power	L-2	39 – 41 (63 – 66)	35 – 38 (57 – 61)

(Throttle opening: 5%)

2. Under the conditions listed below the operation of either or all the 3rd Gear, overdrive and lock-up clutch will be cancelled.

Condition	3rd Gear	Overdrive	Lock-up Clutch
The stop light switch comes on (during braking).	—	—	Released
The IDL points of the throttle position sensor close.	—	—	↑
The vehicle speed drops 6 mph (10 km/h) or more below the set speed while the cruise control system is operating.	—	Cancelled	↑
The coolant temperature falls below 90°F (35°C) and the vehicle speed drops below 25 mph (40 km/h).	Cancelled	↑	↑
The coolant temperature falls below 140°F (60°C) and the vehicle speed drops below 37 mph (60 km/h).	—	↑	↑

DIFFERENTIAL

LSD (Limited-Slip Differential)

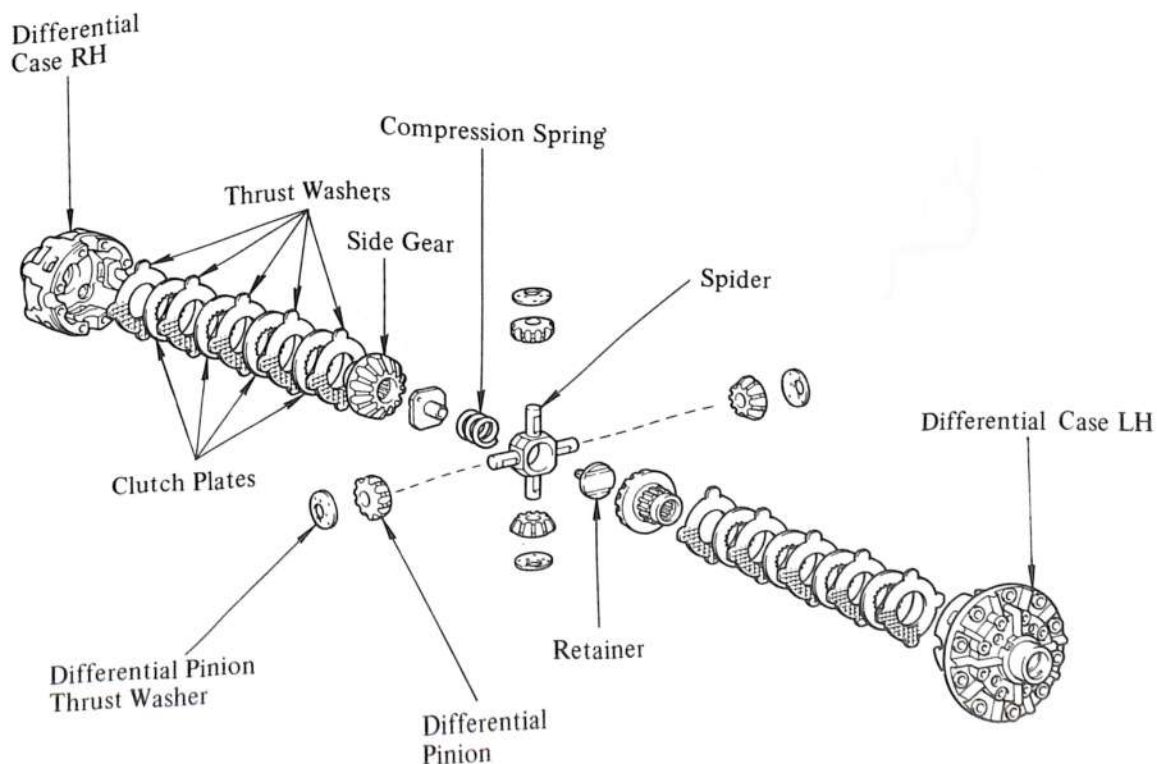
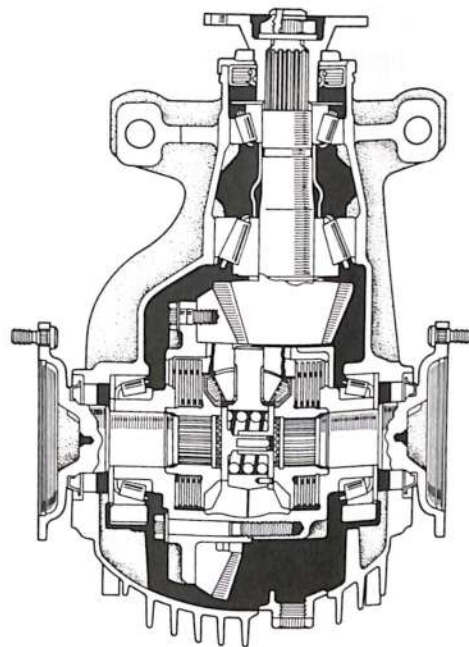
CONSTRUCTION

Thrust washers and clutch plates are mounted, in alternating sequence, between the side gears and the differential case.

Four projections of the thrust washers fit into the guide grooves of the differential case, and the clutch plates are splined to the side gears.

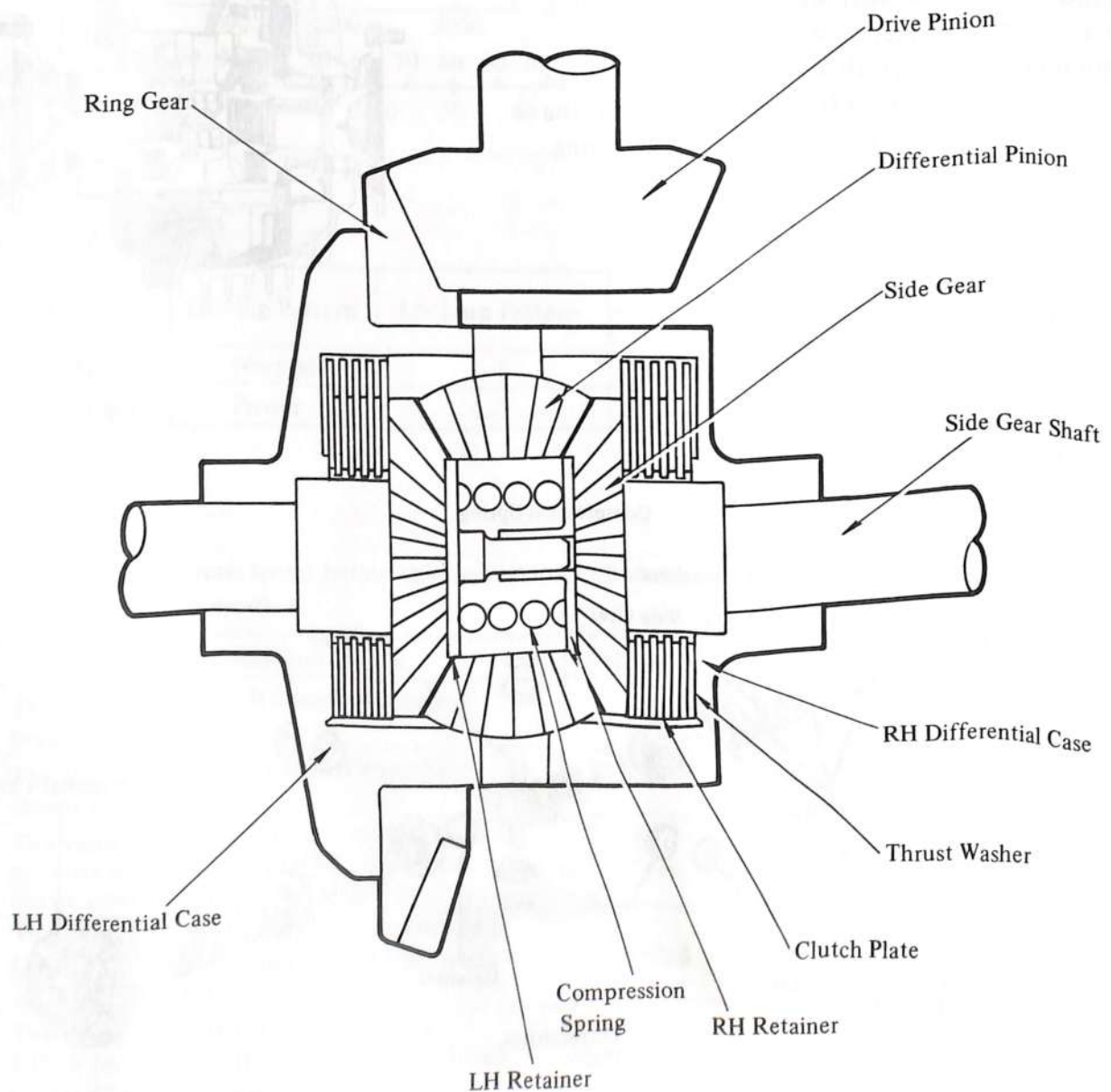
A barrel shaped compression spring is fitted between the left and right side gears to keep the thrust washers pressed up against the clutch plates via the retainers and side gears.

This means, in effect, that the side gears are kept pressed against the differential case (via the thrust washers and clutch plates) by the spring.



OPERATION

If there is a large difference in the rates at which the left and right wheels turn (as, for example, when the vehicle is cornering) a corresponding difference is produced in the rates at which the side gears and differential case turn. This difference would result in slippage between the thrust washers and clutch plates. Since these are pushed together by the spring, friction torque is created between the thrust washers and clutch plates (that is, between their surfaces, which are in direct contact with each other). This torque attempts to make the differential case and side gears rotate as a unit. This is called the "limited slip effect".



SUSPENSION

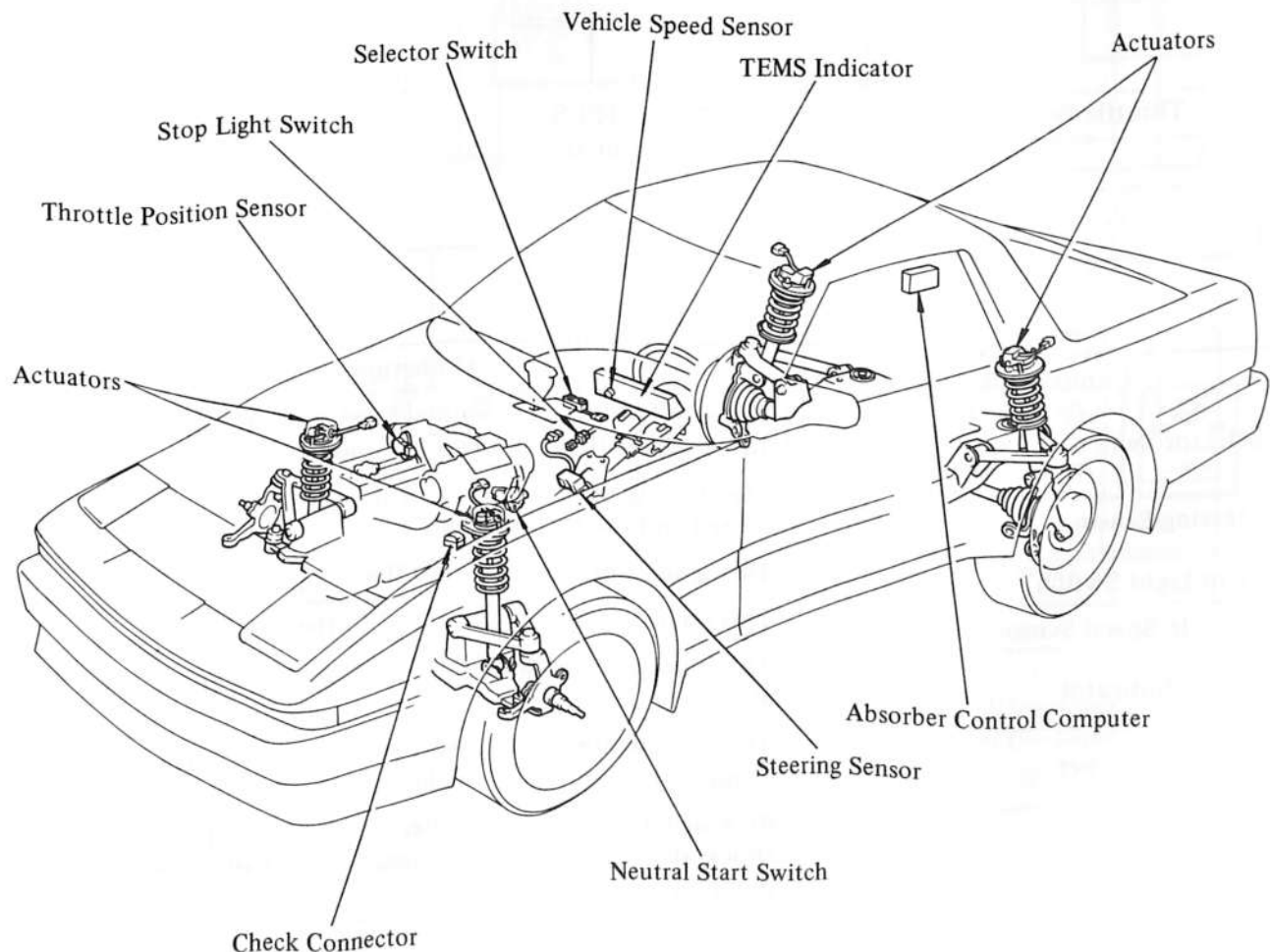
TEMS (Toyota Electronic Modulated Suspension)

This is a system in which the damping force of the 4 shock absorbers is changed automatically depending on the driving conditions and which delivers superb riding comfort and better driving stability.

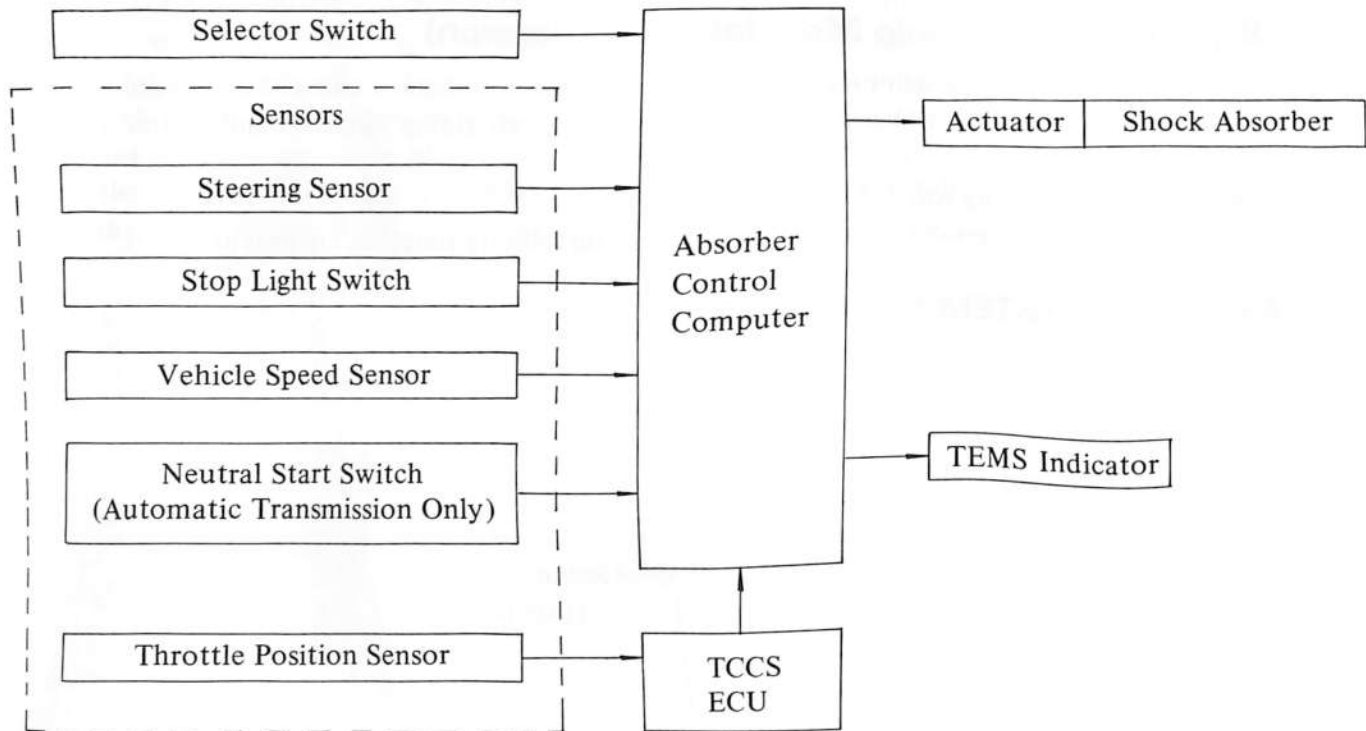
The shock absorbers' damping force changes in 3 stages.

Also, the driver can select 2 modes. A diagnosis system and fail-safe function are also included.

LOCATION OF SYSTEM COMPONENTS

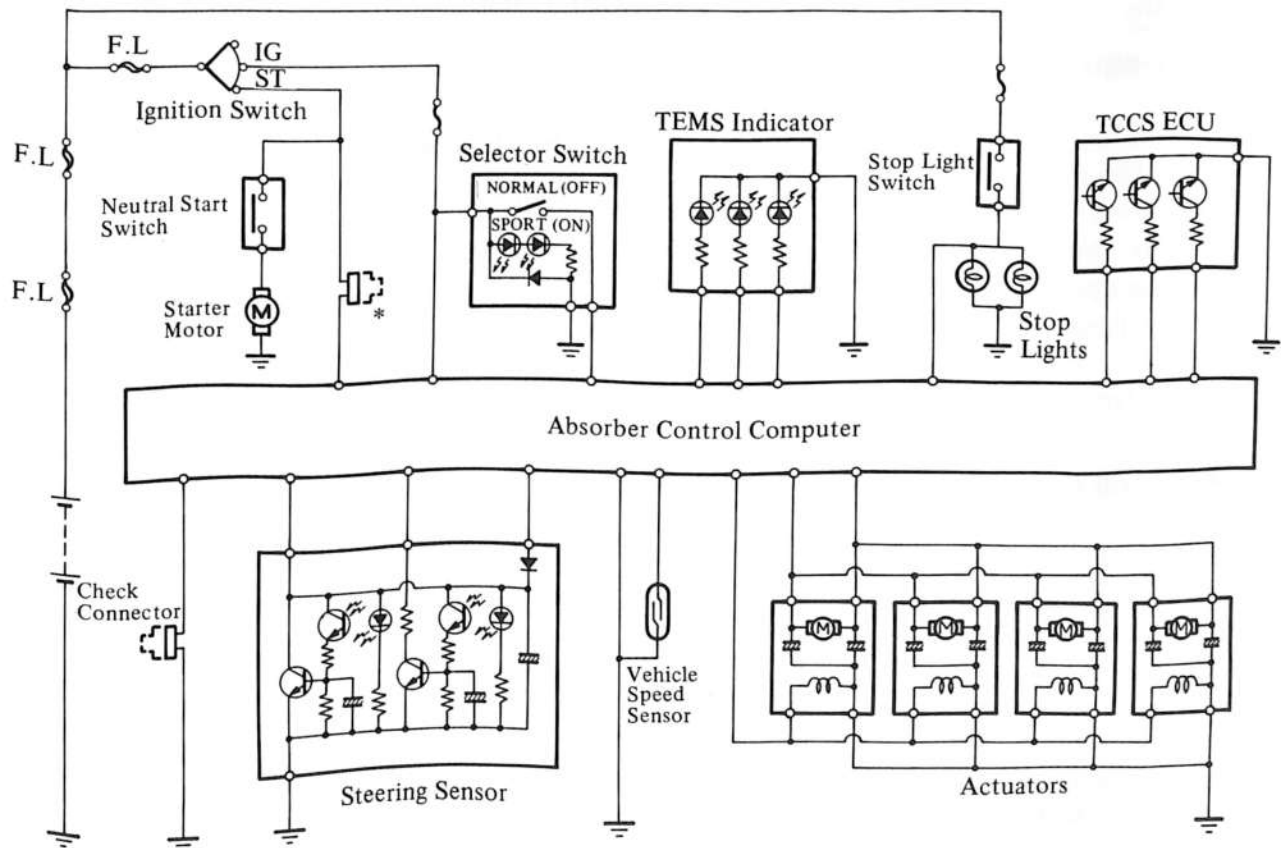


FUNCTION OF COMPONENTS



Component	Function
Selector Switch	There are 2 buttons, "Normal" and "Sport", by which the driver selects the damping force mode.
Steering Sensor	This detects the direction in which the steering wheel is turned and the turning angle.
Stop Light Switch	This sends a braking signal to the computer.
Vehicle Speed Sensor	This sends a vehicle speed signal to the computer.
TEMS Indicator	This indicates the damping force conditions of the shock absorbers.
Shock Absorber	These shock absorbers have a built-in rotary valve which changes the damping force in 3 stages.
Actuator	By a signal from the computer, the actuator drives the shock absorber control rod (rotary valve) and changes the damping force.
Absorber Control Computer	This computer uses signals from each sensor and controls the shock absorber damping force according to the mode selected.
Throttle Position Sensor	This detects the throttle valve opening angle and sends signals to the absorber control computer through the TCCS ECU.
Neutral Start Switch (Automatic Transmission only)	This sends signals to the computer that the shift position is the "N" or "P" range.

WIRING DIAGRAM



M/T— Open
 * A/T— Short

CONTROL SYSTEM

The computer carries out the following controls in accordance with signals from each sensor. When the computer concludes from the signals sent to it by even one control system that the damping force of the shock absorbers should be Firm (or Medium), the computer will maintain the damping force in Firm (or Medium).

1. Normal Driving

The damping force is determined according to which mode the selector switch is in. When the switch is Normal, the damping force is Soft and when the switch is Sport, the damping force is Medium.

2. Anti-squat Control

In order to reduce squat during starting or during sudden acceleration, when the vehicle speed is below 13 mph (20 km/h), and either the throttle valve opening angle becomes large or the throttle valve opening speed is high, the damping force is changed to Firm. After about 3 seconds, or the vehicle speed reaches 31 mph (50 km/h), the damping force returns to its previous level.

RELEVANT SENSOR

Vehicle Speed Sensor
Throttle Position Sensor

	Selector Switch	
	NORMAL	SPORT
Shock Absorber Damping Force	Soft ↓ Firm	Medium ↓ Firm

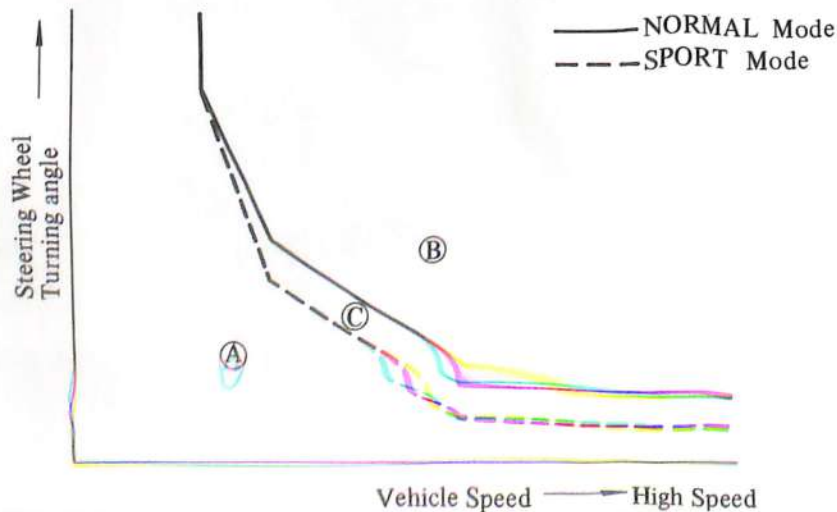
3. Anti-roll Control

The control system works to check body roll when cornering or driving "S" curves. In the graph of vehicle speed and steering wheel turning angle below, when the damping force change line is crossed (when the speed and angle change from A → C → B with the selector switch in "Normal" or when they change from A → C → B with the selector switch in "Sport"), the damping force changes to Firm. Then, about 2 seconds later, the damping force returns to the previous level. However, turning the steering wheel even more or turning the steering wheel sharply left and right while the damping force is Firm, lengthens the time the damping force is kept in Firm.

RELEVANT SENSOR

Vehicle Speed Sensor
Steering Sensor

	Selector Switch	
	NORMAL	SPORT
Shock Absorber Damping Force	Soft ↓ Firm	Medium ↓ Firm



4. Anti-dive Control

This control system works to reduce nose dive during braking.

When the stop light switch (brake lights) goes on with the vehicle speed is above 37 mph (60 km/h), the damping force changes to Firm. About 2 seconds after the stop light switch goes off, the damping force returns to the previous level.

RELEVANT SENSOR		
Vehicle Speed Sensor Stop Light Switch		
	Selector Switch	
	NORMAL	SPORT
Shock Absorber Damping Force	Soft ↓ Firm	Medium ↓ Firm

5. Anti-shift Squat Control (Automatic Transmission Only)

This control system works to suppress vehicle squat when the automatic transmission is engaged from a standing start.

When the vehicle speed is below 6 mph (10 km/h) and the shift position is "N" or "P", the damping force changes to Large.

Then about 5 seconds after the transmission is shifted out of "N" or "P", or when the vehicle speed reaches 9 mph (15 km/h), the damping force returns to the previous level.

RELEVANT SENSOR		
Vehicle Speed Sensor Neutral Start Switch		
	Selector Switch	
	NORMAL	SPORT
Shock Absorber Damping Force	Soft ↓ Firm	Medium ↓ Firm

6. High Speed Sensing Control

This control system works to raise stability when driving at high speeds. When the vehicle speed is above 75 mph (120 km/h), the damping force changes to Medium. Then when the vehicle's speed drops below 62 mph (100 km/h), the damping force returns to the previous level. When the Sport mode is used, the damping force does not change.

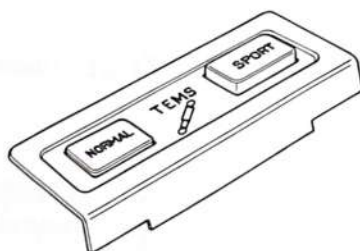
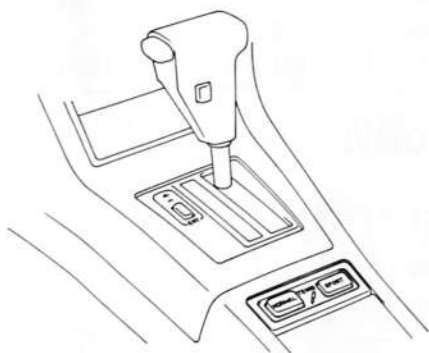
RELEVANT SENSOR		
Vehicle Speed Sensor		
	Selector Switch	
	NORMAL	SPORT
Shock Absorber Damping Force	Soft ↓ Medium	Medium

CONSTRUCTION AND OPERATION OF MAIN COMPONENTS

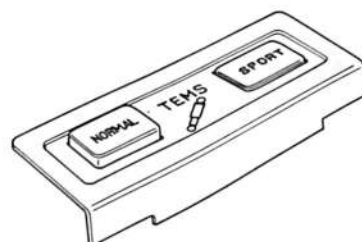
1. Selector Switch

The selector switch is installed in the center console and is used by the driver to select the damping force mode.

With this switch, two modes, Normal and Sport, can be selected.



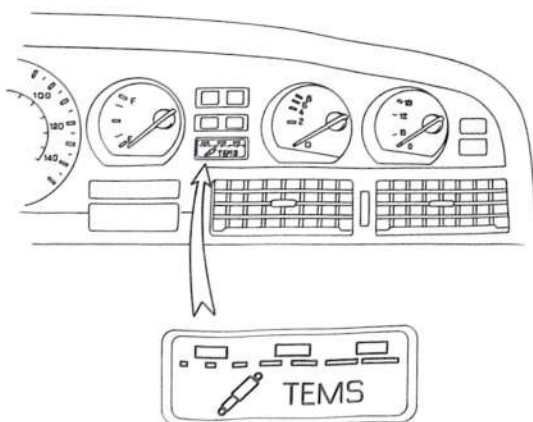
Normal Mode

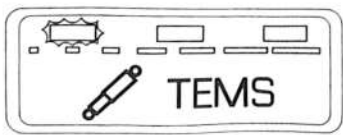
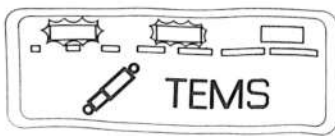
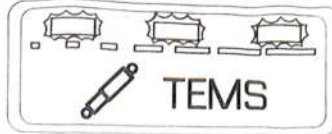


Sport Mode

2. TEMS Indicator

This indicator displays the shock absorber damping force condition, and is built into the combination meter. This indicator is also used as an indicator for the diagnosis and for the fail-safe function. For about 2 seconds after the ignition switch is turned on, all 3 indicator lamps light up as a check for burned out lamps.

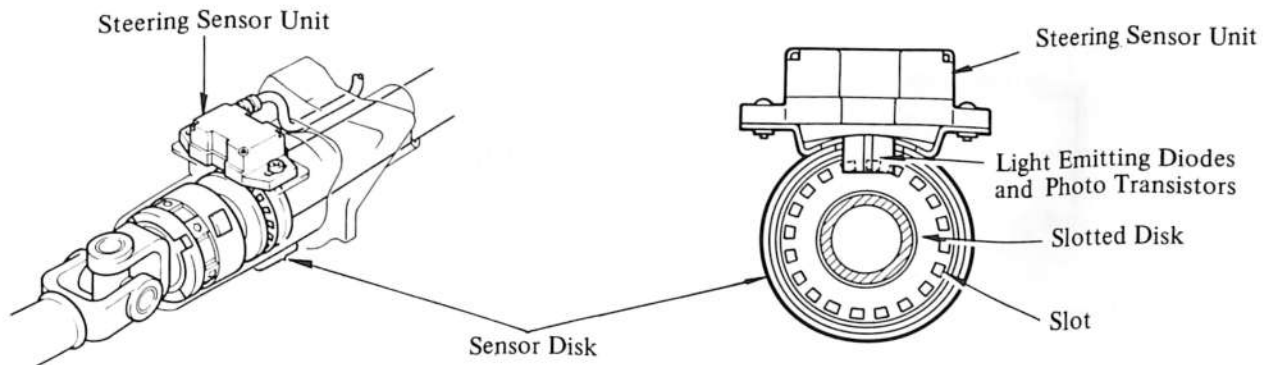


Shock Absorber Damping Force	TEMS Indicator
Soft	 TEMS
Medium	 TEMS
Firm	 TEMS

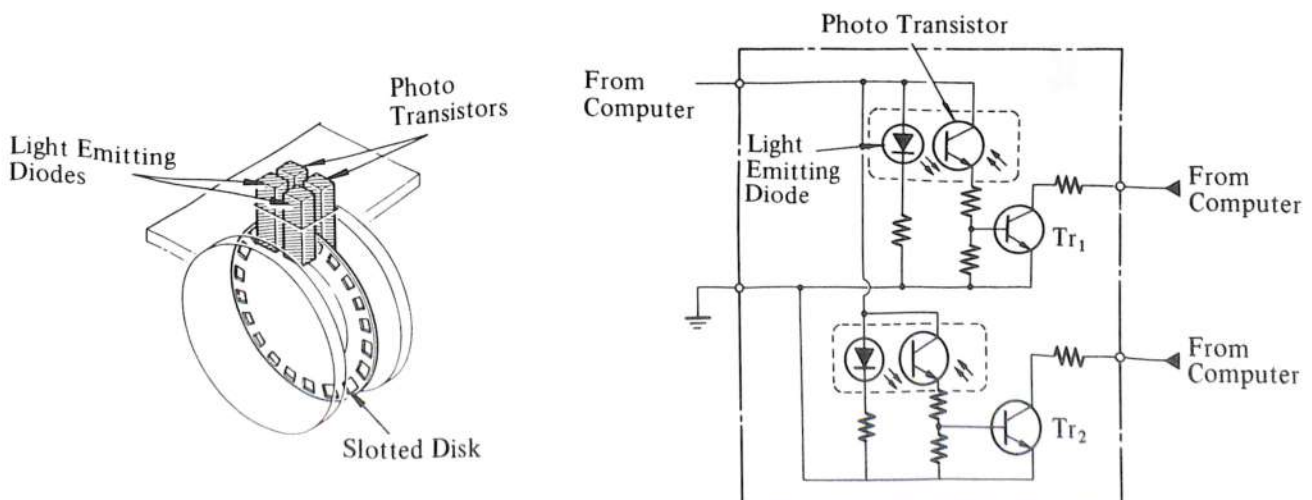
3. Steering Sensor

This sensor detects the steering wheel turning angle and the turning direction. It is composed of a steering sensor unit and a sensor disk. The steering sensor unit is fixed on the steering column tube and has two light emitting diodes and photo transistors. The sensor disk is fixed on the steering main shaft and turns with it.

The sensor disk includes a slotted disk which has 20 slots around its circumference. The slotted portion of the disk lies between the two light emitting diodes and two photo transistors, of the steering sensor unit.

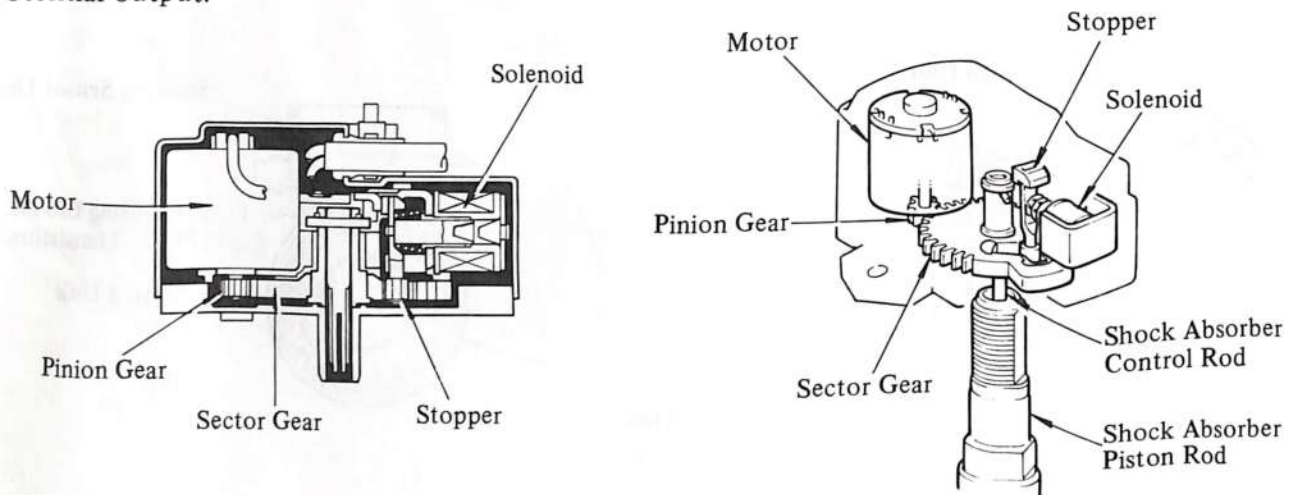


When the steering wheel is turned, the slotted disk in the sensor disk also turns. Light from the light emitting diodes is alternately cut off and passed as the slots pass by them. The photo transistors pick up the on and off light pattern. The computer senses these on-off conditions, and the steering wheel turning angle and turning direction are detected.



4. Actuator

This device drives the control rod of the shock absorber by means of a motor and is installed on top of the shock absorber. The motor is a series motor which has a low starting current. This gives it very fast response to the signals from the absorber control computer, and makes it capable of repeated operation. The 4 motors, each installed on one of the shock absorbers, are connected in parallel and all four operate at the same time. The motors are activated by the computer for about 0.15 seconds at a time. Also, the computer controls the turning direction of the motors, by reversing its electric potential output.

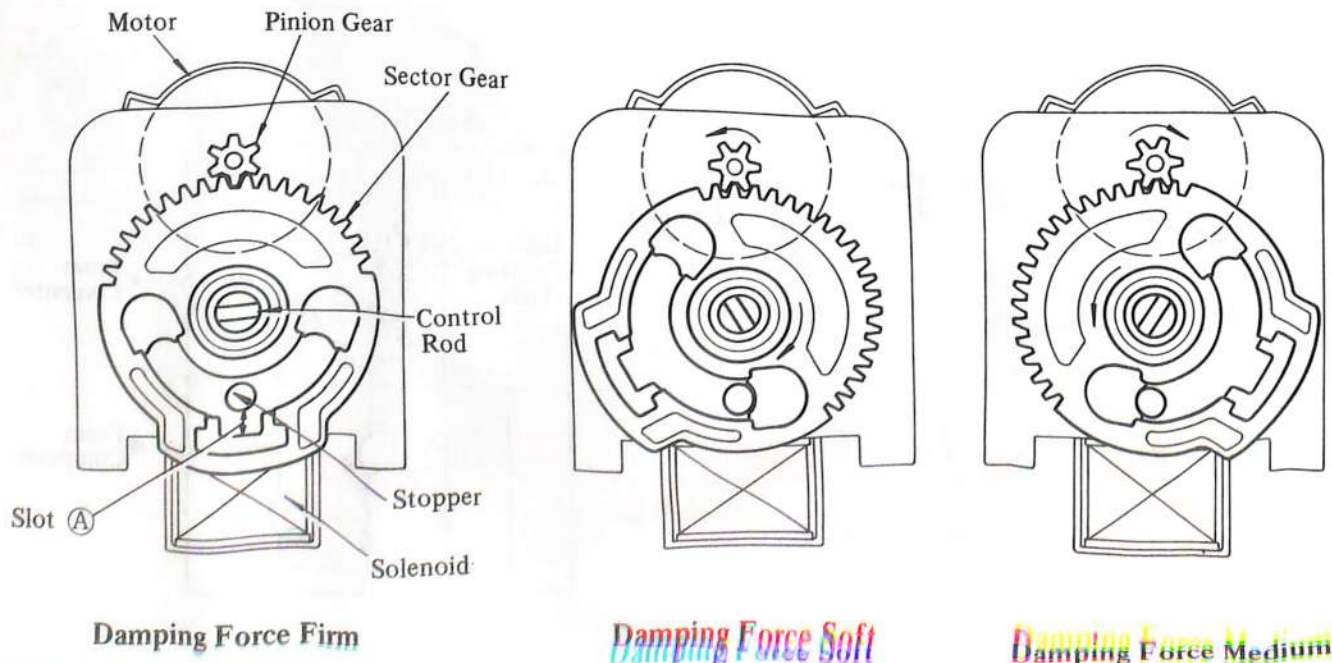


OPERATION

When the motors are turned by current from the computer, the sector gear is turned by the pinion gear on the end of the motors. This causes the control rod of the shock absorber which is connected to the center of the sector gear, to turn changing the damping force of the shock absorber.

When the damping force is changed to Medium or Soft, the sector gear is turned until it comes to the stopper.

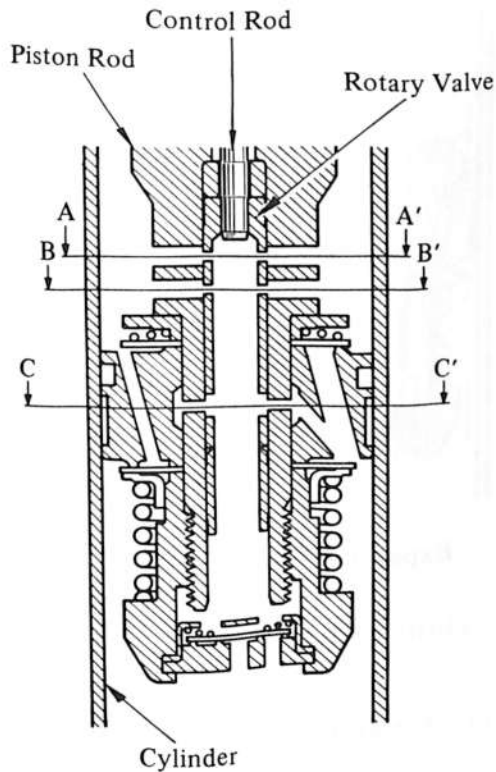
When the damping force is changed to Firm from Medium or Soft, the stopper is attracted by the solenoid, and the sector gear is turned and stopped at the position in which the stopper engages in slot (A) in the sector gear.



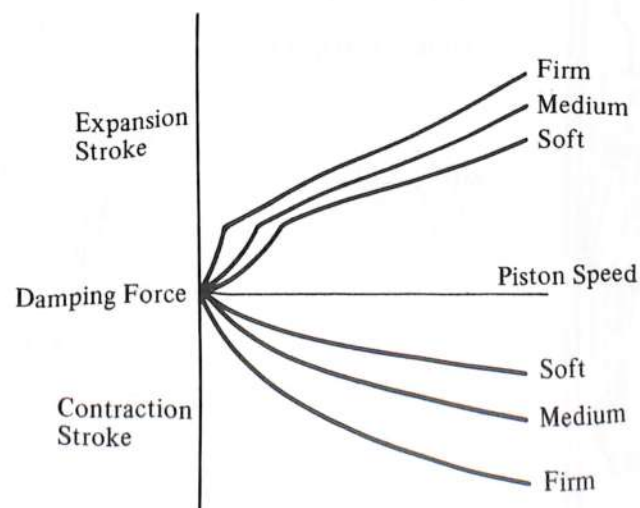
NOTE: The actuator as viewed from below.

5. Shock Absorber

The mechanism and operation of the shock absorber are basically the same as with the conventional type. It differs from ordinary shock absorbers in that the damping force can be regulated by opening and closing additional orifices. The piston rod and the rotary valve, which turns as one unit with the control rod, have the orifices at three levels, as shown in the figure below. By turning the rotary valve, the orifices are opened and closed, as shown in the chart below, and the damping force is changed in three stages.



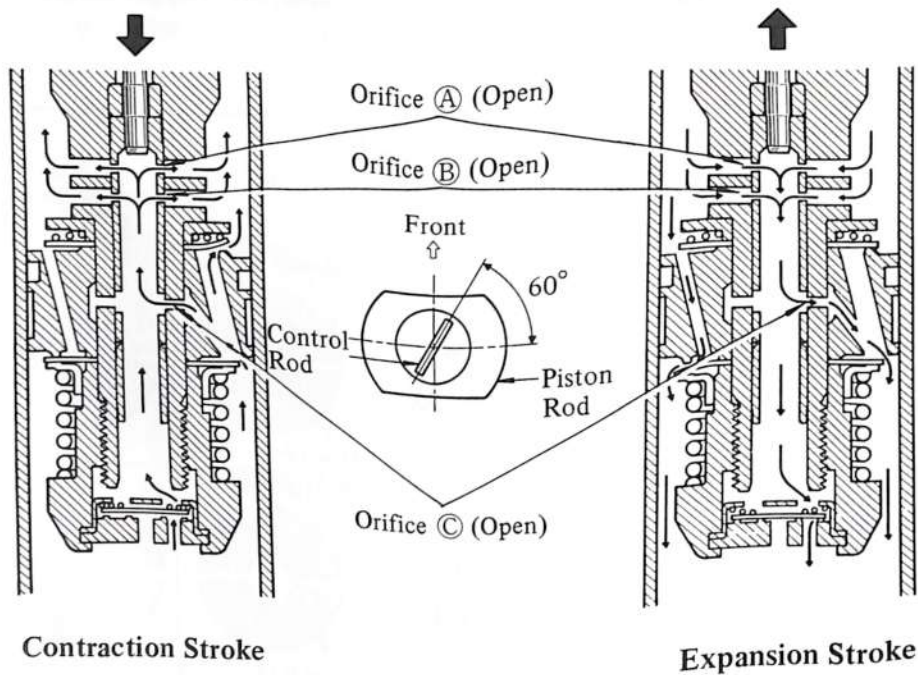
Damping Force Cross Section	Soft	Medium	Firm
A – A' Orifice (A)			
B – B' Orifice (B)			
C – C' Orifice (C)			



OPERATION

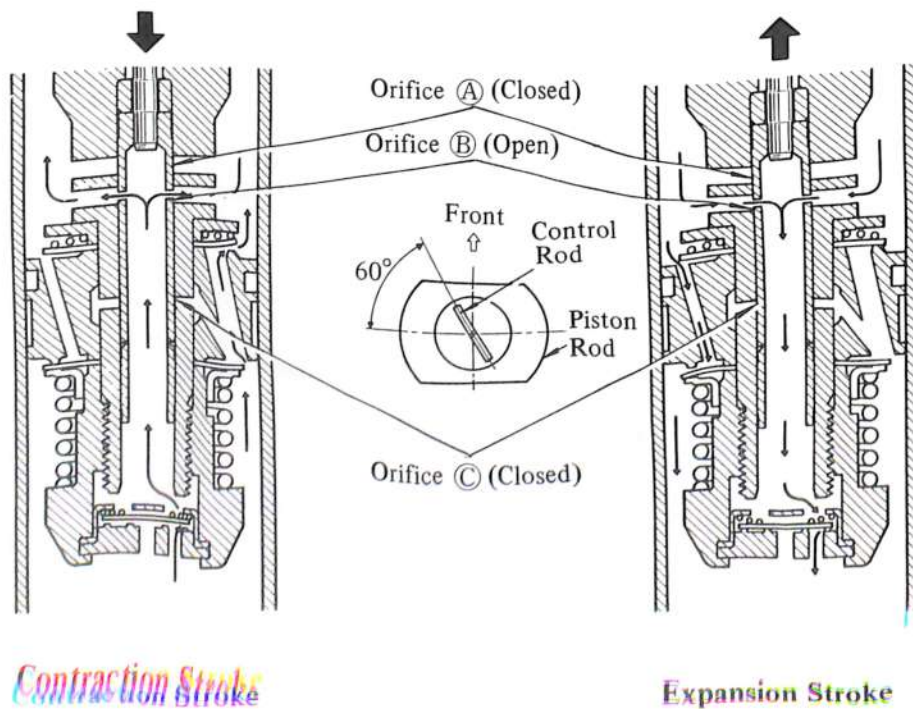
1) Soft Damping Force

All three orifices are open, and oil flow is as shown in the figure below.



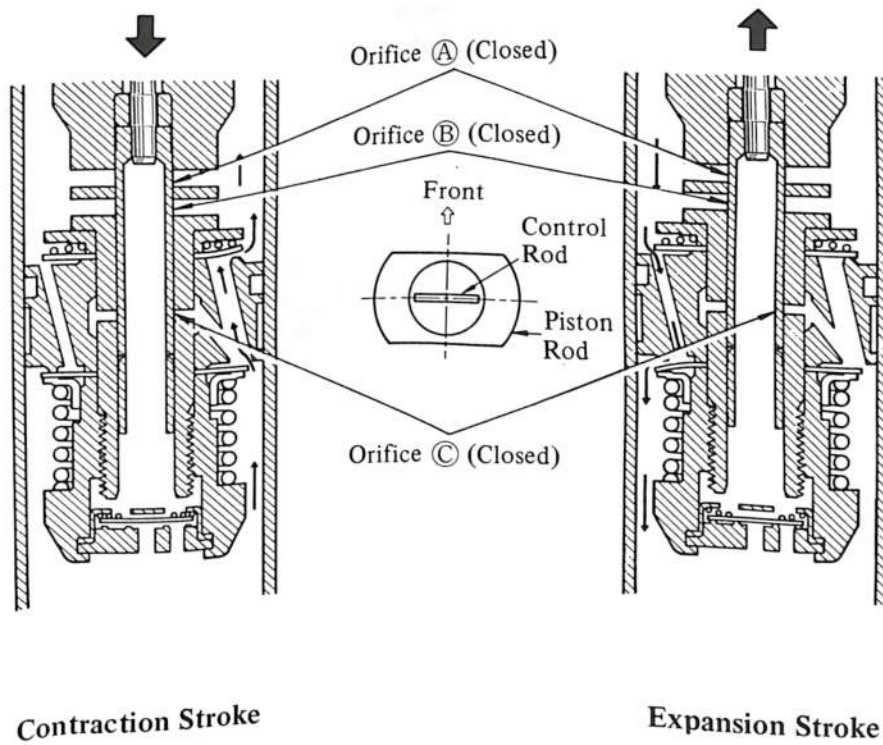
2) Medium Damping Force

Orifice (B) is open and orifices (A) and (C) are closed. Oil flow is as shown in the figure below.



3) Firm Damping Force

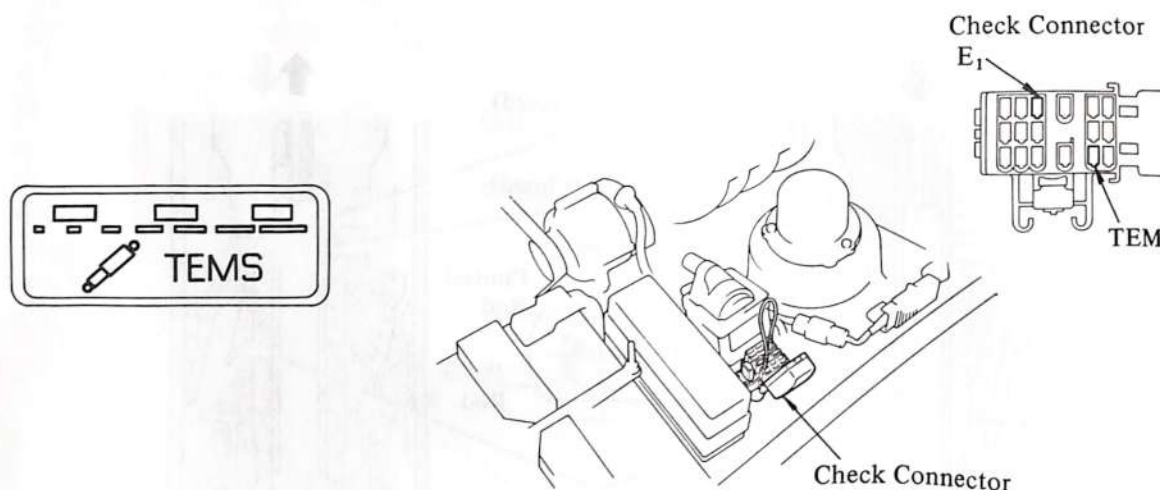
All three orifices are closed. Oil flow is as shown in the figure below.



6. Diagnosis

By connecting the TEM and E₁ terminals in the check connector, the steering sensor circuit and the damping force can be checked.

Results of the check are displayed on the TEMS indicator in the combination meter.

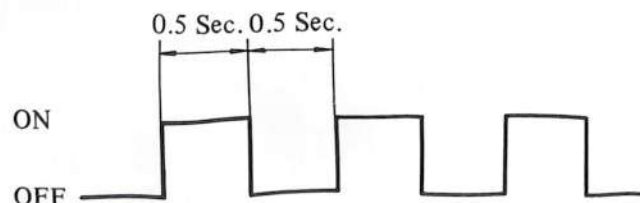


1) Steering Sensor Circuit Check System

With this check system, the steering sensor and steering sensor circuits' condition can be checked. When the Normal selector switch is pressed after the ignition switch is turned on, with the TEM and E₁ check terminals connected, if the following results are output in accordance with the steering wheel position, then the circuit is normal.

Steering Wheel Position	TEMS Indicator		
	Left	Center	Right
Turned to the left more than 45°.	Blink	OFF	OFF
Turned to the right more than 45°.	OFF	OFF	Blink
In the straight ahead position.	Blink	OFF	Blink

The indicator will blink once every 1.0 second.



2) Shock Absorber Damping Force Check

When the TEM and E₁ check terminals are connected and the ignition switch turned on, the actuators' position can be set at a Soft or Firm depending on the selector switch position. At this time, the damping force can be checked by rocking the body.

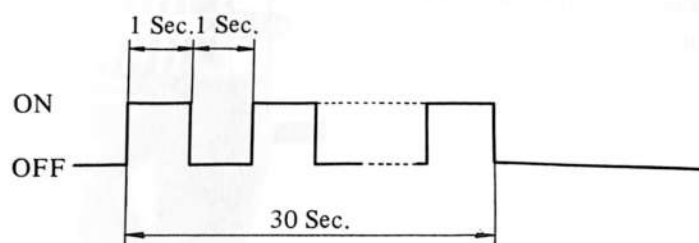
Selector Switch	Actuator	TEMS Indicator
NORMAL	Set at Soft	Differs depending on the steering wheel turning angle (Refer to the table in 1) above.)
SPORT	Set at Firm	All 3 lamps light up.

7. Fail-safe Function

If an abnormality occurs with the actuator circuit, current flowing to the actuators stops and the TEMS indicator comes on informing the driver that trouble has occurred.

- When the actuator is shorted.

The center lamp of the TEMS indicator flashes at 1 second intervals for about 30 seconds, then goes off. Then at that time, the left and right indicator lamps of the TEMS indicator go off.

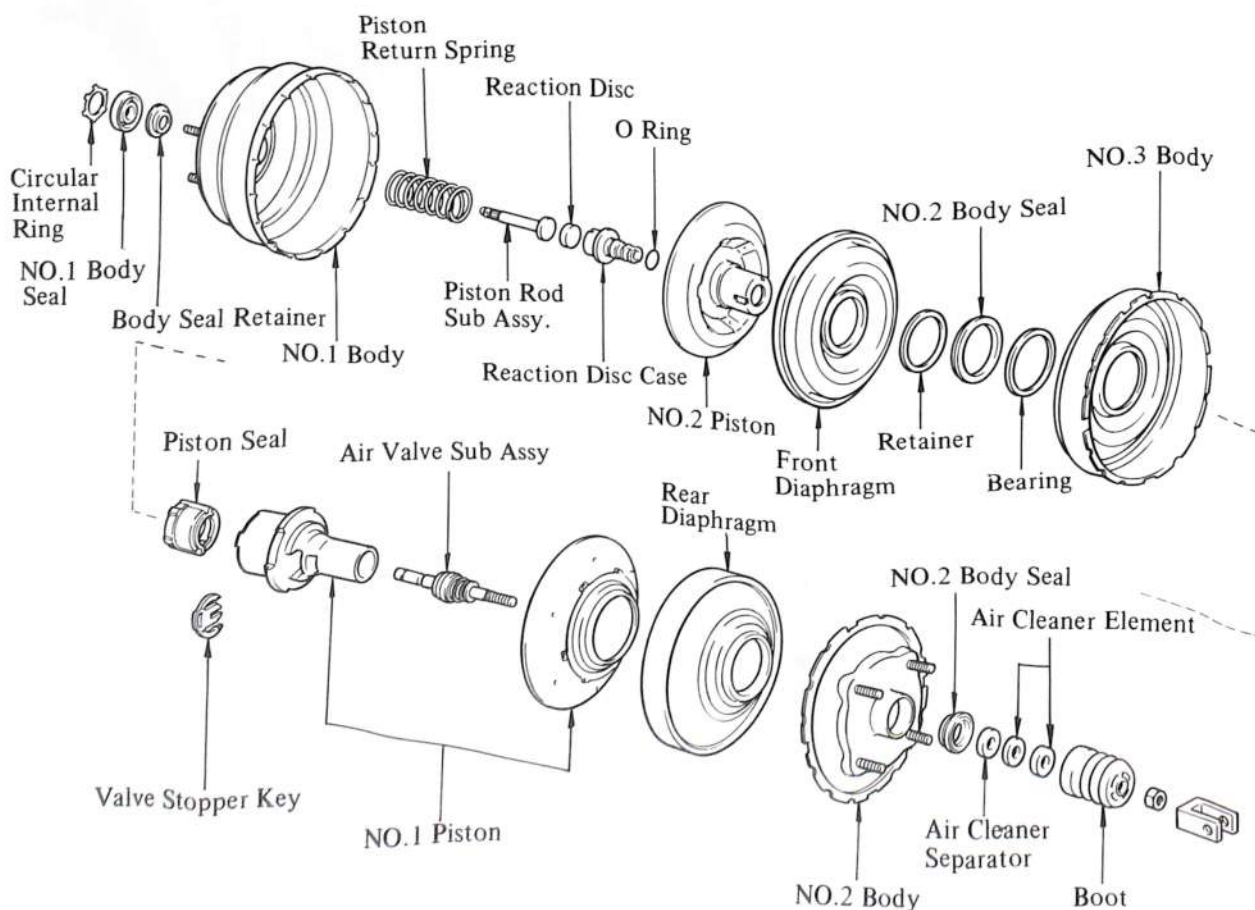
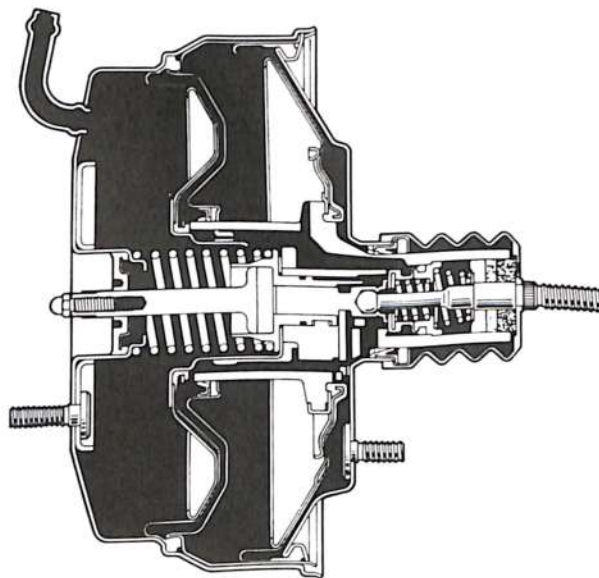


BRAKES

TANDEM TYPE BRAKE BOOSTER

The tandem type brake booster is a compact and extremely powerful unit having two vacuum chambers (8 inch diameter in the front, 9 inch diameter in the rear).

Basically, it is built and operates the same as the conventional 7.5-inch tandem type brake booster. The air passage connecting the front and rear variable pressure chambers has been moved from outside to inside of the piston.

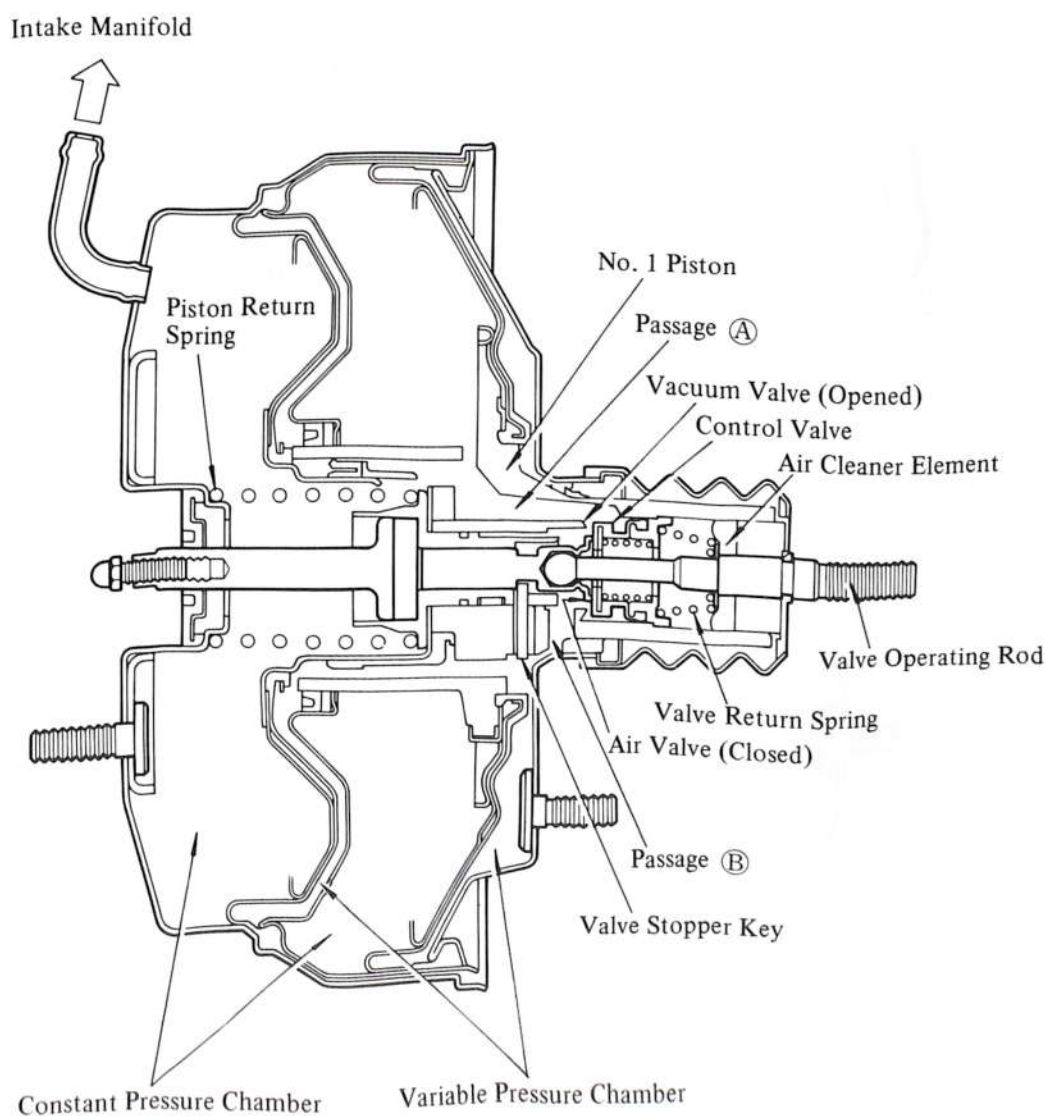


OPERATION

Non-operating State

When there is no force on the valve operating rod, the air valve and valve operating rod are pushed to the right by the tension of the valve return spring and stop when they make contact with the valve stopper key. At this time, since the air valve pushes the control valve back toward the right, the passage, through which atmospheric air from the air cleaner element enters the booster, is closed. On the other hand, the vacuum valve and the control valve are separated, so passage ① leads to passage ②.

Therefore, both the constant pressure chamber and the variable pressure chamber conduct air and there is no difference in the pressure in the chambers on both sides of the piston.

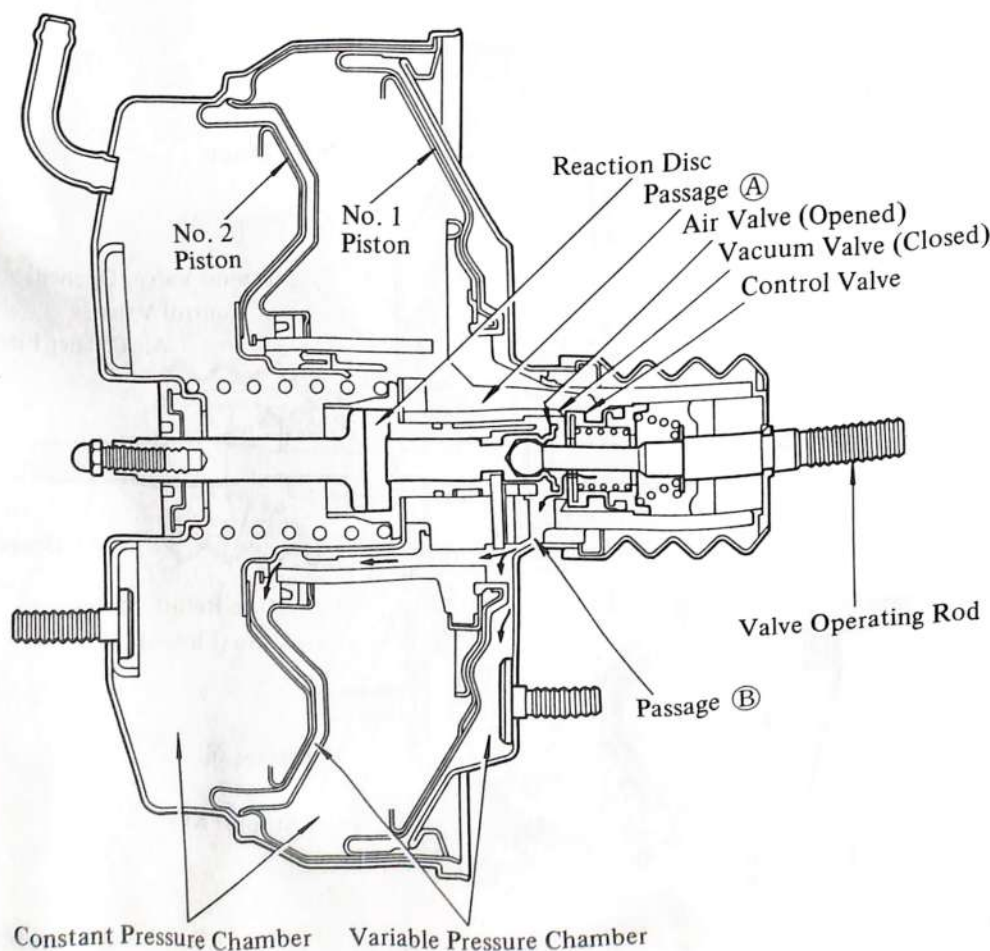


Operating State

When the brake pedal is depressed, the valve operating rod and air valve are pushed to the left together. As a result, first, the control valve and vacuum valve are in contact cutting off the continuity between passage ① and ② (the continuity between constant pressure chamber and variable pressure chamber).

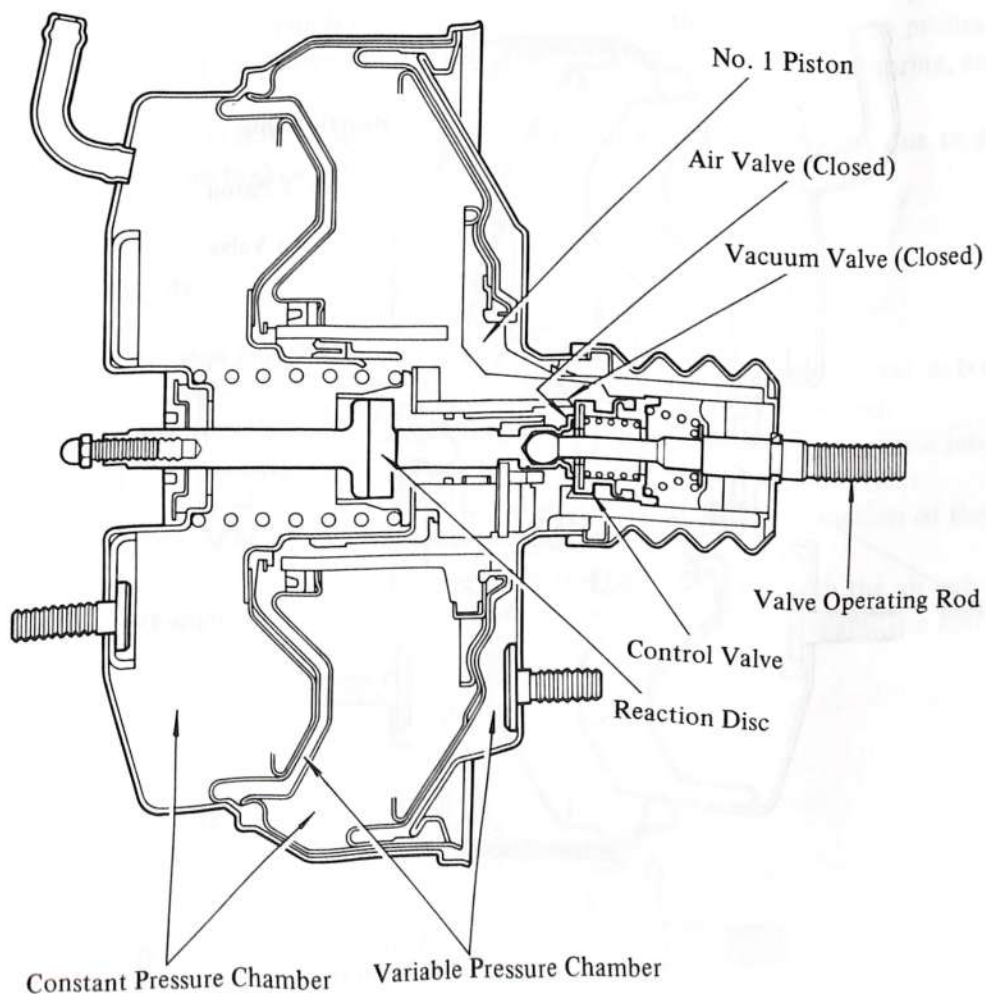
Next, the air valve is separated from the control valve and atmospheric air from the air cleaner element passes through passage ② and enters the variable pressure chamber. This generates a pressure difference between the variable pressure chamber and the constant pressure chamber and the pistons move to the left.

The piston force, occurring due to the pressure difference, is transmitted to the reaction disc via the reaction disc case. It is further transmitted to the master cylinder push rod and forms the booster output force. The pressure contact area of pistons No. 1 and No. 2, multiplied by the pressure difference between the constant pressure chamber and variable pressure chamber, equals the booster output force.



Holding State

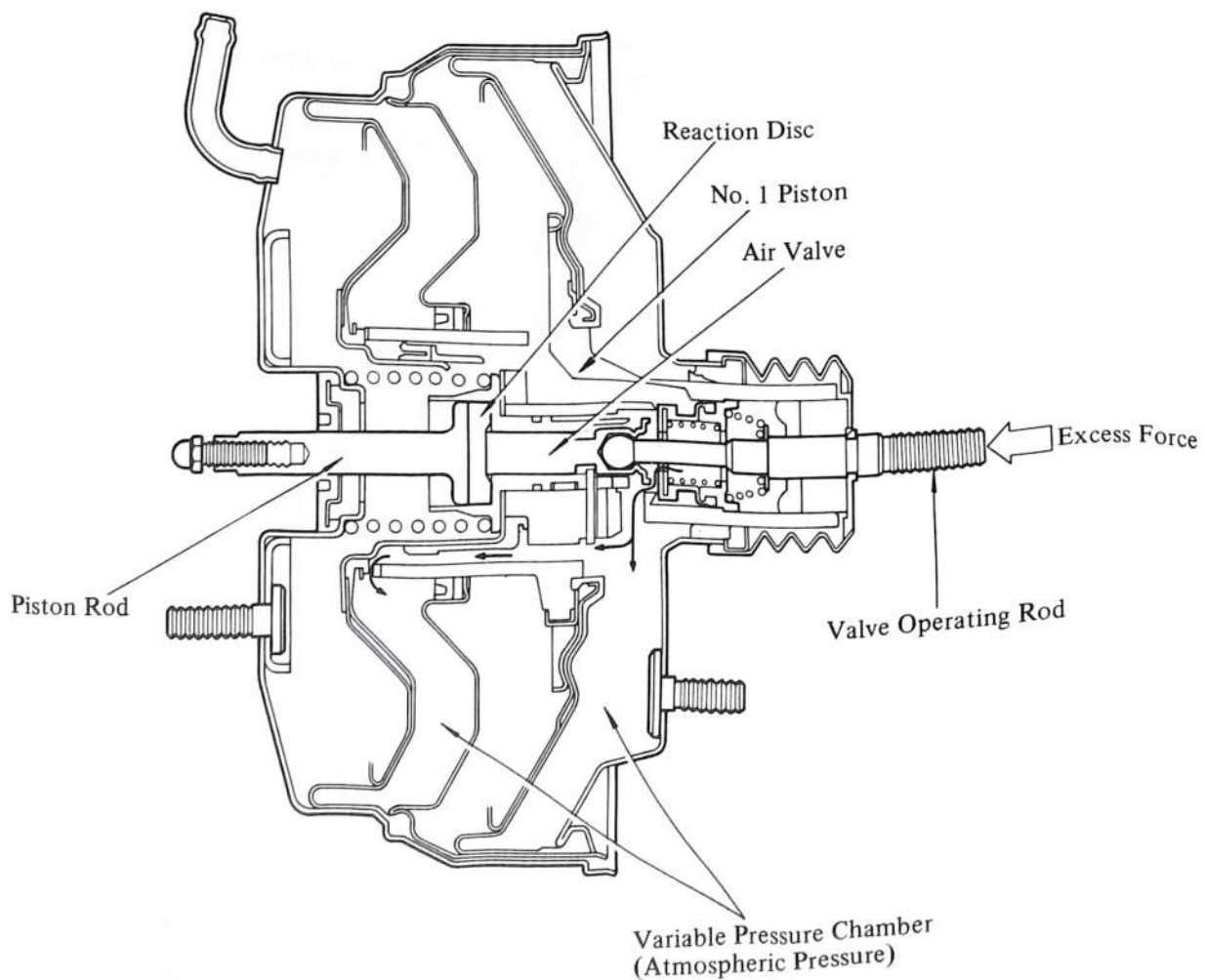
When the brake pedal is depressed, the force applied on the air valve via the valve operating rod and the force on the piston, resulting from the pressure difference (between the constant pressure chamber and variable pressure chamber) will push the reaction disc. Consequently, the central portion of the reaction disc (portion touching the air valve) is pushed back. If the air valve has a balanced pressure on it, the control valve will be making contact with the air valve and vacuum valve.



Maximum Boosting State

When a greater pressure is applied to the brake pedal, the variable pressure chamber will be fully supplied with atmospheric pressure and the pressure difference applied on the piston will be at maximum. Any force exceeding this will not have an effect on the piston operation.

If the brake pedal is depressed even further, there will no longer be a balance between the reaction disc and air valve, so the excess force will then be applied on the piston rod.



Released State

As pedal pressure is reduced, the reaction disc and air valve will no longer be balanced so the air valve will be pushed back toward the right, making contact with the control valve and shutting off the variable pressure chamber from entry of atmospheric air. At the same time, it will push back the control valve and open the vacuum valve.

Consequently, the air in the variable pressure chamber will be drawn into the constant pressure chamber, cancelling out the pressure difference between the two. The piston assembly will be pushed back to a non-operating state by the piston return spring.

No Vacuum Condition

In this case, both the constant pressure chamber and variable pressure chamber are supplied with atmospheric air.

If the brake pedal is depressed, the valve operating rod pushes the air valve and moves to the left, making contact with the reaction disc. The reaction disc pushes against the master cylinder push rod which, in turn, pushes the master cylinder piston. At this time, the air valve also pushes the valve stopper key fitted in the No. 1 piston, overcoming the tension of the piston return spring, and pushing the piston assembly toward the left.

Of course, there is no booster action at this time, but since fluid pressure occurs due to the master cylinder piston being pushed, the brakes will function.

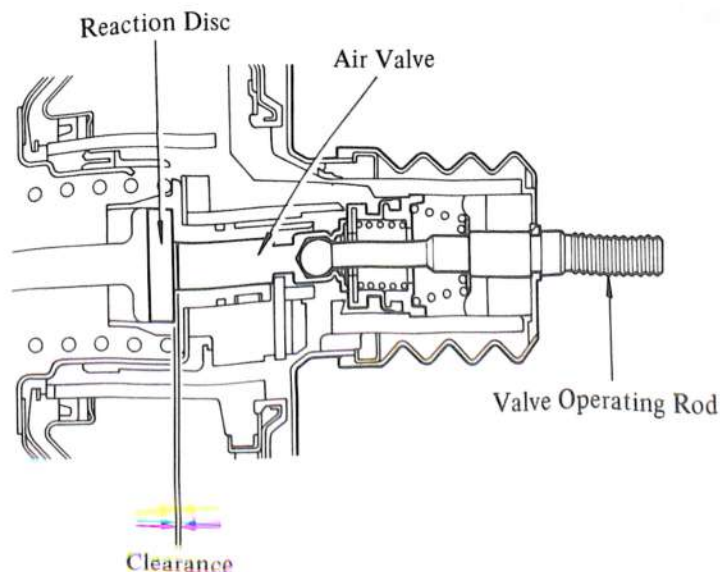
Dynamic Booster Action

During a non-operating state, due to a clearance between the reaction disc and air valve, booster output power will occur to a certain point, regardless of force on the valve operating rod.

In other words, the instant the vacuum valve closes and the air valve opens, No. 1 piston moves to the left, producing booster output force so that the force on the operating rod has no effect.

Consequently, there is little reaction force on the operating rod. At the termination of the dynamic action, the reaction disc and air valve are in contact with each other.

The force on the valve operating rod is transmitted to the reaction disc, through the air valve. Therefore, force on the piston rod is the sum of the assist force occurring in the piston and the force applied to the operating rod.



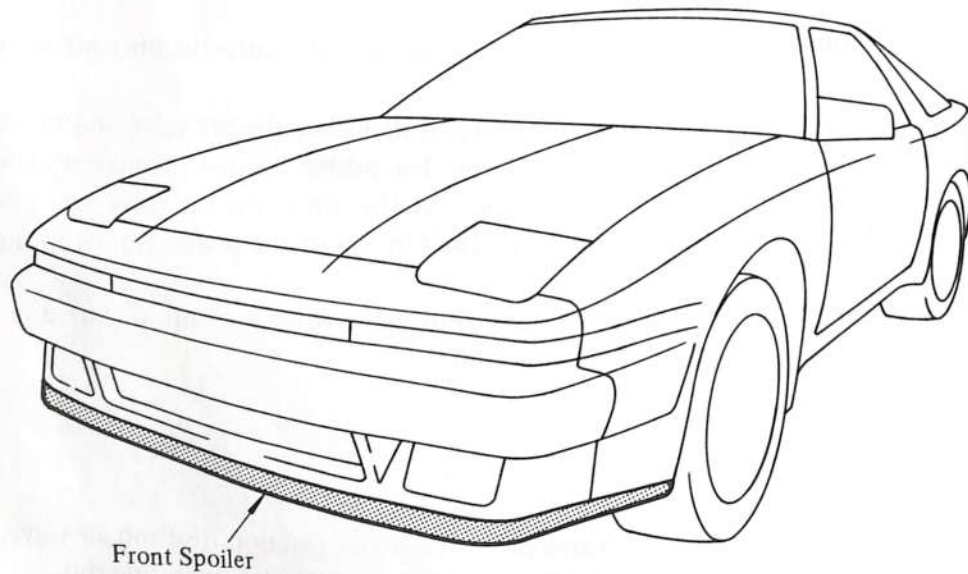
BODY

AERODYNAMICS

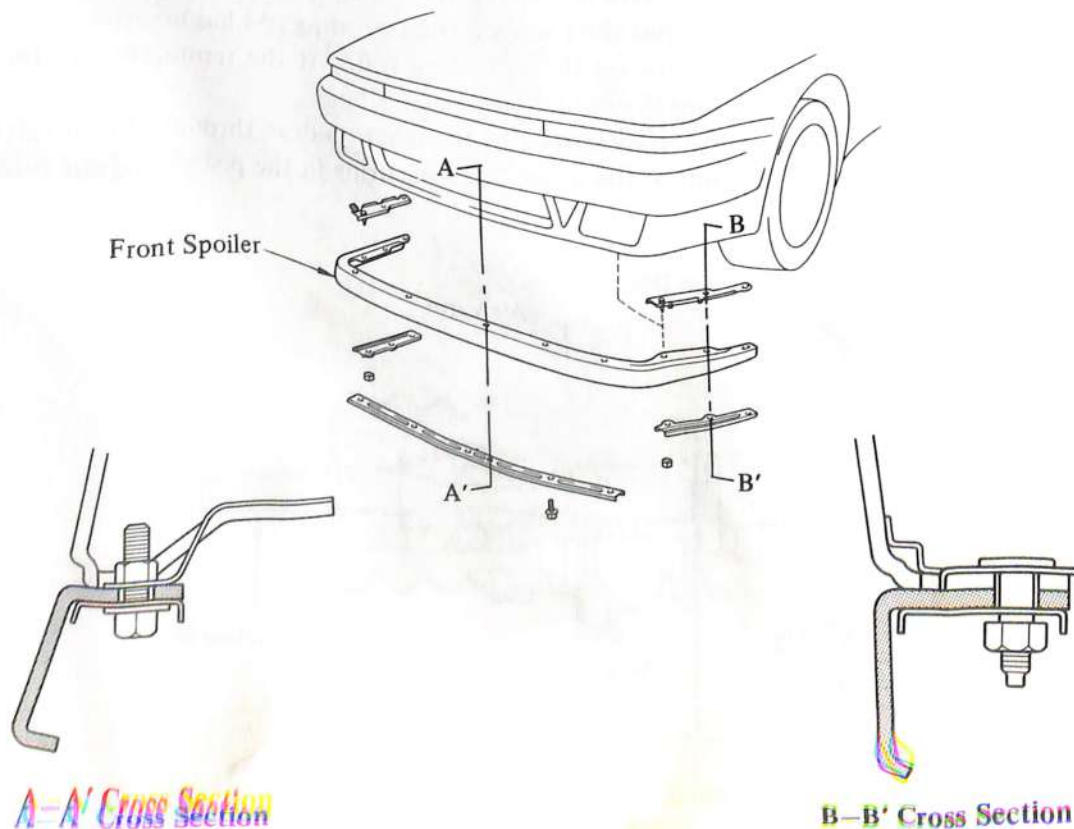
FRONT SPOILER

1. Description

- A spoiler is installed under the front bumper, further improving aerodynamic characteristics.
- The front spoiler is made of Urethane.



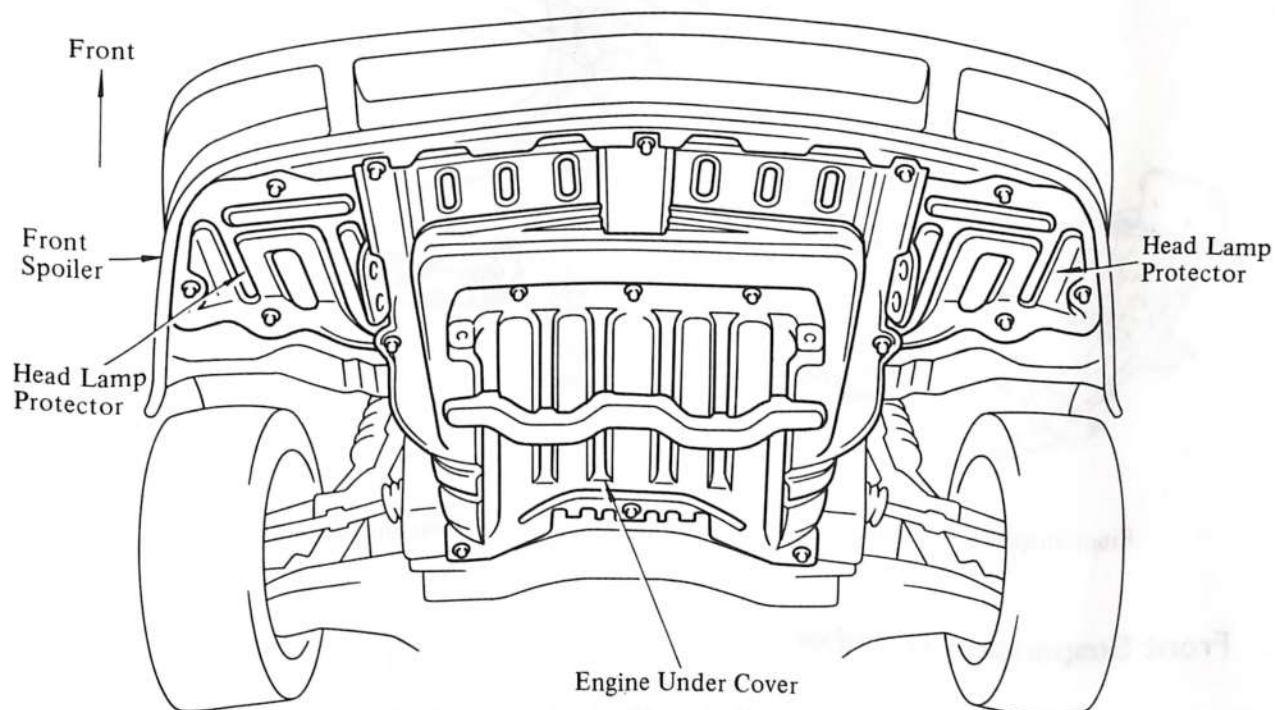
2. Construction



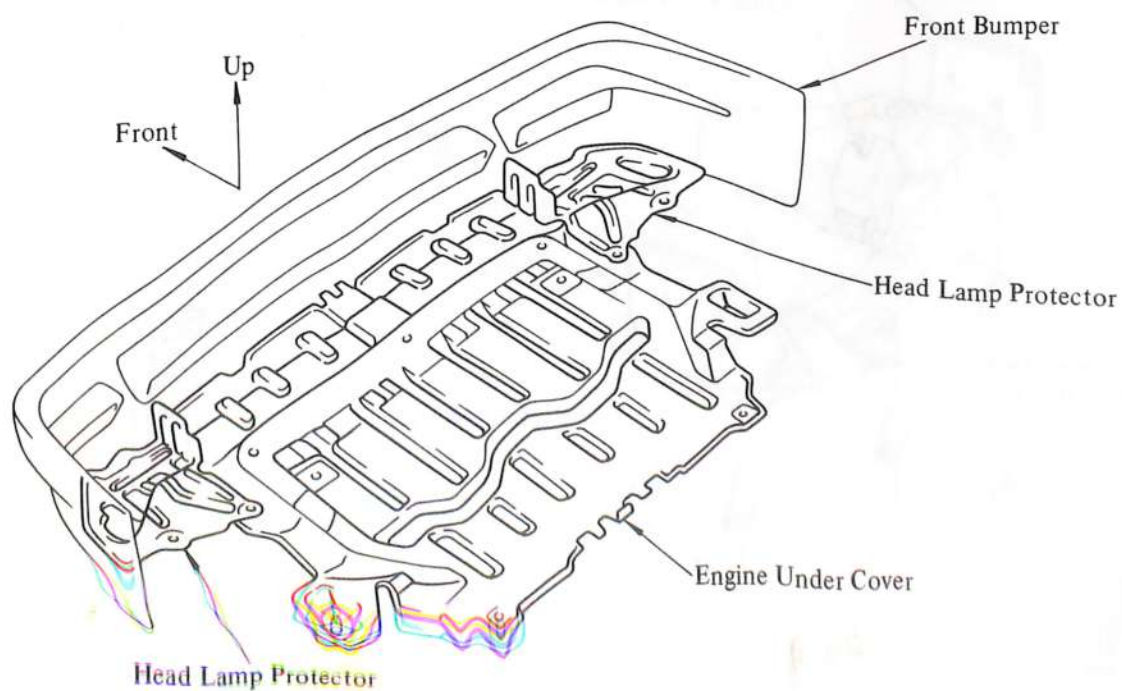
UNDER COVER

Through the installation of the spoiler under the front bumper, the engine under cover and the head lamp protectors, the air flow is smoother and aerodynamic characteristics are improved.

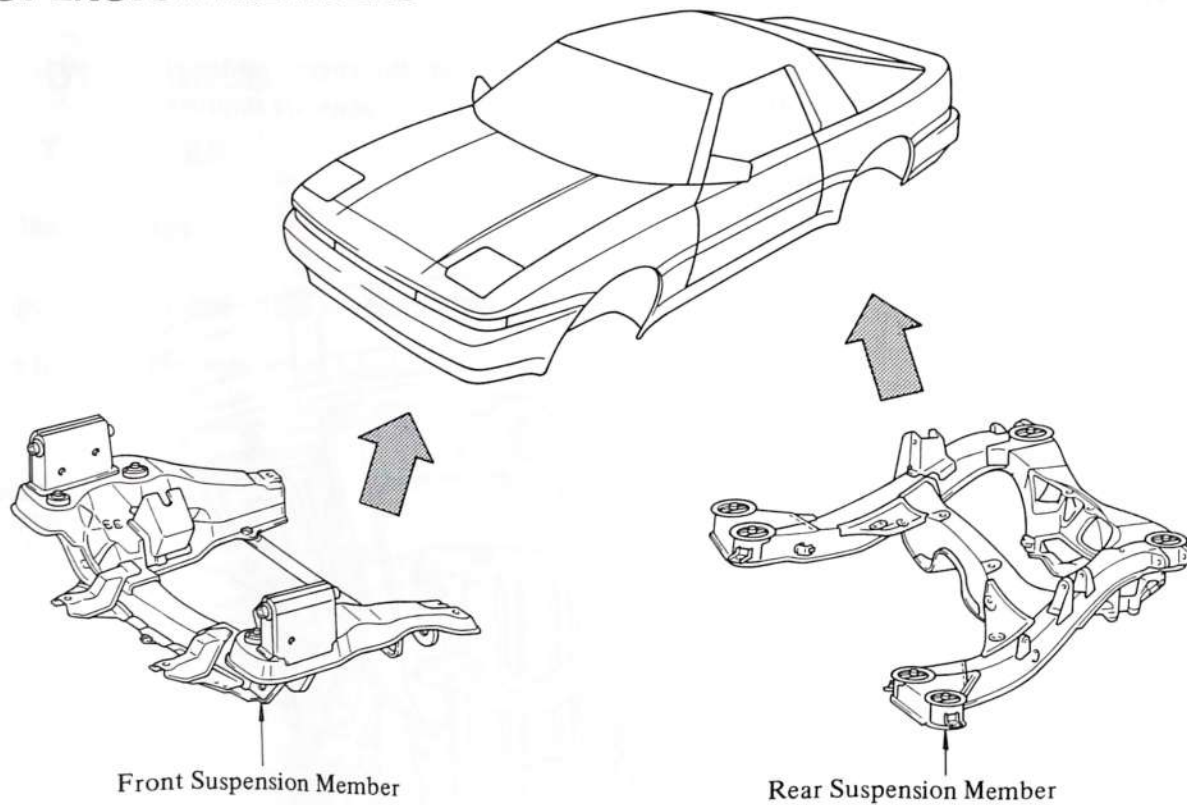
a. Viewed from underneath the vehicle



b. Viewed from inside the vehicle

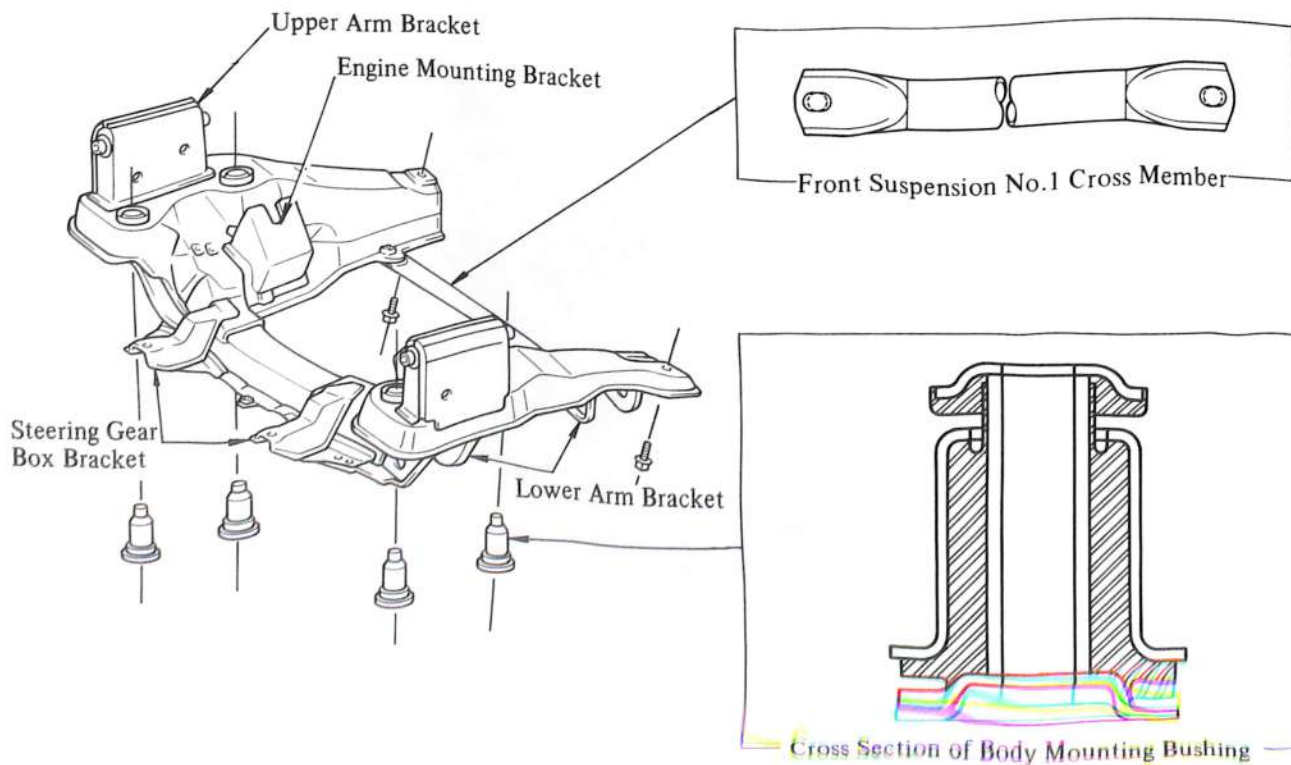


SUSPENSION MEMBERS



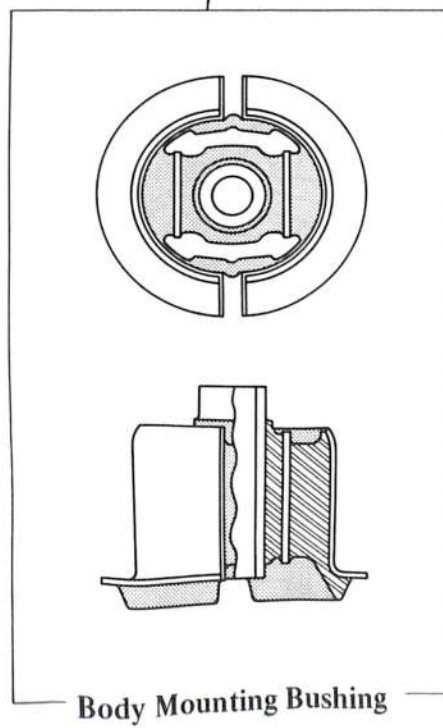
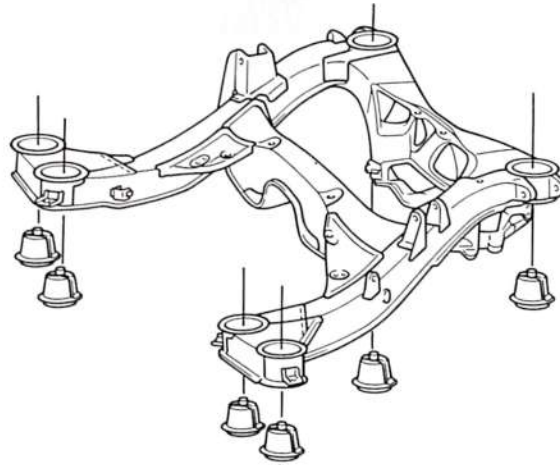
1. Front Suspension Member

- The front suspension member is mounted to the body at four places via bushings and two places via bolts.



2. Rear Suspension Member

- The rear suspension member is mounted to the body at six places via bushings.

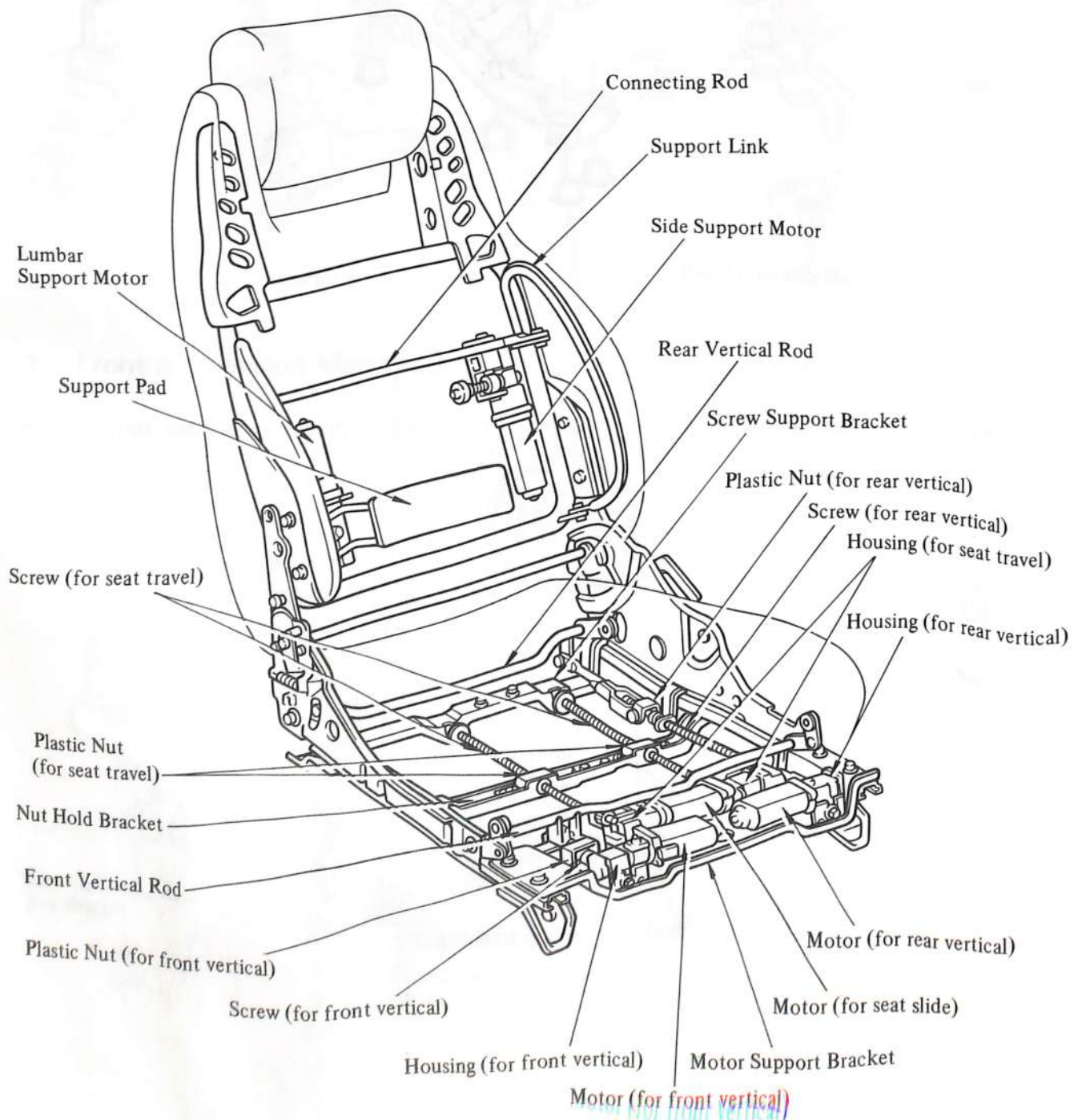


POWER SEAT

DESCRIPTION

The driver's seat can be adjusted forward and backward and the seat cushion front and rear can be adjusted up and down separately through motors operated with a switch.

Also the side support and lumbar support can be adjusted with motors. The side support and lumbar support mechanisms are the same as in the 1986 Celica (ST 162 Series).



CONSTRUCTION AND OPERATION

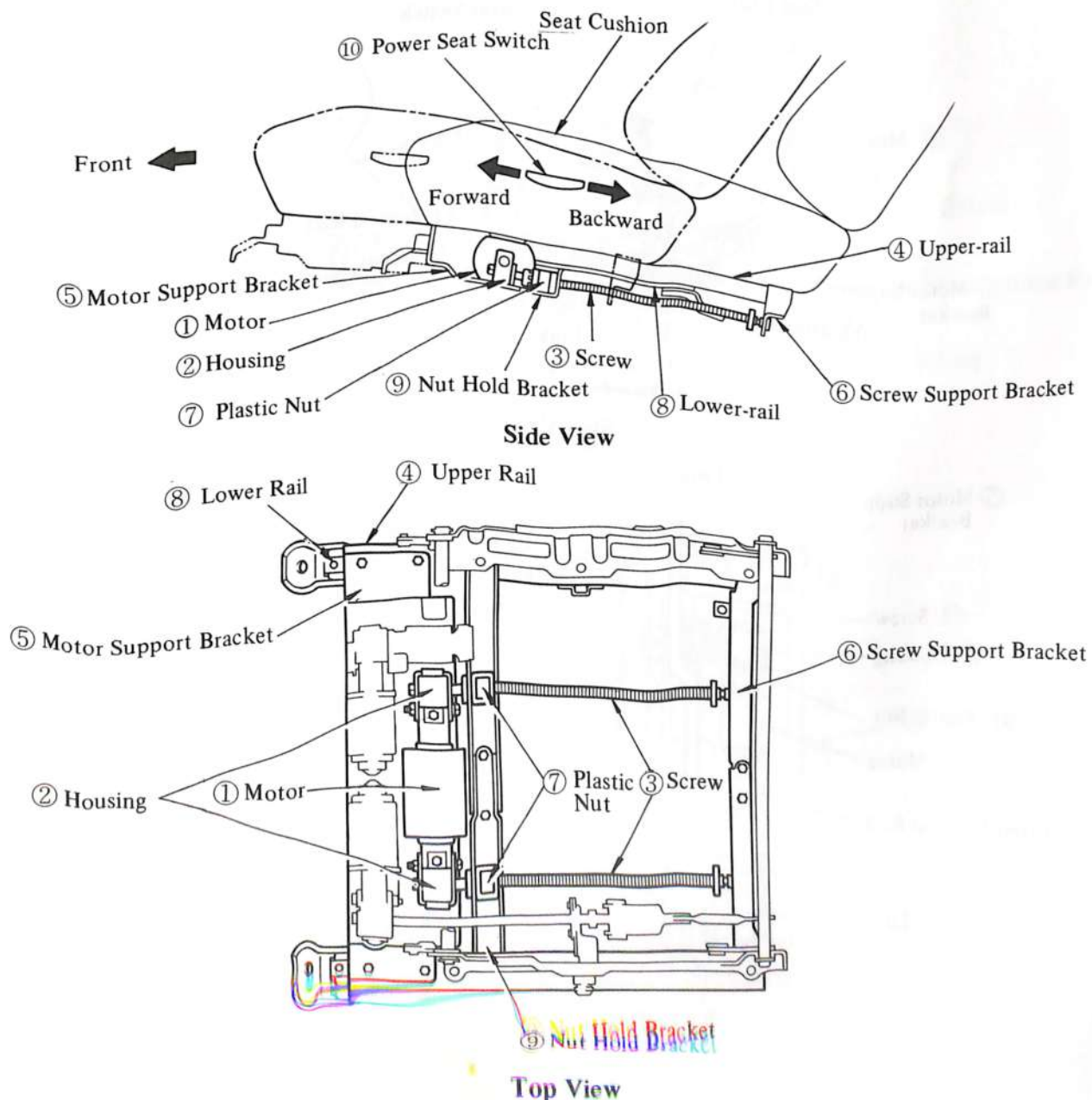
1. Adjusting Seat Travel (Forward and Backward)

CONSTRUCTION

- The Motor ①, Housing ② and Screw ③ are supported by the Motor Support Bracket ⑤ and Screw Support Bracket ⑥ fastened to the Upper Rail ④.
- The Plastic Nut ⑦ is held by the Nut Hold Bracket ⑨ fastened to the Lower Rail ⑧. Also, the Plastic Nut ⑦ is engaged with the Screw ③.

OPERATION

- When the Power Seat Switch ⑩ is operated forward (backward), the Motor ① turns via the Housing ② turns the Screw ③, moving the seat forward (backward). The seat travel stroke is 9.4 in. (240 mm).



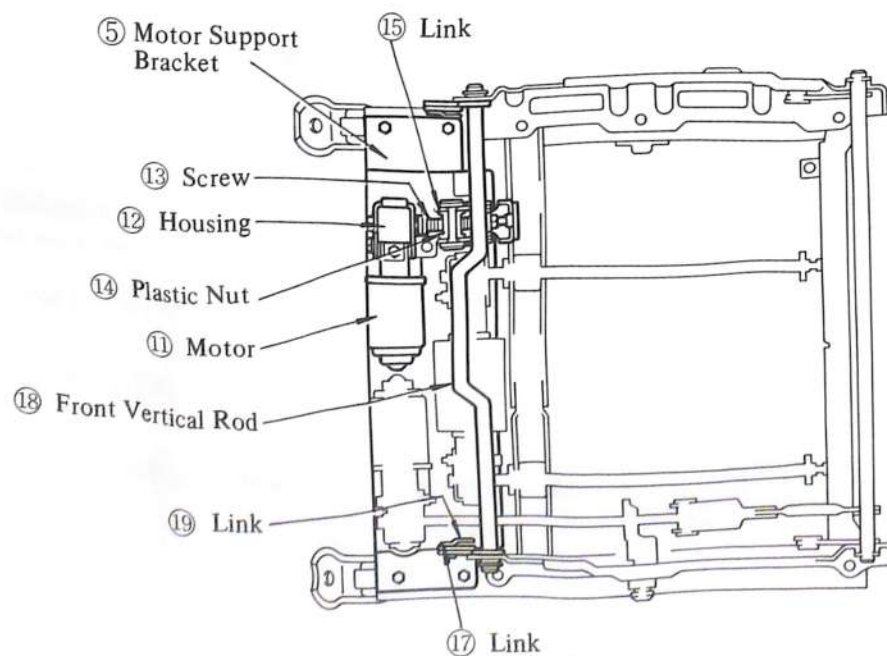
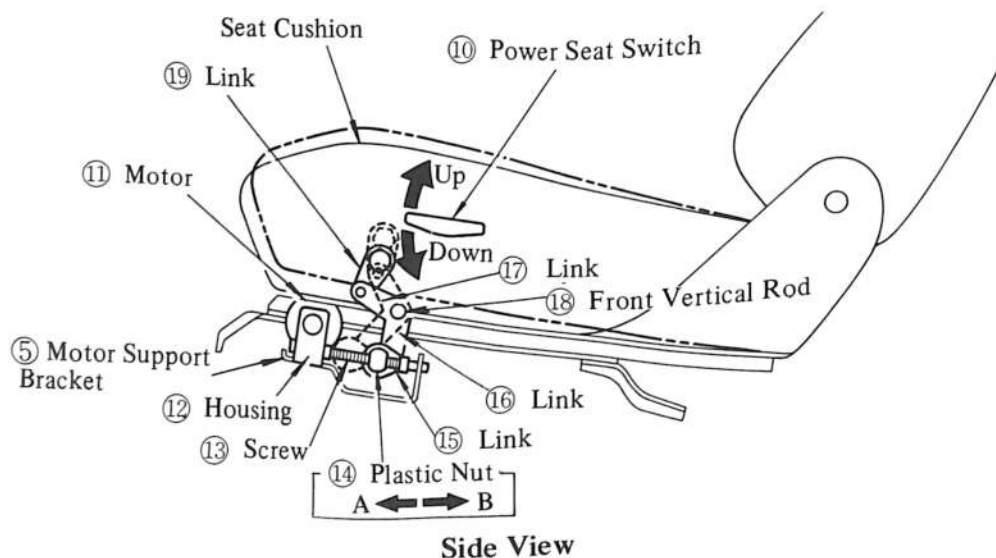
2. Adjusting Seat Front Cushion Height

CONSTRUCTION

- The Motor ⑪, Housing ⑫ and Screw ⑬ are held by the Motor Support Bracket ⑤.
- The Plastic Nut ⑭ is held by the Link ⑮ and is engaged in Screw ⑬.
- Link ⑯ and Link ⑰ are welded to the Front Vertical Rod ⑱ and Link ⑯ is connected to Link ⑮. Link ⑰ is connected to Link ⑲.

OPERATION

- When the Power Seat Switch ⑩ is operated up (down), the Screw ⑬ turns and the Plastic Nut ⑭ travels in direction A: up (B: down). Therefore, Link ⑯, via Link ⑮, turns the Front Vertical Rod ⑱ so the seat cushion front edge is moved up (down) via Links ⑰ and ⑲.



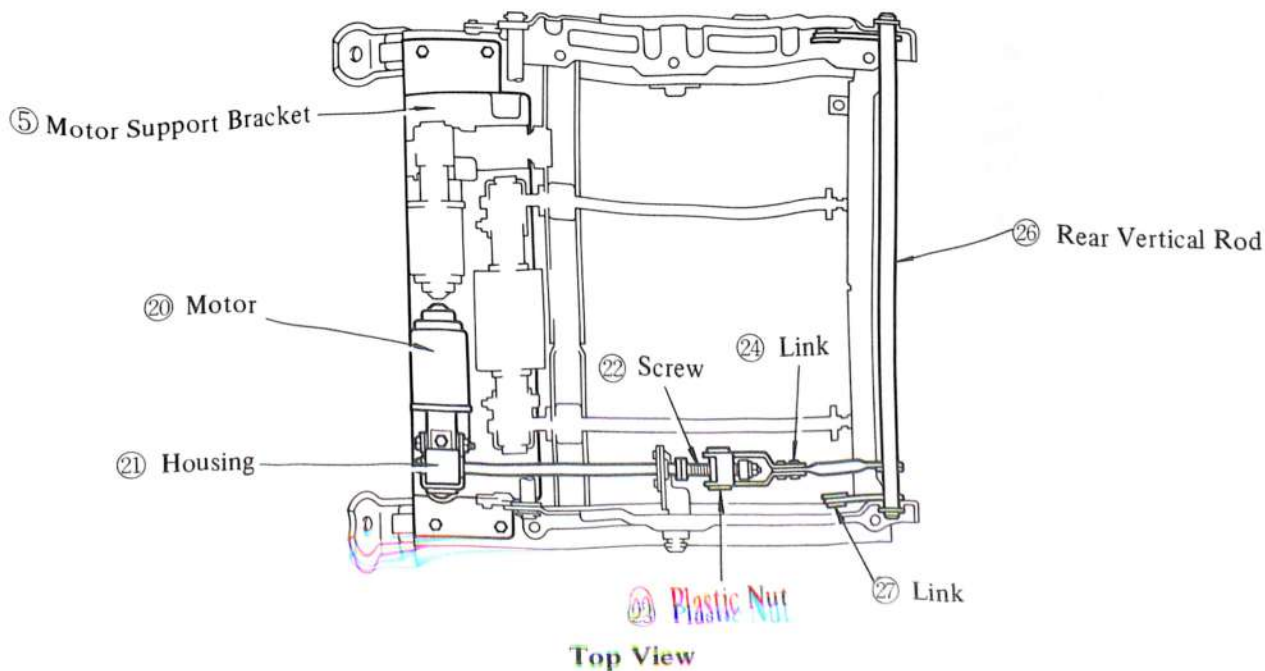
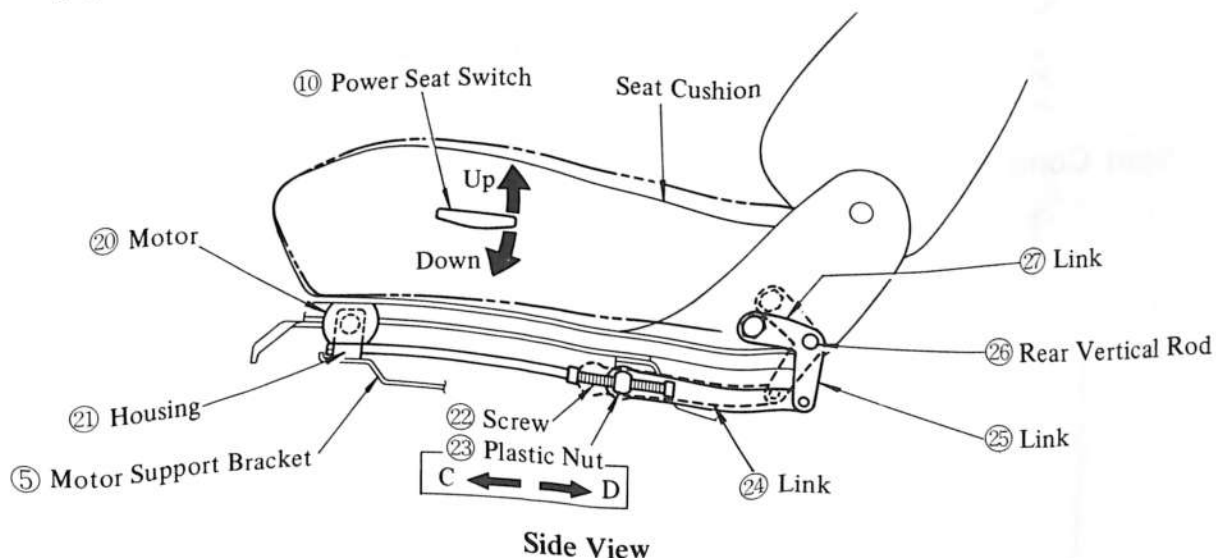
3. Adjusting Seat Rear Cushion Height

CONSTRUCTION

- The Motor ②①, Housing ②① and Screw ②② are supported by the Motor Support Bracket ⑤.
- The Plastic Nut ②③, at the same time as it is supported by the Link ②④, is engaged with Screw ②②.
- Link ②⑤ and Link ②⑦ are welded to the Rear Vertical Rod ②⑥ and Link ②⑤ is connected to Link ②④. Link ②⑦ is connected to the seat cushion.

OPERATION

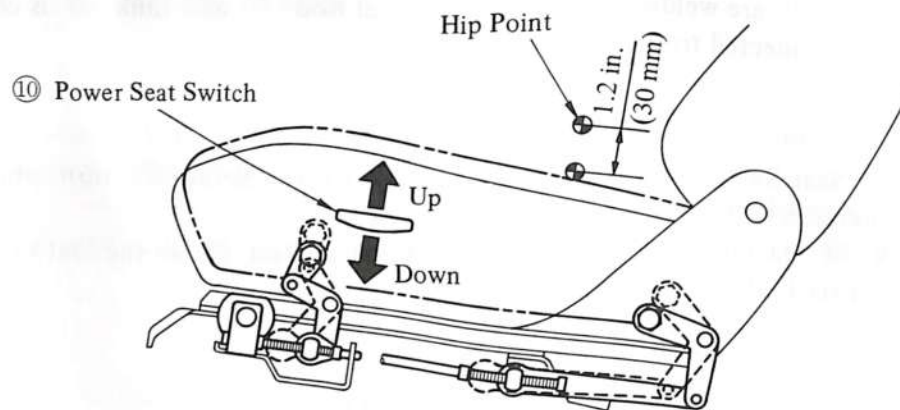
- When the Power Seat Switch ①⑩ is operated up (down), the Screw ②② turns and the Plastic Nut ②③ travels in direction C: Up (D: Down). Therefore, Link ②⑤ via Link ②④ turns the Rear Vertical Rod ②⑥ so the seat cushion rear edge is moved up (down) via Link ②⑦.



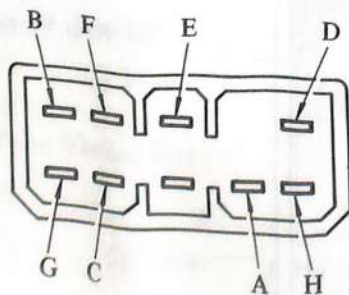
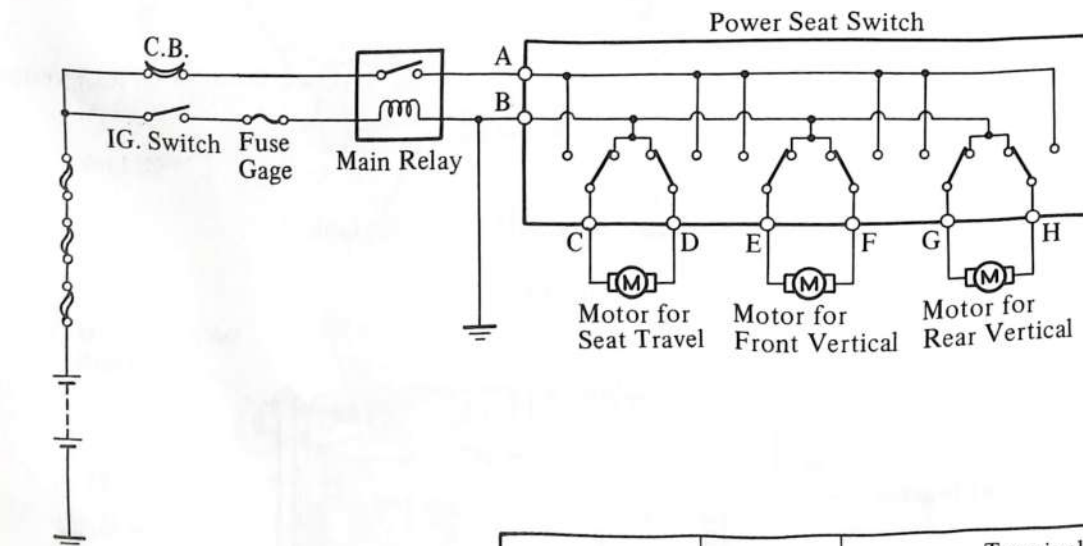
4. Adjusting Seat Cushion Height (Front and Rear)

OPERATION

- When the entire Power Seat Switch ⑩ is operated up (down), the Front Seat Cushion Height Adjustment, mentioned in 2 and Rear Seat Cushion Height Adjustment, mentioned in 3 are carried out at the same time, and the entire seat cushion moves up (down). The seat cushion height adjusting stroke is 1.2 in. (30 mm) at the hip point.



5. Seat Control System Circuit



Connector for Power Seat Switch

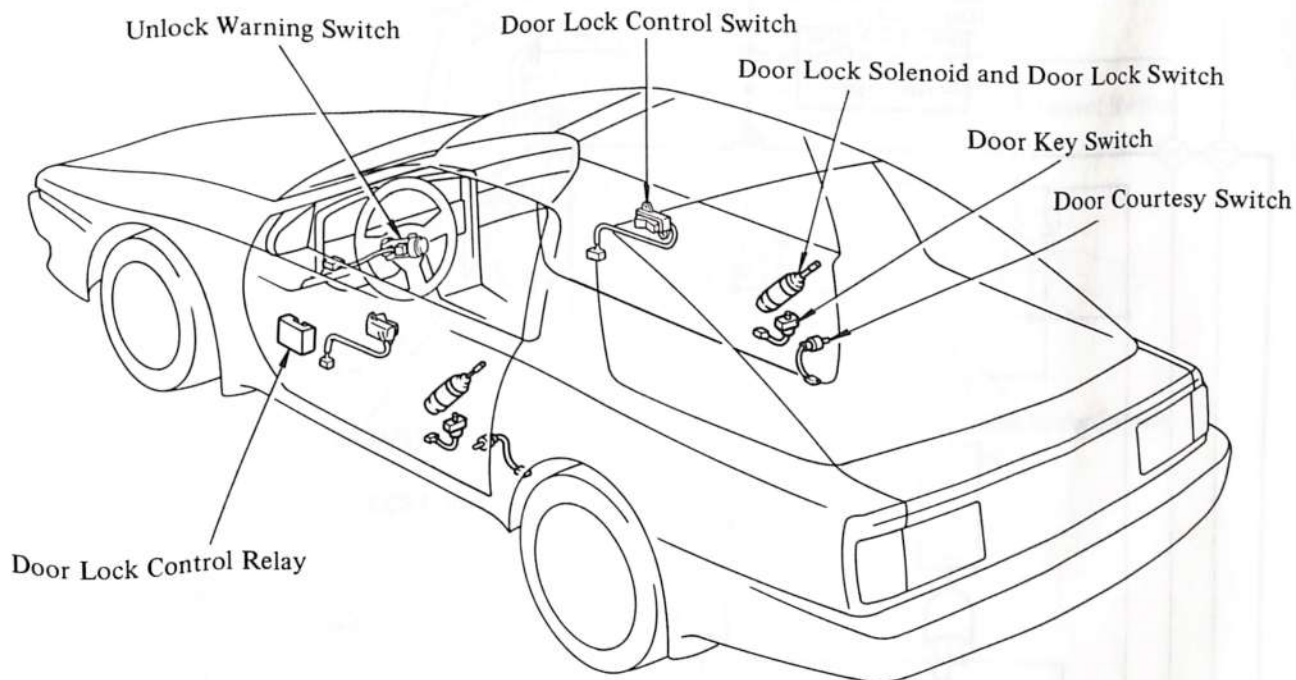
Switches	Operation	Terminals							
		B	F	E	A	D	G	C	H
Seat Travel	Front	○			○	○			
	Off	○				○			
	Rear	○				○			
Front Vertical	Up	○	○		○				
	Off	○	○						
	Down	○	○	○					
Rear Vertical	Up	○			○		○		○
	Off	○					○		
	Down	○					○		

BODY ELECTRICAL SYSTEM

DOOR LOCK SYSTEM

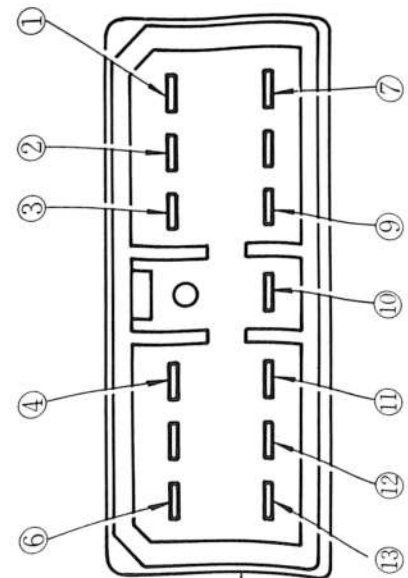
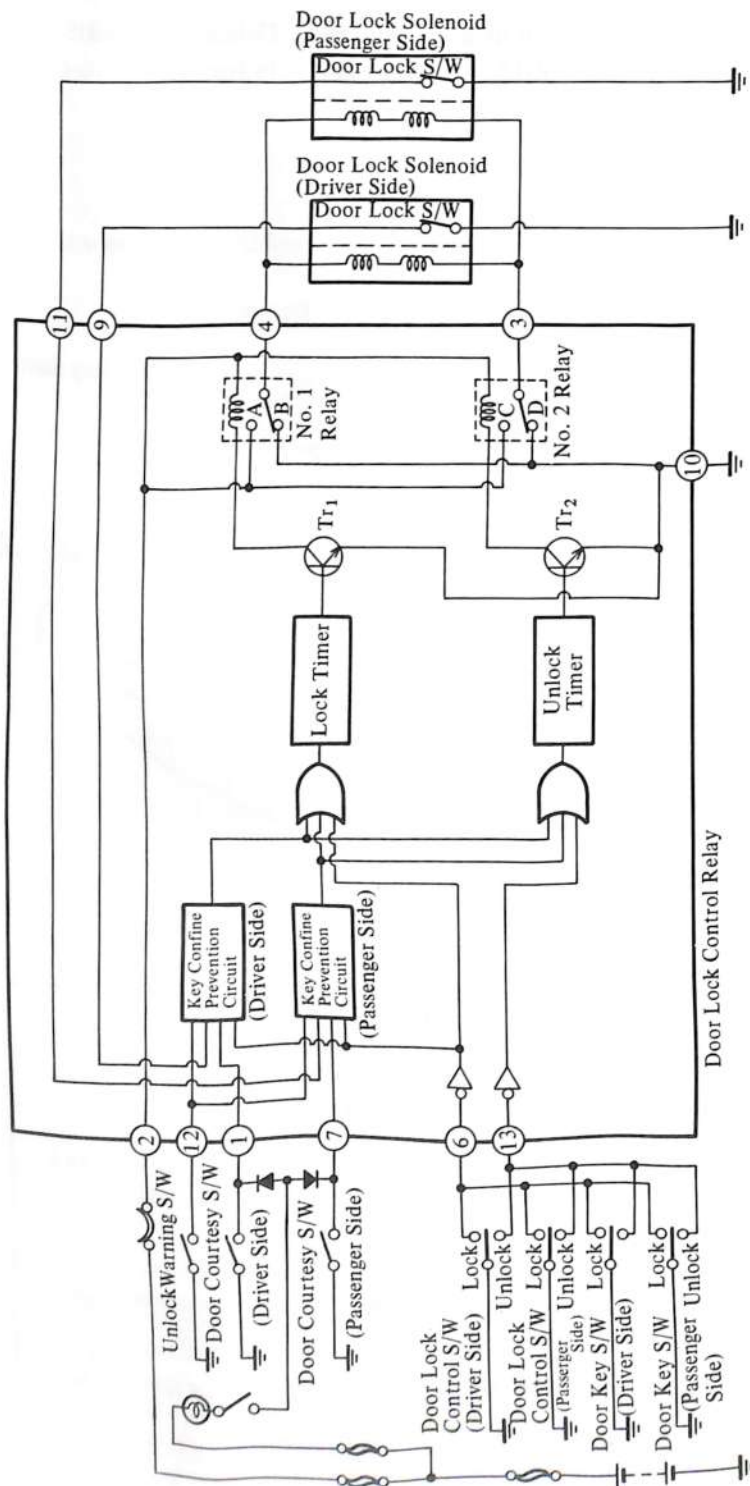
DESCRIPTION

- The door lock system in the new Supra is the same system as in the 1986 Celica (ST 162 Series). Please refer to the New Car Features (Pub. No. NCF001U, Section TD-117) for the 1986 Celica.



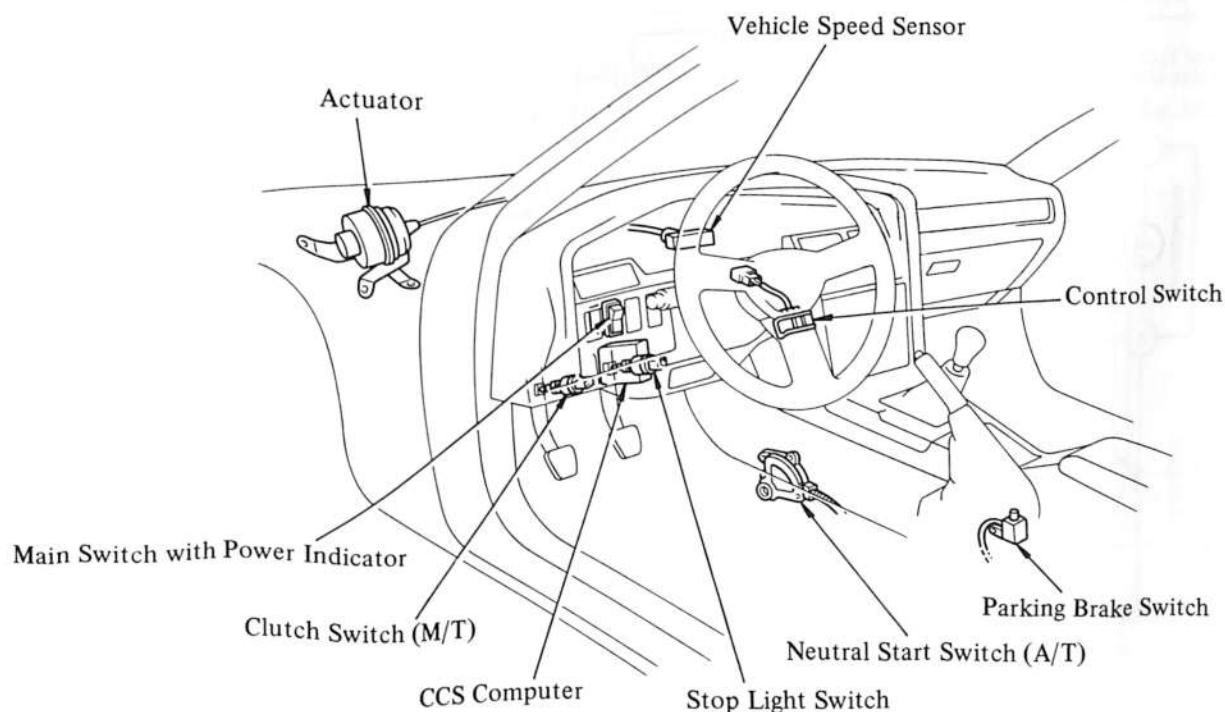
COMPONENT	FUNCTION
Door Lock Control Switch	Through the operation of this switch, a lock signal or an unlock signal is sent to the door lock control relay.
Door Key Switch	This switch sends a lock signal or an unlock signal to the door lock control relay when the door key is operated from the outside.
Door Lock Solenoid	These are solenoids which lock or unlock the doors.
Door Lock Switch	This switch is incorporated into the door lock solenoid and detects when the door is locked.
Unlock Warning Switch	This switch detects when the key is inserted into the ignition key cylinder.
Door Courtesy Switch	This switch detects if the door is open.
Door Lock Control Relay	This relay sends current to the door lock solenoids in accordance with the signals from the switches. (Current is sent in opposite directions depending on whether the door is being locked or unlocked.)

WIRING DIAGRAM



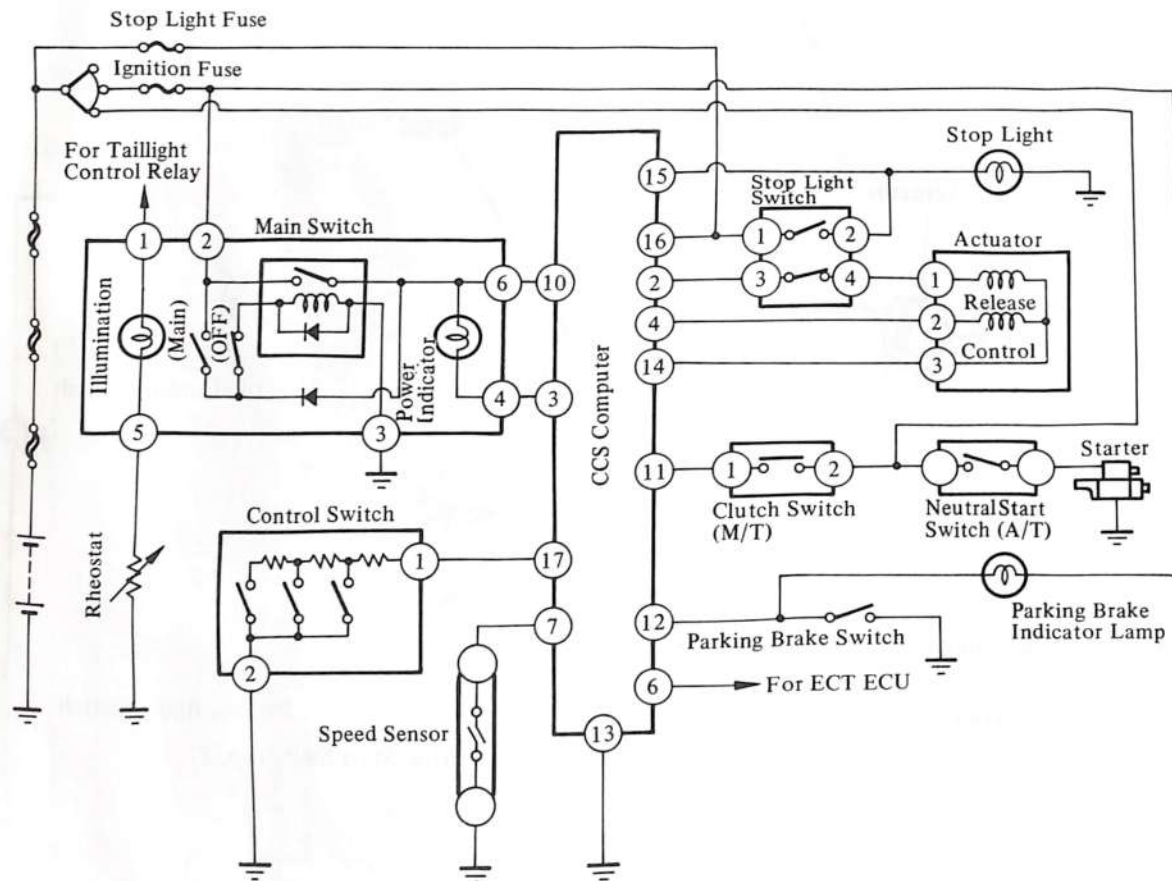
Connector for Door Lock Control Relay

CRUISE CONTROL SYSTEM (CCS)

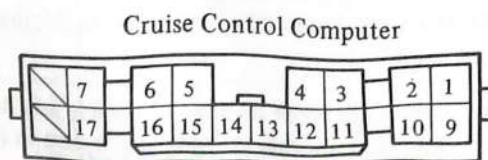


COMPONENT	FUNCTION
Vehicle Speed Sensor	This is mounted on the speedometer driven gear and produces pulse signals. The cruise control computer detects vehicle speed by sensing the pulse frequency.
CCS Computer	Receives signals from each sensor and controls total CCS functioning.
Actuator	This is controlled by the CCS computer, to increase or decrease the throttle valve opening angle.
Control Switch	This is used to control the CCS when setting the vehicle at a desired cruising speed or resetting it at another cruising speed, and to cancel the CCS.
Main Switch with Power Indicator	This is used to connect the CCS to the power source. Lights up when the main switch is ON, indicating that power is being supplied in the system.
Stop Light Switch	Supply CCS release signals
Parking Brake Switch	
Clutch Switch (M/T)	
Neutral Start Switch (A/T)	

WIRING DIAGRAM



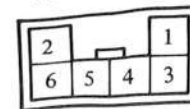
MAJOR CONNECTORS



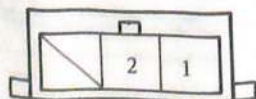
Actuator



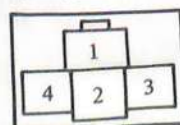
Main Switch



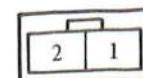
Control Switch



Stop Light Switch



Clutch Switch

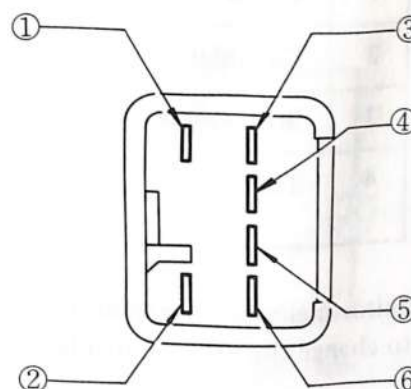
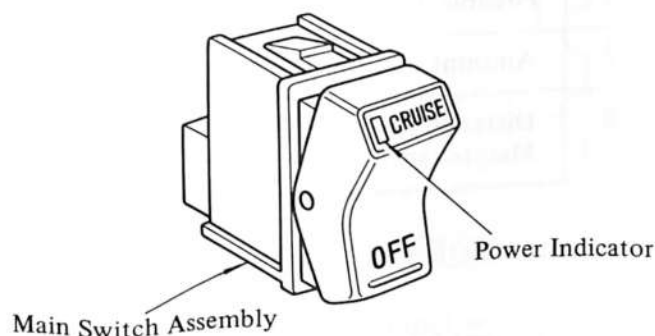


OPERATION

- The construction and operation of the cruise control system is the same as previous systems. (Basically, it is the same as that on the 1986 Celica ST 162 Series.)

Main Switch

- Even though the Main Switch is in the ON position, if the Ignition Switch is turned off, the Main Switch goes off at the same time. When the Ignition Switch is turned on again, the Main Switch remains off.

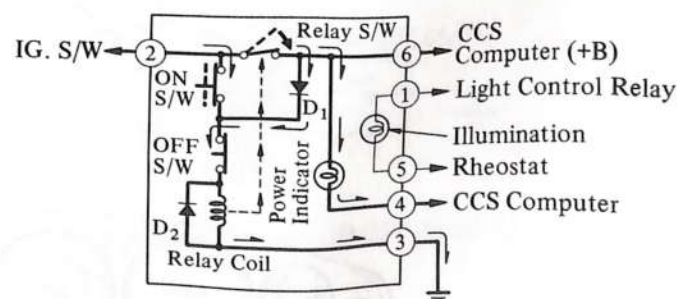


Connector for Main Switch

OPERATION

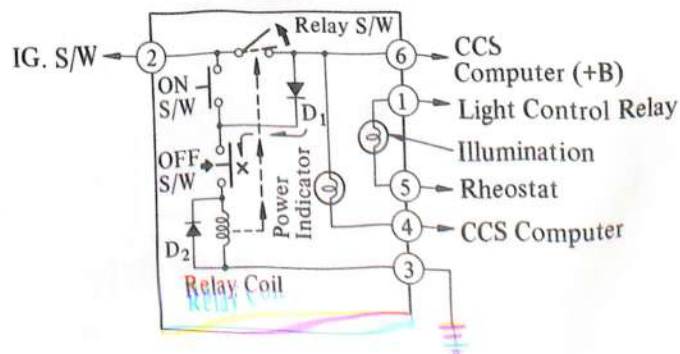
1) Main Switch ON

- With the Ignition Switch ON, if the Main Switch is turned ON, Terminal ③ is grounded by Terminal ② through the On Switch, Off Switch and Relay Coil.
- The Relay Switch goes on and current flows to Terminal ⑥.
- Also, since current is flowing through the Relay Coil through D₁, even if the Relay Switch is separated from the On switch, it remains ON. (Self-hold Circuit) The Power Indicator Lamp Lights up.



2) Main Switch OFF

- When the Main Switch is ON, if the Off Switch is pressed, the current flowing from D₁ is cut off and the flow of current to the Relay Coil is stopped, causing the Main Switch goes off.
- Also, when the Ignition Switch is turned OFF, the Relay Coil is no longer charged and the Main Switch goes off.



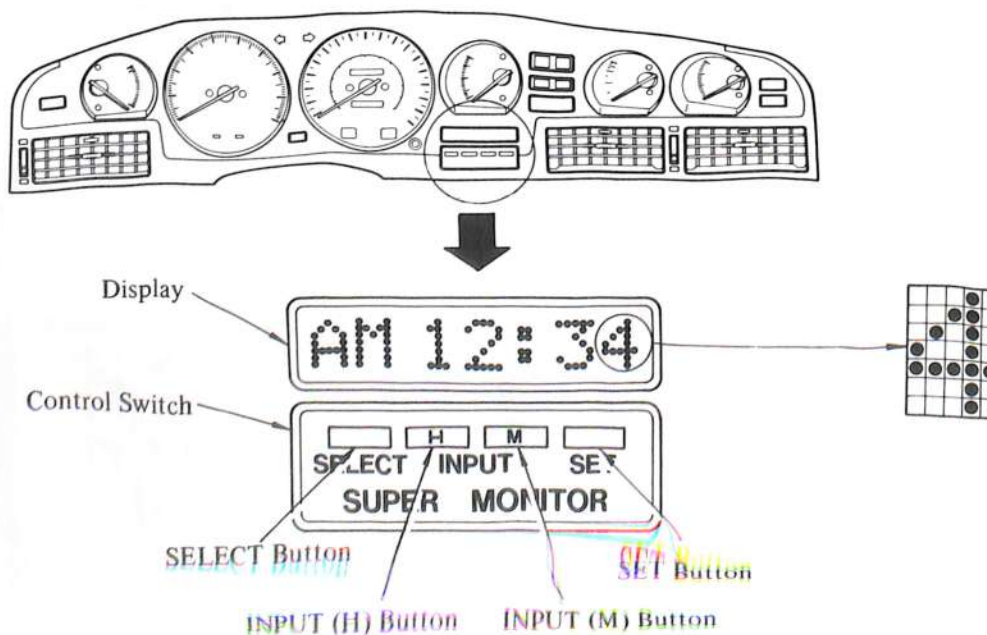
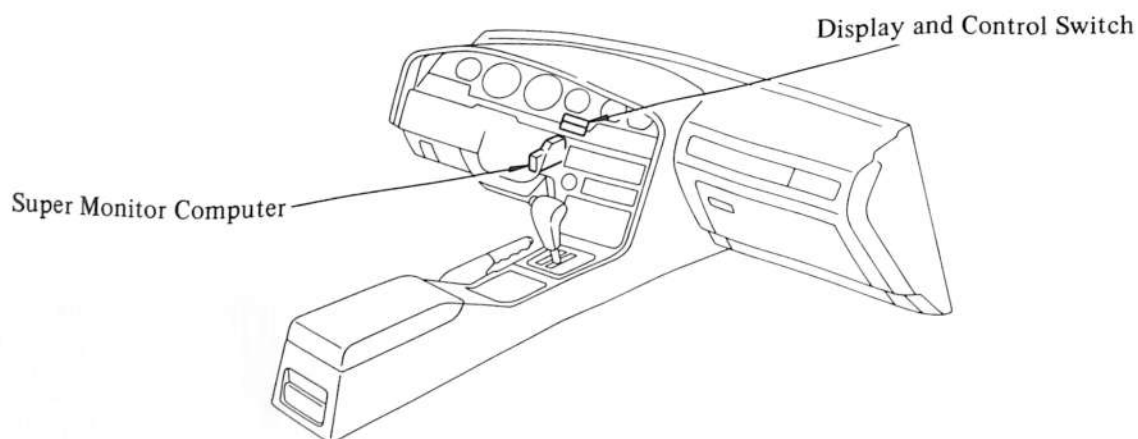
SUPER MONITOR SYSTEM

DESCRIPTION

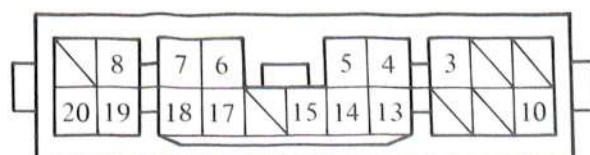
- A fluorescent display capable of displaying up to 8 digits is used. It can display figures and alphabet characters as well as symbols.
- In ordinary use, this system monitors the following items.

1	Clock	5	Average Fuel Consumption
2	Calendar	6	Possible Travel Distance
3	Stopwatch	7	Amount of Fuel Used
4	Timer	8	Distance Remaining until Maintenance

- This monitor includes an engine oil maintenance warning function which informs the driver that it is time to change the oil by a display and an alarm.
- The monitor also displays numerically the diagnostic codes sent from the TCCS ECU and ECT ECU (A/T models only).



Wiring Diagram



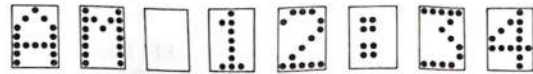
Connector for Super Monitor Computer

OPERATION

1. Clock

DISPLAY

- Press the “Select” button to display “Time”.
- The time is displayed in a 12 hour cycle, with AM or PM indications.



SET AND RESET

Operation	Operation Button	Display (Example)
Press the “Select” button to display “Time”.	    SELECT INPUT SET	AM 12 : 34
Press the “Input (H)” button and input the hour.* ¹	    SELECT INPUT SET	PM 3 : 34
Press the “Input (M)” button to input the minutes.* ¹ Setting is completed. (It is not necessary to press the “Set” button.)	    SELECT INPUT SET	PM 3 : 45

*¹: While the button is being pressed, the hour or minute changes rapidly.

- Setting the Correct Time

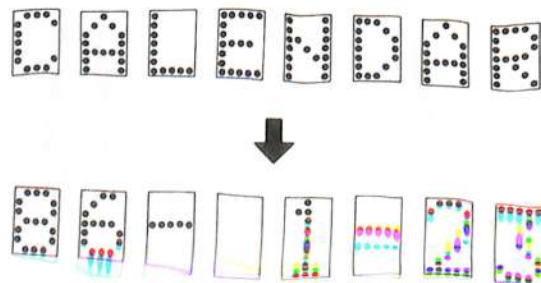
Operation	Operation Button	Display (Example)
Setting the correct time is accomplished using the “Set” button. If the minutes display is 0 ~ 29 min., it subtracts minutes to “00”. If the minutes display is 30 ~ 59 min., it adds minutes up to “00”.	    SELECT INPUT SET	AM 12 : 20 ↓ AM 12 : 00 AM 12 : 34 ↓ PM 1 : 00

2. Calendar

DISPLAY

- Press the “Select” button to “Calendar.”
- The year, month and day are displayed.
- The year display is the last two digits of the current year.

Example: 1986 → 86, 2000 → 00



SET AND RESET

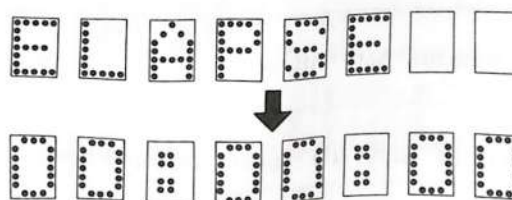
Operation	Operation Button	Display (Example)
Press the "Select" button to display "Calendar." (For the first 1 second only, the word "Calendar" is displayed.)	 H M  SELECT INPUT SET	CALENDAR ↓ 86 - 1 - 23
Press the "Set" button for 1 second or longer.	 H M  SELECT INPUT SET	CHANGE ? ↓ READY
Release the "Set" button.	 H M  SELECT INPUT SET	86 - 1 - 23
Press the "Select" button and input the year.* ¹	 H M  SELECT INPUT SET	89 - 1 - 23
Press the "Input (H)" button and input the month.* ¹	  M  SELECT INPUT SET	89 - 8 - 23
Press the "Input (M)" button and input the day.* ¹	 H   SELECT INPUT SET	89 - 8 - 31
Press the "Set" button to complete the input.	 H M  SELECT INPUT SET	OK ↓ CALENDAR ↓ 89 - 8 - 31

*¹: While the button is being pressed, the year, month or day changes rapidly.

3. Stopwatch

DISPLAY

- Press the "Select" button to display "Elapse".
- Timing up to 99 hrs., 59 min. and 59 sec. in 1 second units is possible. After 99 hrs., 59 min., and 59 seconds, the display returns to 00 hrs., 00 min. and 00 sec.



SET AND RESET

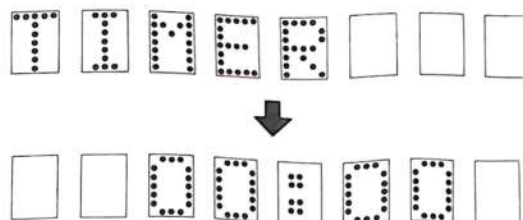
Operation	Operation Button	Display (Example)
Press the "Select" button to display "Elapse". (For the first 1 second only, the word "Elapse" is displayed.)	 H M  SELECT INPUT SET	ELAPSE ↓ 00 : 00 : 00
Press the "Input (H)" button to start the stopwatch.	  M  SELECT INPUT SET	00 : 01 : 23
Press the "Input (M)" button to stop the stopwatch.	 H   SELECT INPUT SET	01 : 23 : 45
Pressing the "Set" button resets the stopwatch.	    SELECT INPUT SET	00 : 00 : 00

- While the stopwatch is running, even if other displays are selected, timing (or the stopwatch stopped state) continues.
- Even when the ignition switch is turned off, timing (or the stopwatch stopped state) continues.
- When the stopwatch is stopped with the “Input (M)” button, if the “Input (H)” button is pressed it resumes timing. (However, this can only be done when the stopwatch is displayed.)

4. Timer

DISPLAY

- Press the “Select” button to display “Timer”.
- The timer will operate in 1 minute units from 1 min. to 24 hrs. and 59 min., displaying remaining time.
- When the remaining time reaches 0 min., an alarm sounds and an alarm display, “TIMER” flashes on the display.
- The alarm sounds for 1 minute.
- Even if the ignition switch is off, the alarm will operate.
- If a button (any button is OK) is pressed during the time the alarm is sounding, the alarm will stop.



SET AND RESET

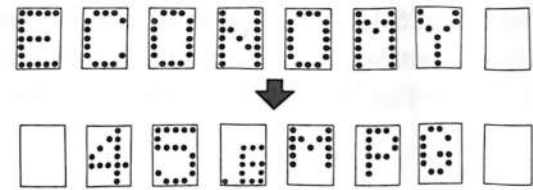
Operation	Operation Button	Display (Example)
Press the “Select” button to display “Timer.” (For the first 1 second only, the word “TIMER” is displayed.)	H M SELECT INPUT SET	TIMER ↓ 00 : 00
Press the “Set” button for 1 second or longer.	H M SELECT INPUT SET	CHANGE ? ↓ READY
Release the “Set” button.	H M SELECT INPUT SET	00 : 00
Press the “Input (H)” button and input the hour.* ¹	H M SELECT INPUT SET	2 : 00
Press the “Input (M)” button and input the minute.* ¹	H M SELECT INPUT SET	2 : 34
If the “Set” button is pressed, operation of the timer will start.	H M SELECT INPUT SET	OK ↓ TIMER ↓ 2 : 34

*¹ : While the button is being pressed, the hour or minute changes rapidly.

5. Present Average Gas Mileage

DISPLAY

- Press the “Select” button to display “ECONOMY.”
- After resetting, the present average gas mileage is displayed in 0.1 mile/gallon units.
- After resetting, the present average gas mileage value is calculated after the vehicle has traveled 328 ft. or more. Therefore, the display up to that point will read “0.0 MPG.”



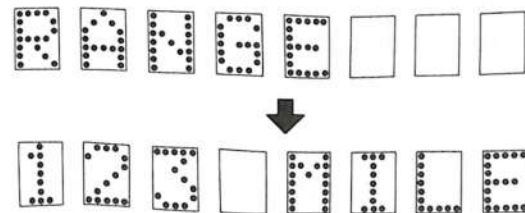
RESET

Operation	Operation Button	Display (Example)
Press the “Select” button to display the Economy display. (For the first 1 second only, the word “ECONOMY” is displayed.)	SELECT INPUT SET	ECONOMY ↓ 45.6 MPG
Press the “Set” button for 1 second or longer.	SELECT INPUT SET	RESET ? ↓ OK
Release the “Set” button. Resetting is completed.	SELECT INPUT SET	ECONOMY ↓ 0.0 MPG

6. Possible Travel Distance

DISPLAY

- Press the “Select” button to display “Range.”
- If reset when the tank is filled up with fuel, the distance which can be traveled on the fuel remaining is displayed in 1 mile units as a criterion.



RESET

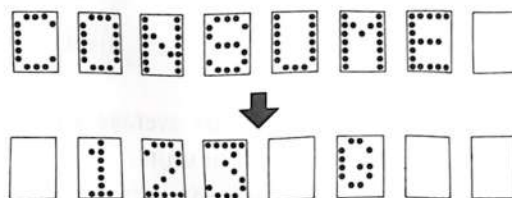
Operation	Operation Button	Display (Example)
Press the “Select” button to display Range. (For the first 1 second only, the word “RANGE” is displayed.)	SELECT INPUT SET	RANGE ↓ 123 MILE
Press the “Set” button for 1 second or longer.	SELECT INPUT SET	RESET ? ↓ OK
Release the “Set” button. Resetting is completed.	SELECT INPUT SET	RANGE ↓ 283 MILE

NOTE: Be sure to reset this function when the tank is filled.

7. Amount of Fuel Used

DISPLAY

- Press the “Select” button to display “Consume.”
- After resetting, the amount of fuel used is displayed in 1 gallon units up to 999 gallons.



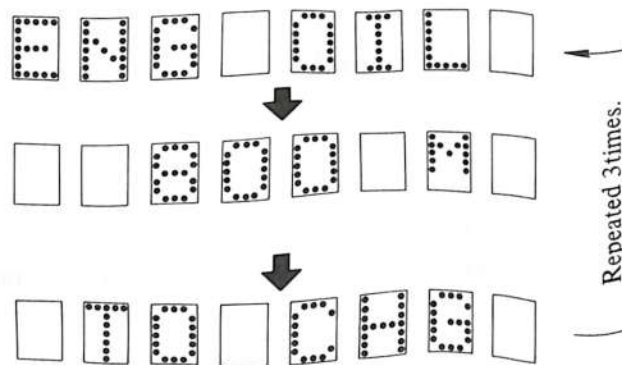
RESET

Operation	Operation Button	Display (Example)
Press the “Select” button to display “Consume.” (For the first 1 second only, the word “CONSUME” is displayed.)	 SELECT INPUT SET	CONSUME ↓ 123 G
Press the “Set” button for 1 second or longer.	 SELECT INPUT SET	RESET ? ↓ OK
Release the “Set” button. Resetting is completed.	 SELECT INPUT SET	CONSUME ↓ 0 G

8. Distance Remaining Until Maintenance

DISPLAY

- Press the “Select” button to display the distance remaining until maintenance.
- If this function is reset at the time the engine oil is replaced, the distance remaining until engine oil maintenance is displayed in 100 mile units, up to a maximum of 10,000 miles, taking into consideration the severity of the conditions under which the engine is run.*1
- After the display at right is repeated 3 times, the display changes to the clock display.

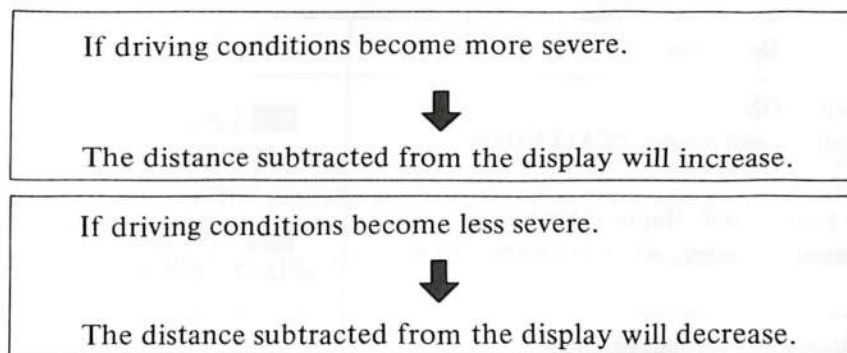


RESET

Operation	Operation Button	Display (Example)
Press the “Select” button to display the distance remaining until maintenance. “ENG OIL” is displayed for 1.5 seconds “800 M” is displayed for 2 seconds. “TO CHG” is displayed for 1.5 seconds.	 SELECT INPUT SET	ENG OIL ↓ 800 M ↓ TO CHG
Press the “Set” button for 1 second or longer.	 SELECT INPUT SET	RESET ? ↓ OK
Release the “Set” button. Resetting is completed.	 SELECT INPUT SET	ENG OIL ↓ 10000 M ↓ TO CHG

*1: Severe conditions are when the engine speed is 2400 rpm or greater and when the intake air manifold vacuum is 7.1 in.Hg or lower.

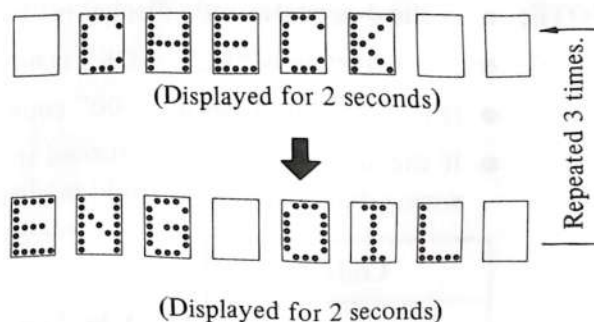
NOTE: ● When the distance displayed by the Distance Remaining Until Maintenance function is reset, it can be used as a criterion for determining how many miles can be traveled before the engine oil should be changed under the present driving method condition. Therefore, as shown below, the method of subtracting the distance remaining will vary depending upon driving conditions, use environment, etc.



- When the engine oil is replaced, be sure to reset this function.

9. Engine Oil Warning

- When it is time for the engine oil to be changed, the driver is informed by the display (at right) and an alarm.
- The warning will be displayed each time the ignition switch is turned from LOCK to ACC until the warning is reset.
- The alarm will sound only the first time that the warning is given. The second time and thereafter, when the warning is displayed, the alarm will not sound.
- When any button on the monitor is pressed during the warning, the warning is cancelled. However, since it is not reset by this operation, the warning will be displayed again the next time the ignition switch is turned from LOCK to ACC.
- Resetting of the warning is accomplished by resetting the Distance Remaining Until Maintenance function.
- The engine oil warning operates under the following conditions.
 - ▶ When the Distance Remaining Until Maintenance has reached 0 miles.
 - or
 - ▶ When 365 days (1 year) has passed since the Distance Remaining Until Maintenance was reset.



10. Diagnosis Mode

- The monitor displays diagnostic codes sent from the TCCS ECU and ECT ECU.
- Diagnostic codes are recorded in the Super Monitor and if a diagnostic code is sent, the recorded code is displayed at intervals of 4 seconds.

1) Diagnosis of TCCS and ECT

Operation	Operation Button	Display (Example)
Turn the ignition switch ON. Press the "Select" button and display "CALENDAR".	    SELECT INPUT SET	CALENDAR ↓ 86 - 1 - 23
Press the "Select" button and "Input (M)" button simultaneously for 3 seconds or longer. After 3 seconds, "DIAG" is displayed.	    SELECT INPUT SET	ERROR ↓ DIAG
Press the "Set" button for 3 seconds or longer. After 3 seconds "ENG—" is displayed. Then, after 5~20 seconds, the diagnostic code is displayed. After the TCCS diagnostic code is displayed, it is followed by the ECT diagnostic code display.	    SELECT INPUT SET	ENG - ↓ ECT -

- NOTE:**
- If the diagnostic code display is "ENG - OK", it means the TCCS system is normal.
 - If the display is "ECT - OK" it means the ECT system is normal.
 - If the display shows a "- 00" code look at the table below to locate the trouble.
 - If the Ignition Switch is turned to the "START" position while in the diagnosis mode, the wrong diagnostic code could be displayed.

Code	Possible Cause
ENG - 00	• A broken wire in the wire harness between the TCCS ECU and the Super Monitor Computer, or a short circuit. • The TCCS ECU is broken down.
ECT - 00	• For vehicles with manual transmission. • A broken wire in the wire harness between the ECT ECU and the Super Monitor Computer, or a short circuit. • The ECT ECU is broken down.

2) Diagnosis Mode Cancel

- If any of the following conditions exist, the diagnosis mode is cancelled.
 - ▶ If the Ignition Switch is turned Off.
 - ▶ If the vehicle moves. (When more than 3 vehicle speed pulses have been detected.)
 - ▶ If any button other than the “Set” button has been pressed.
- As the diagnostic mode is canceled, the diagnostic codes stored inside the super monitor are erased.

11. Back-up Function

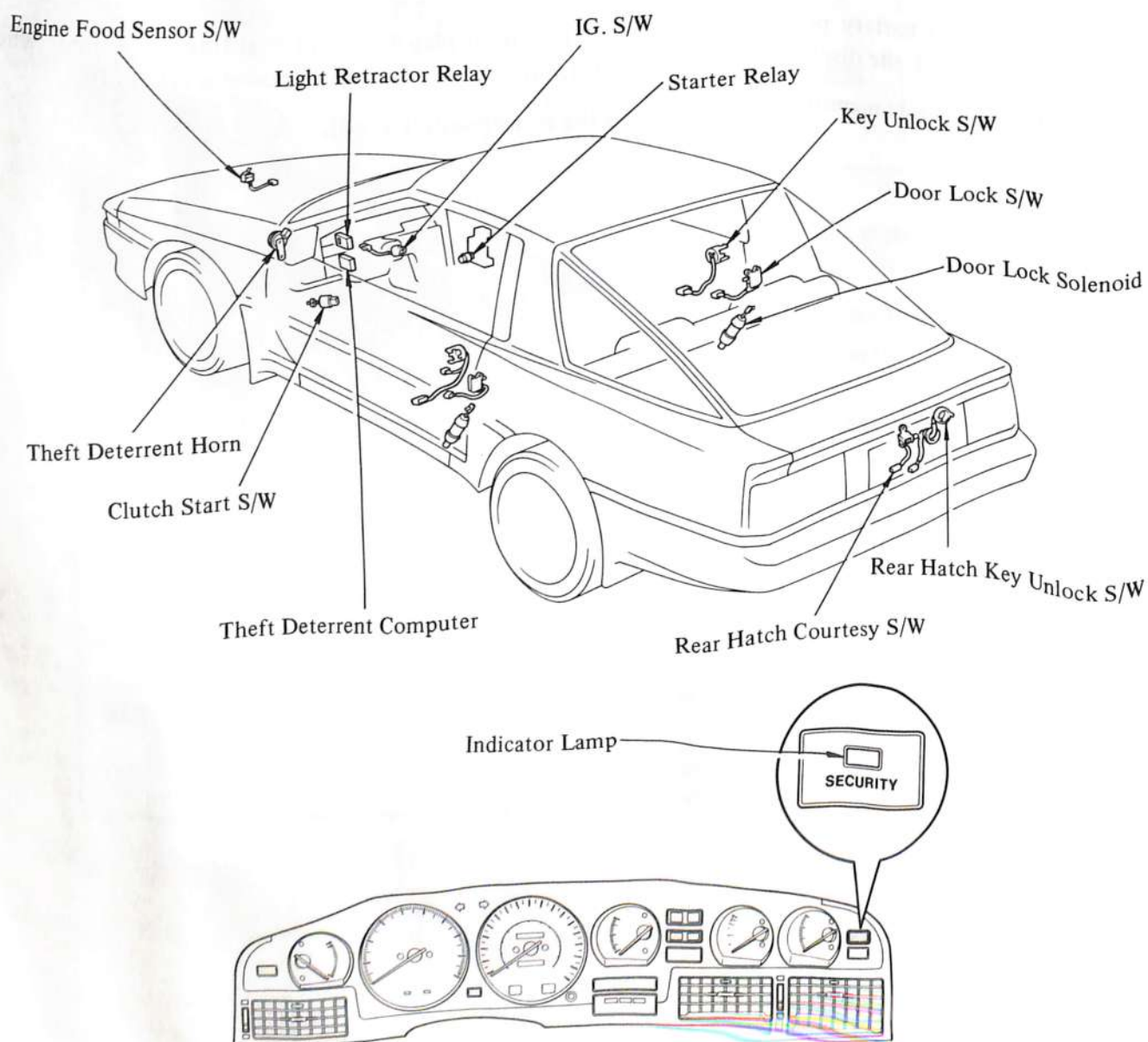
- A back-up battery is built into the Super Monitor to prevent the data stored in the Super Monitor's memory from being erased when the main power supply is disconnected.
- If the main battery is disconnected, the super monitor's power supply is automatically switched to the back-up battery.
- When the main battery power supply is cut off, the display values at that time are stored. When power is restored, the display will show all information as it was before power was cut off.
- The diagnostic code memory is cleared when the power supply is cut.

THEFT DETERRENT SYSTEM (USA Only)

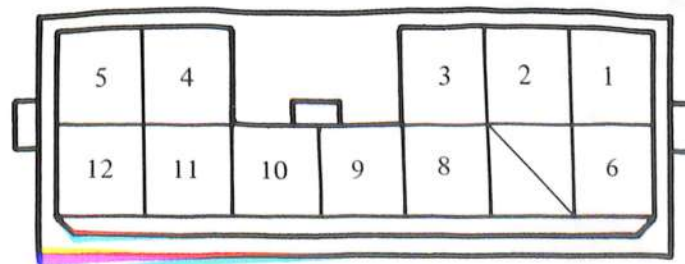
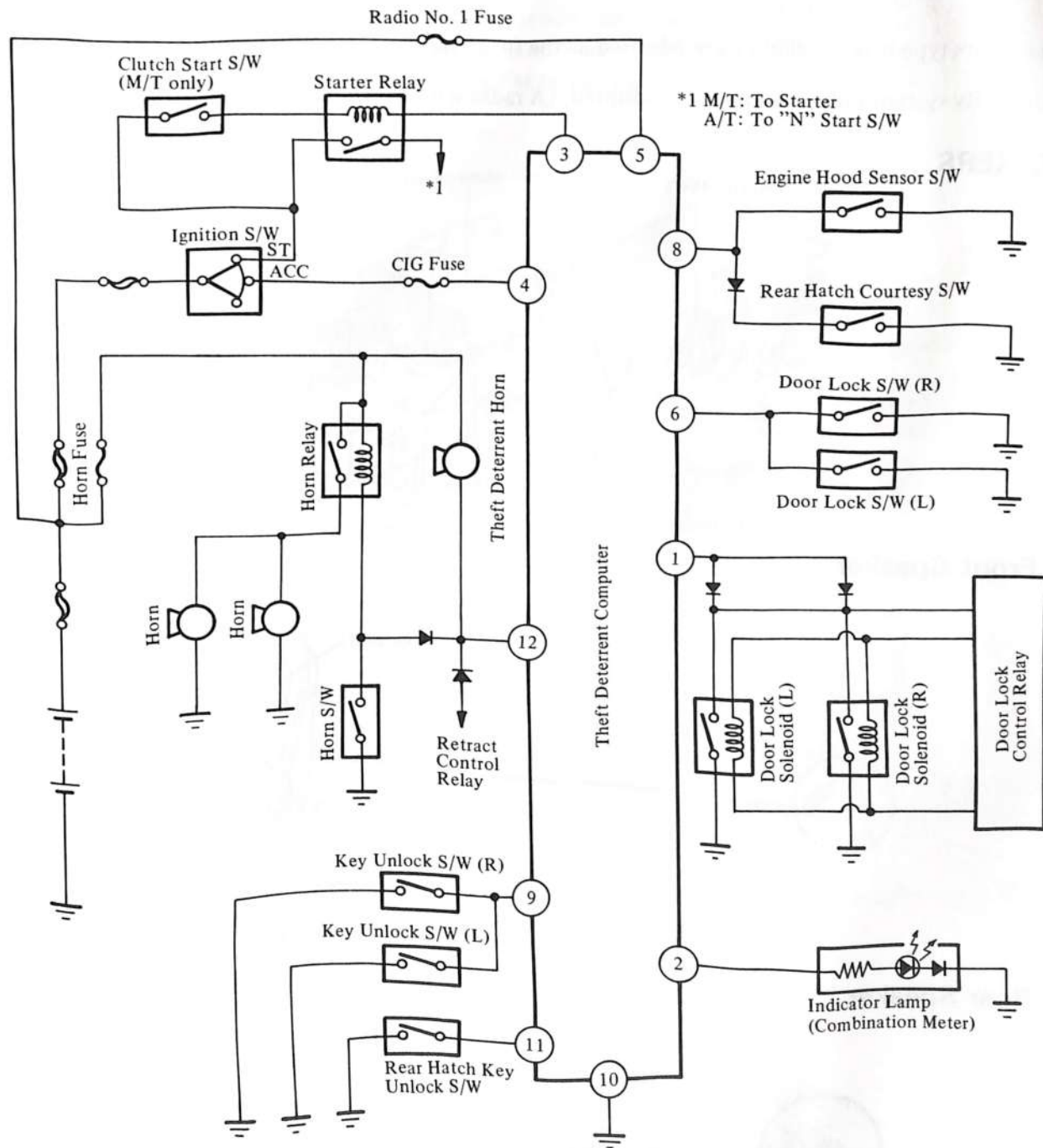
DESCRIPTION

- The Theft Deterrent System adopted for the new Supra functions the same as in the 1986 model Cressida.
- The following items have been added to the Theft Deterrent System which were not included in the Theft Deterrent System in the previous Supra.
 - ▶ An under-hood sensor switch was added to detect unauthorized opening.
 - ▶ A Starter Cut System was added.
 - ▶ A security indicator lamp (red) was installed in the combination meter.

NOTE: The above 3 items have already been adopted for the 1986 model Cressida.



WIRING DIAGRAM



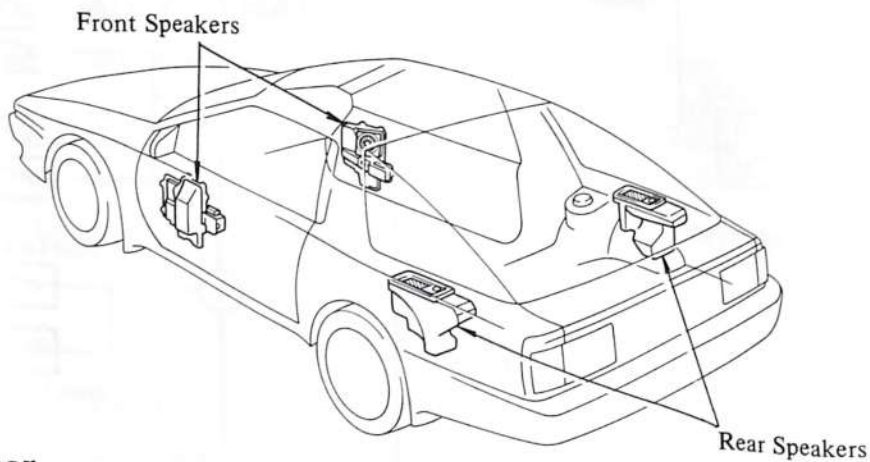
Connector for Theft Deterrent Computer

AUDIO SYSTEM

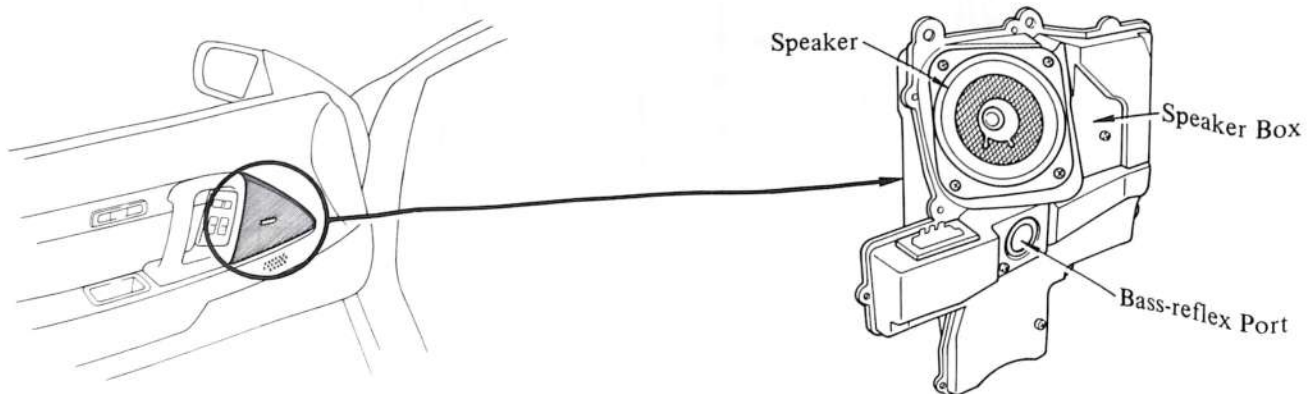
DESCRIPTION

- Bass-reflex type box speakers were adopted as the front and rear speakers in all models.
- A diversity system radio antenna was adopted. (A radio with cassette player is a set option.)

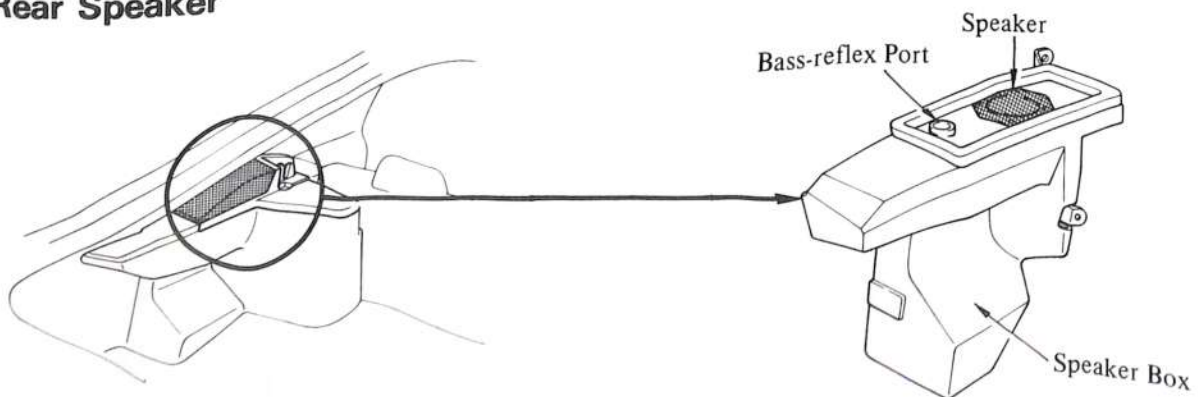
SPEAKERS



1. Front Speaker

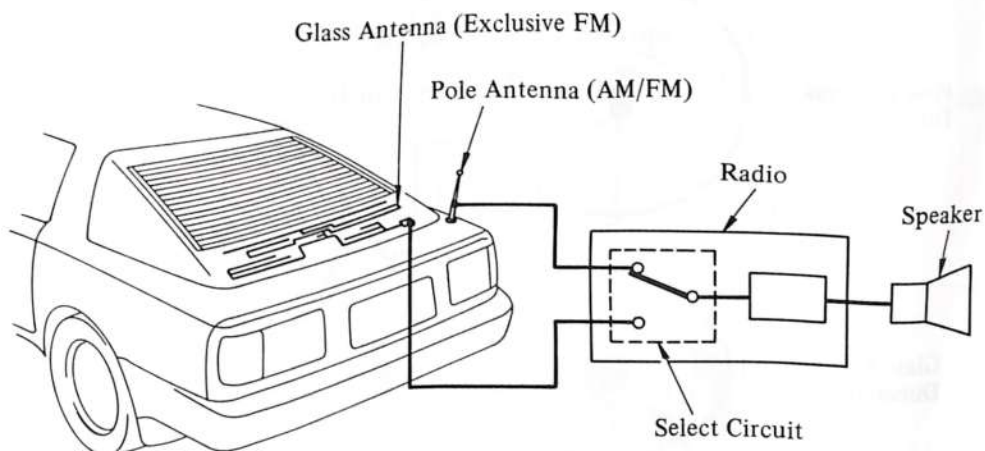


2. Rear Speaker



DIVERSITY ANTENNA SYSTEM

- This system uses the Pole Antenna (AM/FM) mounted in the right rear Quarter Panel and the Glass Antenna mounted in the lower part of the rear window glass (Exclusive FM). A select circuit built into the radio continuously selects the antenna which antenna is receiving the best signal. This reduces Multipath and Static when receiving FM broadcasts.



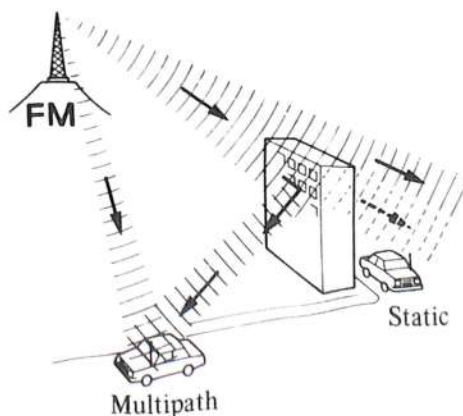
– REFERENCE –

Multipath

Due to the characteristics of FM waves, when they hit a building or a mountain, etc., they are reflected. If radio waves from the broadcasting station and reflected waves are picked up at the same time, distortion will occur due to the difference in arrival times and as a result, noise will be generated.

Static

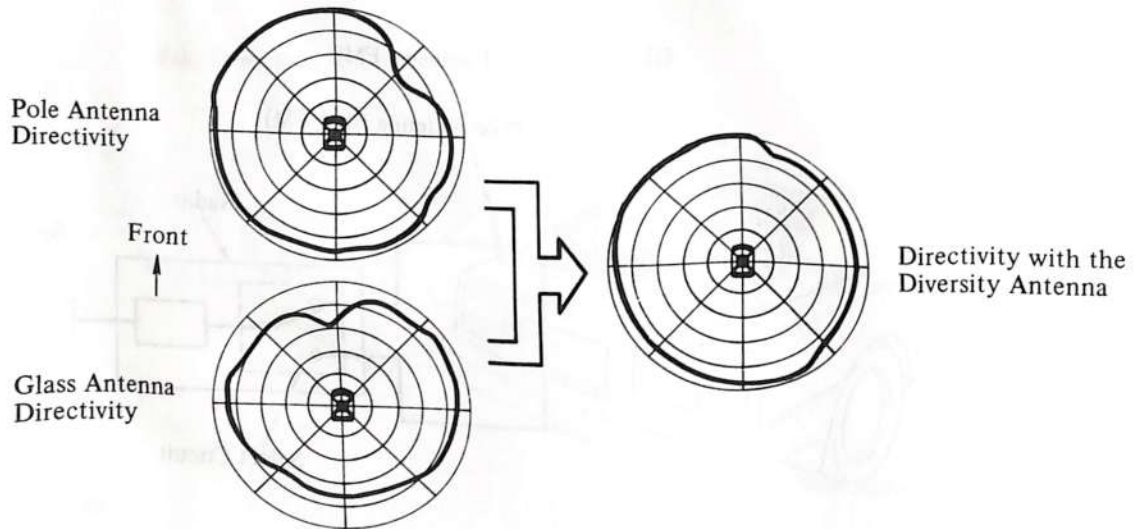
If FM waves pass through a place where there are obstructions such as buildings, the waves will not reach the antenna, and the result will be noise that interrupts the sound.



- The diversity antenna system has the following effects.

► Improved Antenna Directivity

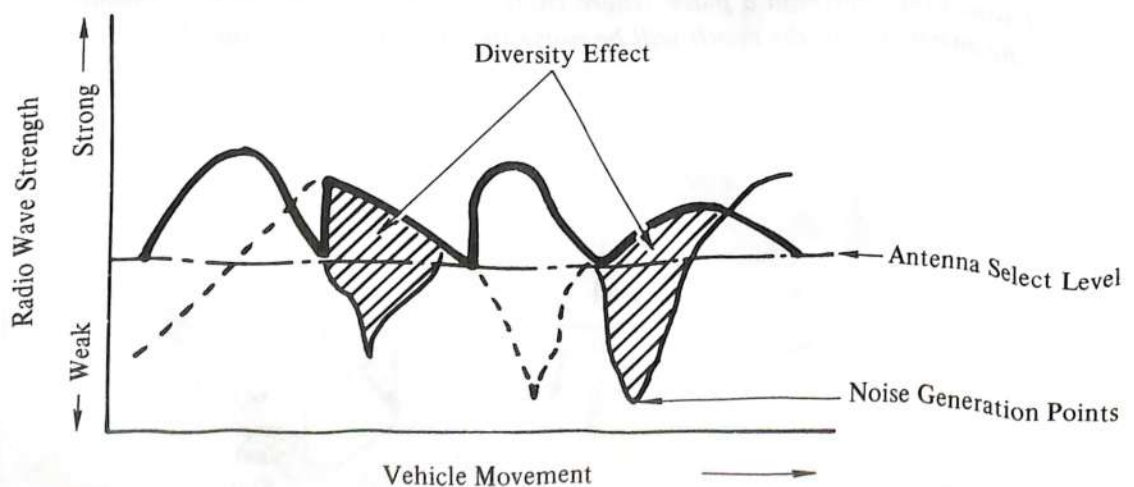
Since radio waves are being received by 2 types of antenna (pole and glass antenna) which have differing directivity, the antenna directivity is as shown in the figure below and the radio's sensitivity is improved.



► Space Diversity Effect

Even if the radio waves reaching one antenna are weak, it is highly unlikely that the radio waves reaching the other antenna will be weak at the same time.

Therefore, the system selects the antenna which has the strongest radio waves entering, changing antennas at the "Antenna Select Level" as in the graph below. This increases the antenna's sensitivity and prevents the generation of noise.



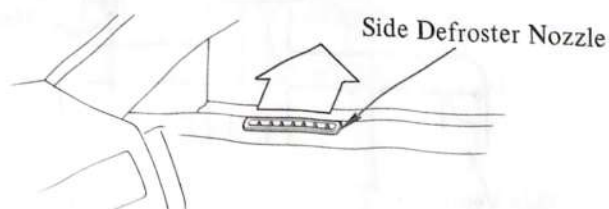
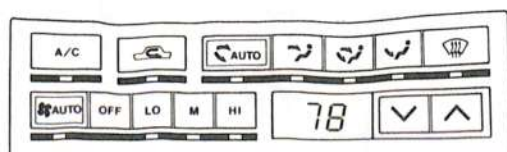
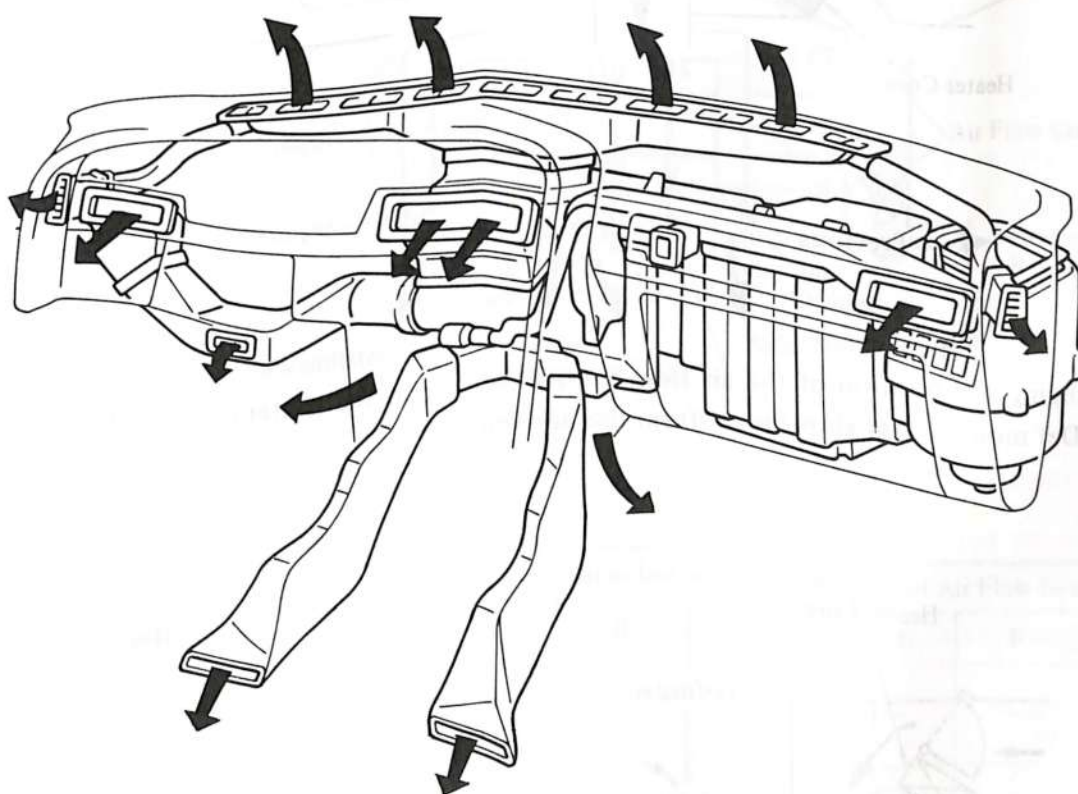
- Diversity Antenna Radio Wave Strength
- Pole Antenna Radio Wave Strength
- ... Glass Antenna Radio Wave Strength

VENTILATION AND HEATER

DESCRIPTION

The following improvements have been made in the ventilation and heater system of the new Supra.

- ▶ By reducing the resistance to air passing through the heater unit, the maximum air flow volume was increased and the dynamic ventilation performance was improved.
- ▶ A push-button type heater control was adopted to improve operability.
- ▶ Side defroster nozzles were mounted in the top of the door trims, improving the defrosting of the side window glass.

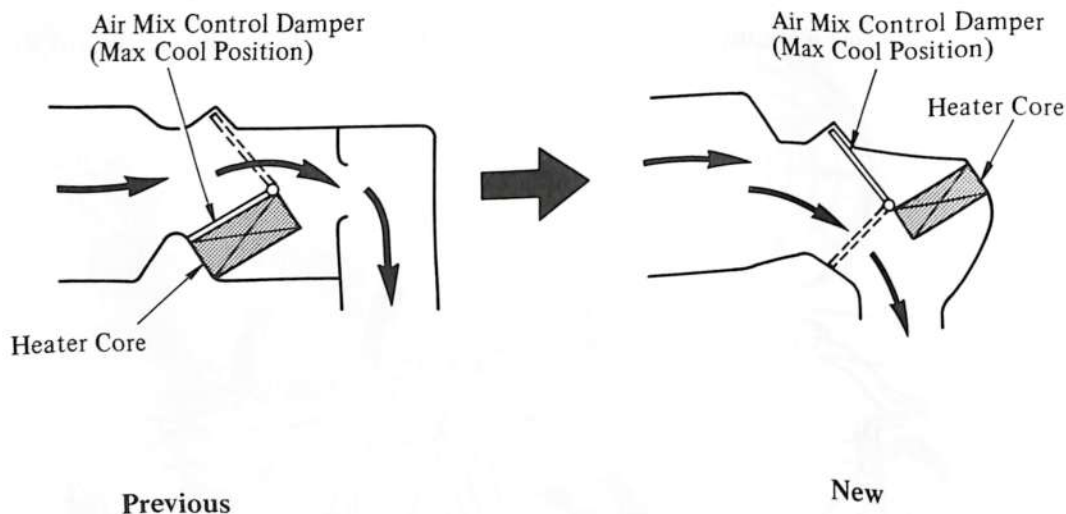


Push-button Type Heater Control Panel

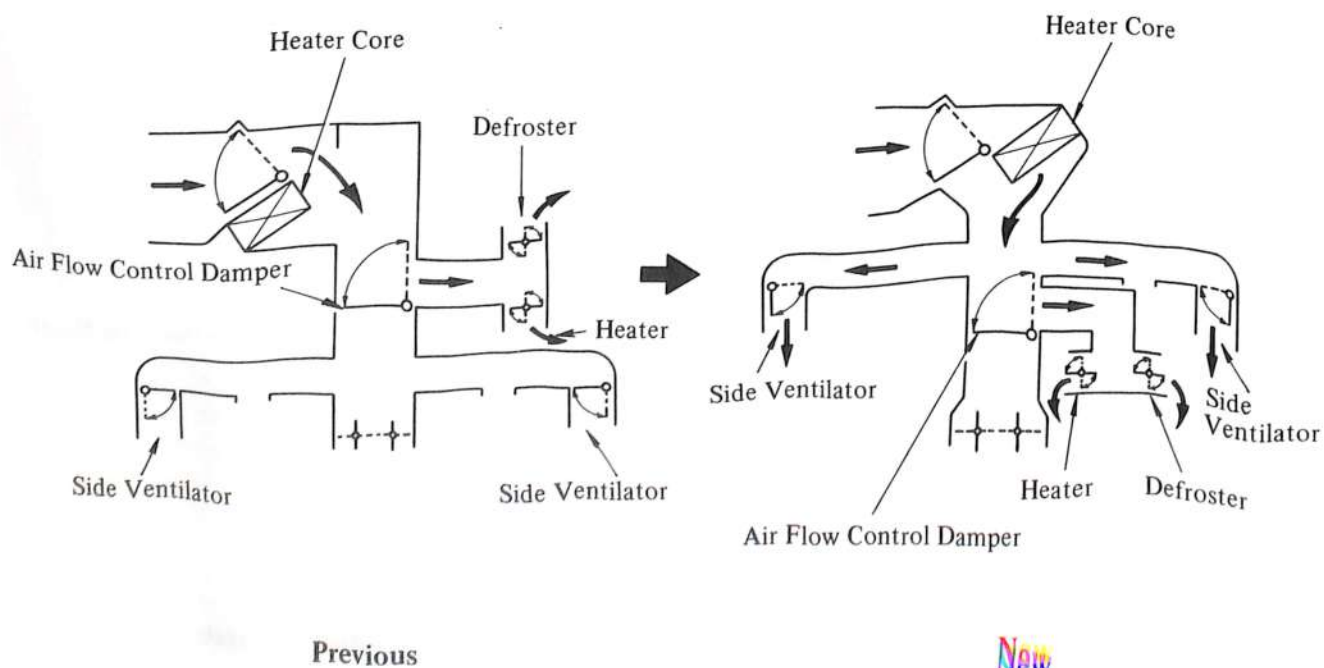
Side Defroster Nozzle

HEATER UNIT AND AIR DUCT

- The position of the heater core has been changed to reduce resistance to air passing through the heater unit.

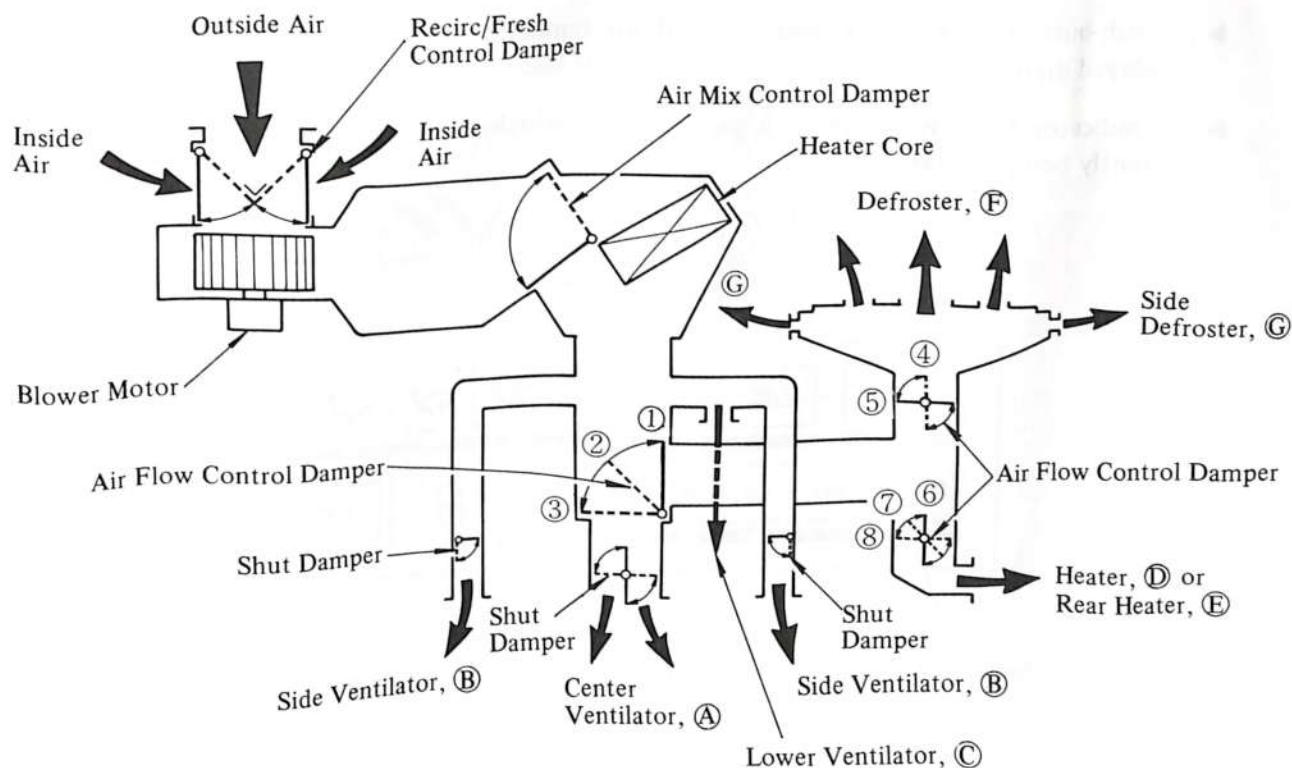


- By changing the position of the air flow control damper in the heater unit, even in the Heat mode or the Def mode, warm air is blown from the side ventilators.



Operation

- The position of the air flow control damper and vents in use in the various modes as well as the proportion of the air flow in each mode are shown in the illustration and table below.



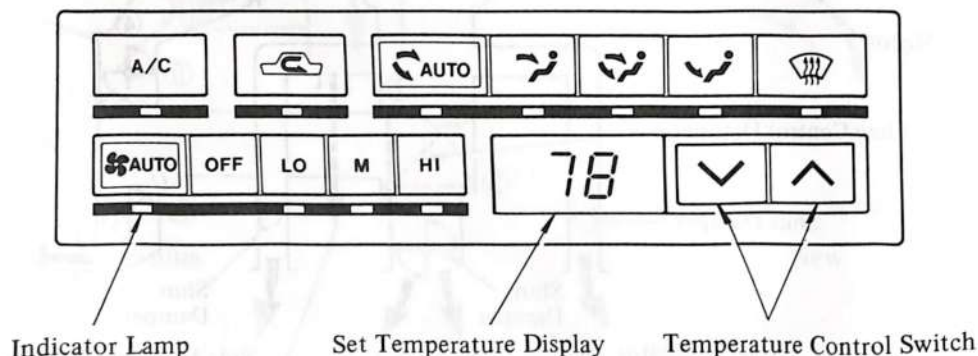
Mode	Air Flow Control Damper Position	Vent in Use and the Proportion of Air Flow to it *1					
		A	B	C	D, E	F	G
Vent 	① ⑤ ⑧				—	—	—
Bi-Level 	② ⑤ ⑦						
Heat 	③ ⑤ ⑥	—					
Def 	③ ④ ⑧	—					
Auto 	Optional	In this mode, vent temperatures are automatically controlled and the air flow mode is automatically changed between the Vent and Heat modes. Therefore, the air flow proportions are the same as those for Vent ~ Heat above.*2					

*1: The size of the circle indicates the proportion of air flow.

*2: Operation of the Auto mode is the same as in the 1986 Celica.

HEATER CONTROL PANEL

- A push-button type heater control was adopted for all models and RECIRC/FRESH control, air flow mode control and temperature control are operated by the various servo motors.
- Although the basic construction and operation are similar the push-button type heater control adopted in the 1986 Celica, the heater control in the new Supra differs in the following points.
 - ▶ A push-button type switch was adopted for temperature control. Also, the set temperature is displayed digitally.
 - ▶ An indicator lamp is under each push switch, which allows better identification of the switch currently being operated.



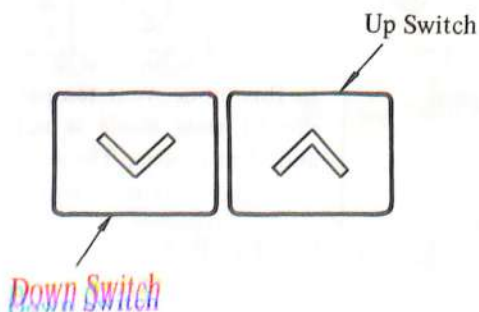
a. Set Temperature Display

- The set temperature is displayed in Fahrenheit (Centigrade in Canada) by a two-digit LED (Light Emitting Diode).
- Display characters are shown below.

1 2 3 4 5 6 7 8 9 0

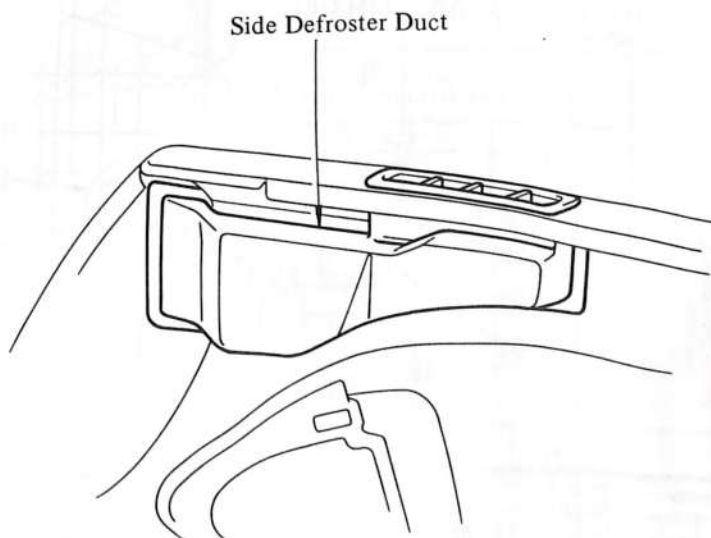
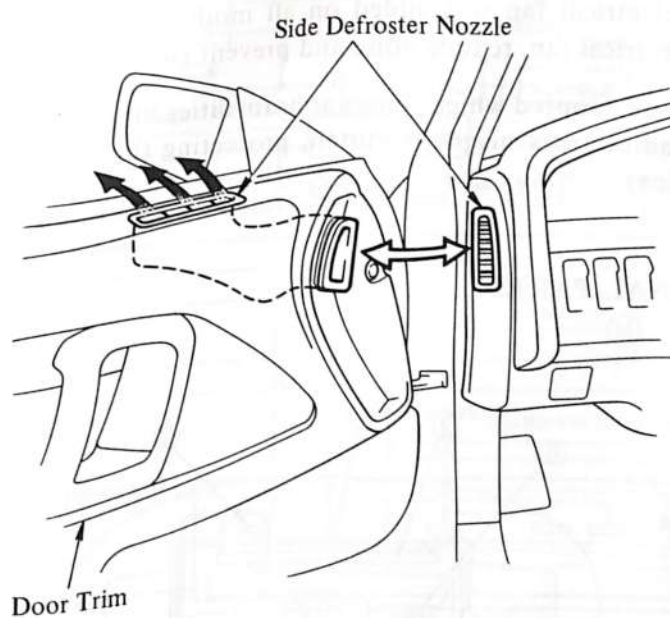
b. Temperature Control Switch

- The set temperature can be changed by $\pm 1^\circ$ units within a range of $65^\circ\text{F} \sim 85^\circ\text{F}$ ($18^\circ\text{C} \sim 32^\circ\text{C}$).
- When the switch is held down for an extended period, the set temperature changes by $\pm 1^\circ$ each 0.4 second.



SIDE DEFROSTER NOZZLE

- The side defroster outlet is located in the top of the door trim to improve defrosting of the side window glass when the defroster is operated.



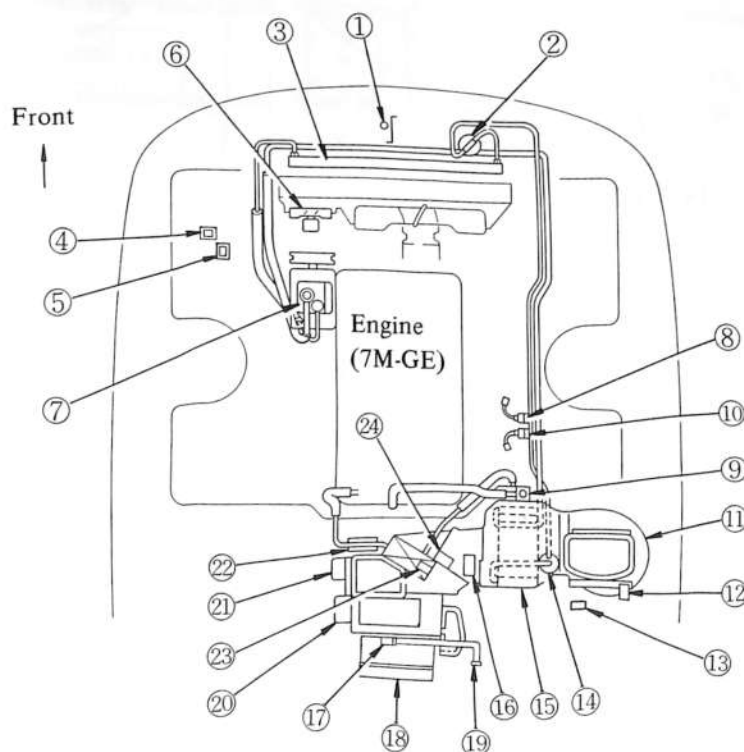
Inside of the Left Front Door Trim

AIR CONDITIONER

DESCRIPTION

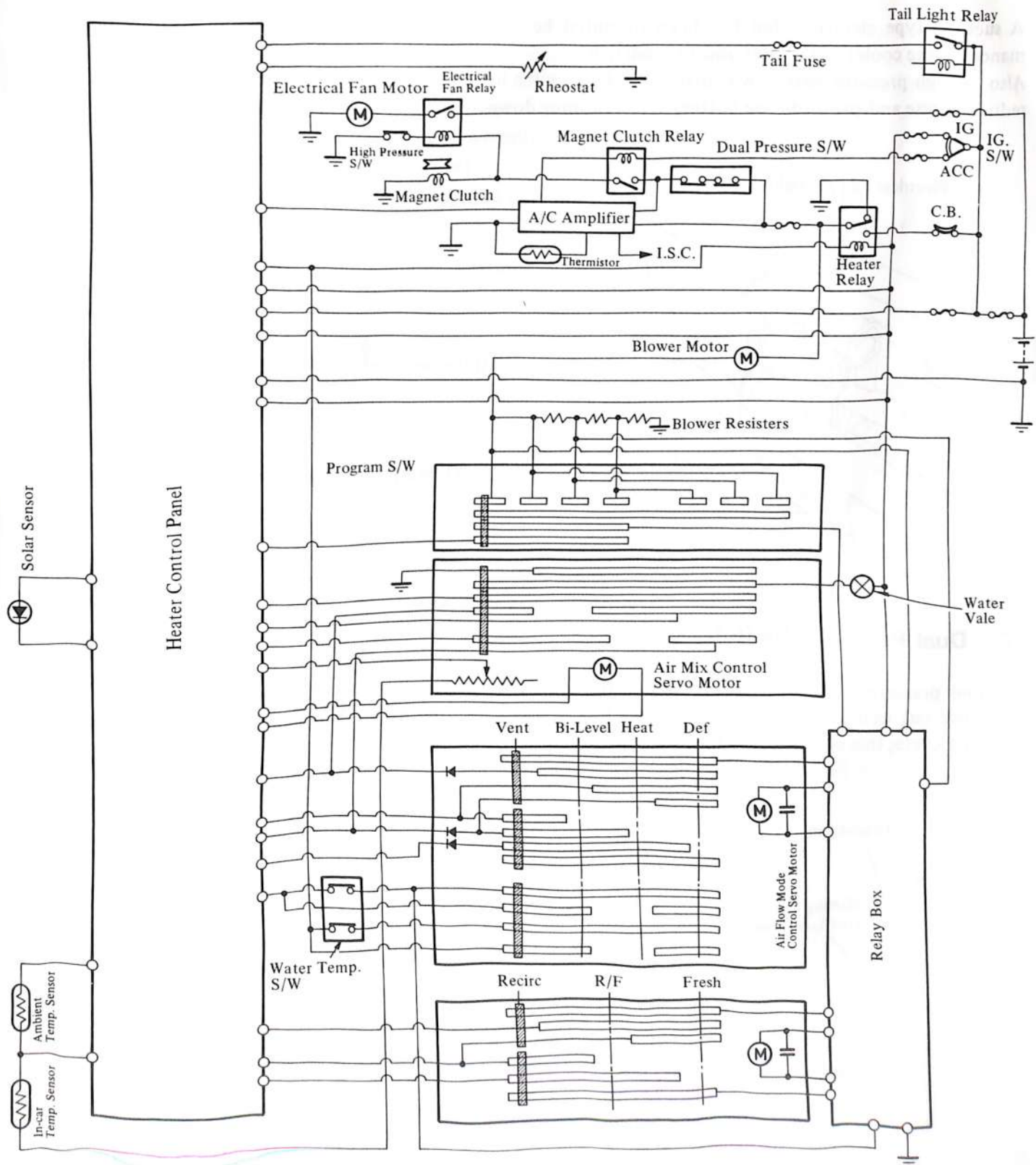
- The automatic air conditioning system has improved usability.
Its basic construction and operation are the same as that of the 1986 Celica.
- In order to maximize the cooling performance of the cooler condenser and engine when the air conditioner operating, an electrical fan was added on all models. Also, a relay is used to lower the utilization rate of the electrical fan, reduce noise and prevent running the battery down.
- A dual pressure switch was adopted which senses abnormalities in the refrigerant condensation pressure de-energizes the compressors magnetic clutch, protecting the compressor from damage. (The same as in the 1986 Celica)

LAYOUT OF FUNCTIONAL PARTS



Engine Room	Interior	
① Ambient Temp. Sensor	⑪ Blower	⑳ Heater Unit
② Receiver Tank	⑫ RECIRC/FRESH control Servo Motor	㉑ Air Flow Mode Control Servo Motor
③ Condenser	⑬ Sunlight Sensor	㉒ Relay Box
④ Electrical Fan Relay	⑭ Expansion Valve	㉓ Coolant Temp. Switch
⑤ Magnet Clutch Relay	⑮ Cooling Unit	㉔ Air Mix Control Servo Motor
⑥ Electrical Fan	⑯ Program Switch	
⑦ Compressor	⑰ Aspirator	
⑧ Dual Pressure Switch	⑱ Heater Control Panel	
⑨ Water Valve	⑲ In-car Temp. Sensor	
⑩ High Pressure Switch		

WIRING DIAGRAM

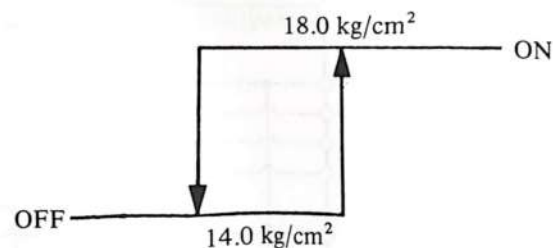
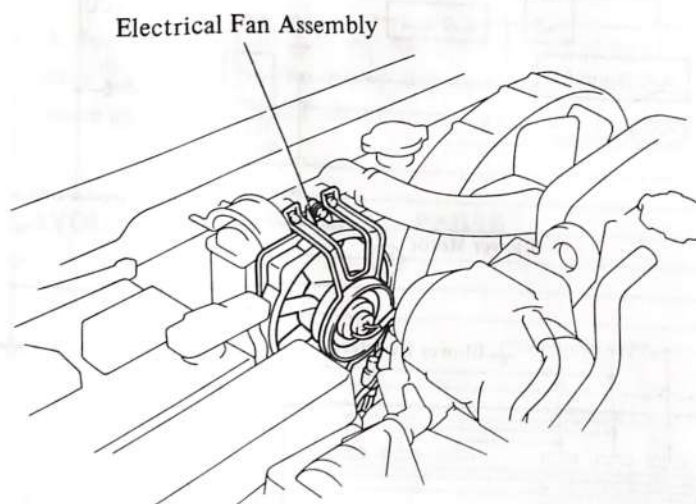


OPERATION

1. Electrical Fan System

A suction type electrical fan has been mounted behind the radiator to improve the cooling performance of the cooler condenser and the radiator.

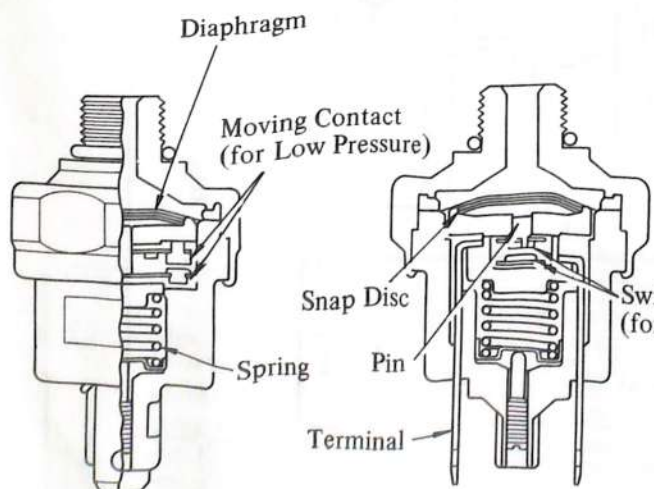
Also, a high pressure switch was installed. This switch lowers the utilization rate of the electrical fan, reduces noise and prevents the battery from running down.



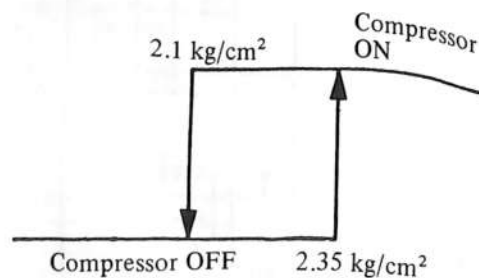
Operation of High Pressure Switch

2. Dual Pressure Switch

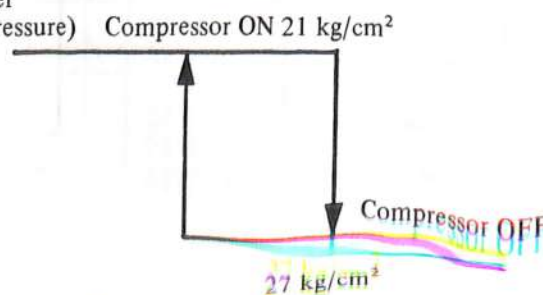
A dual pressure switch, which combines the functions of the high pressure cut switch and the low pressure cut switch (for detection of gas leakage) has been adopted. If a malfunction occurs in the cooling cycle, this switch stops the compressor.



Dual Pressure Switch



Operation Low Pressure



Operation High Pressure

Appendix

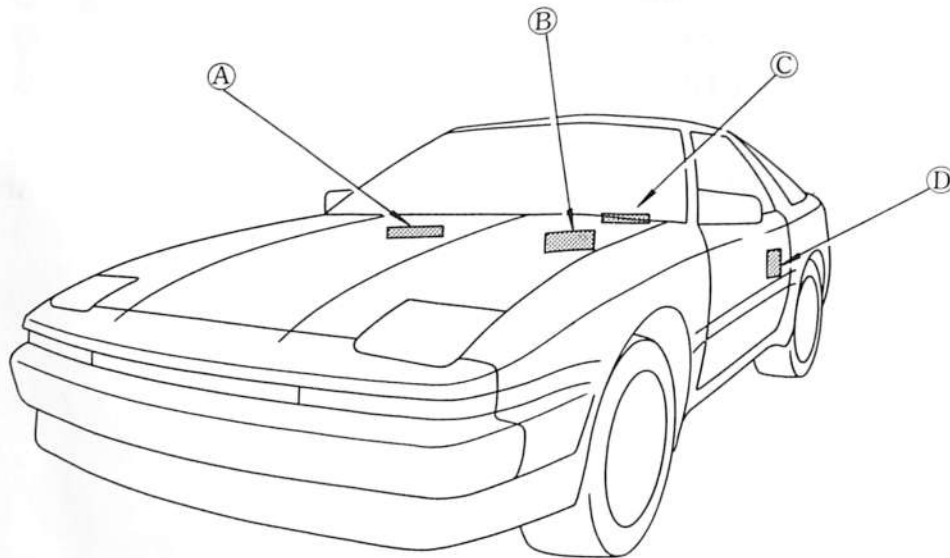
	Page
Identification Information	
Vehicle identification number	AP-2
Engine serial number	AP-2
Vehicle Lift And Support Locations	AP-3
Relay Locations	AP-4
Major Technical Specifications	AP-6

IDENTIFICATION INFORMATION

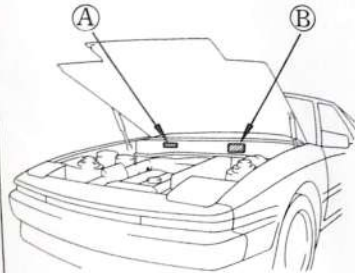
VEHICLE IDENTIFICATION NUMBER

The vehicle identification number is stamped on the cowl panel.

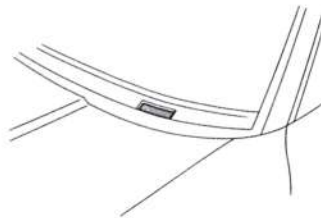
This number has also been stamped on the manufacturer's plate, vehicle identification number plate and certification regulation plate.



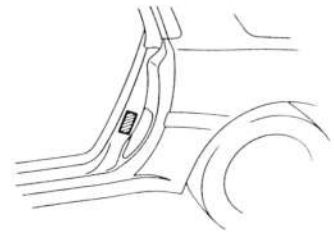
(A) Vehicle Identification Number
(B) Manufacturer's Plate



(C) Vehicle Identification Number Plate

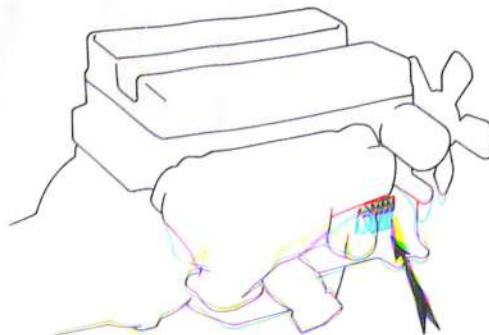


(D) Certification Regulation Plate

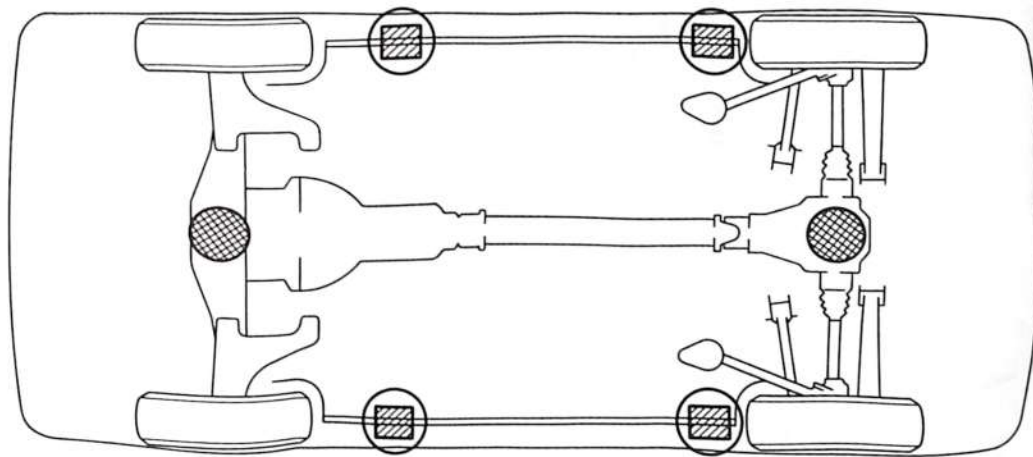


ENGINE SERIAL NUMBER

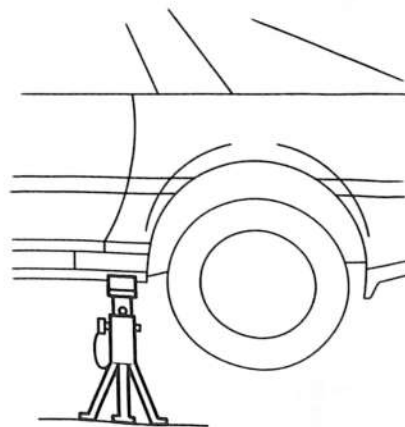
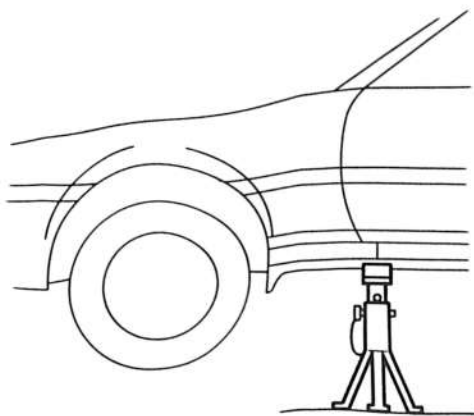
The engine serial number is stamped on the engine block as shown.
7M-GE Engine



VEHICLE LIFT AND SUPPORT LOCATIONS



← Front



JACK POSITION

Front Center of engine mounting center member
Rear Jack up support of rear floor pan

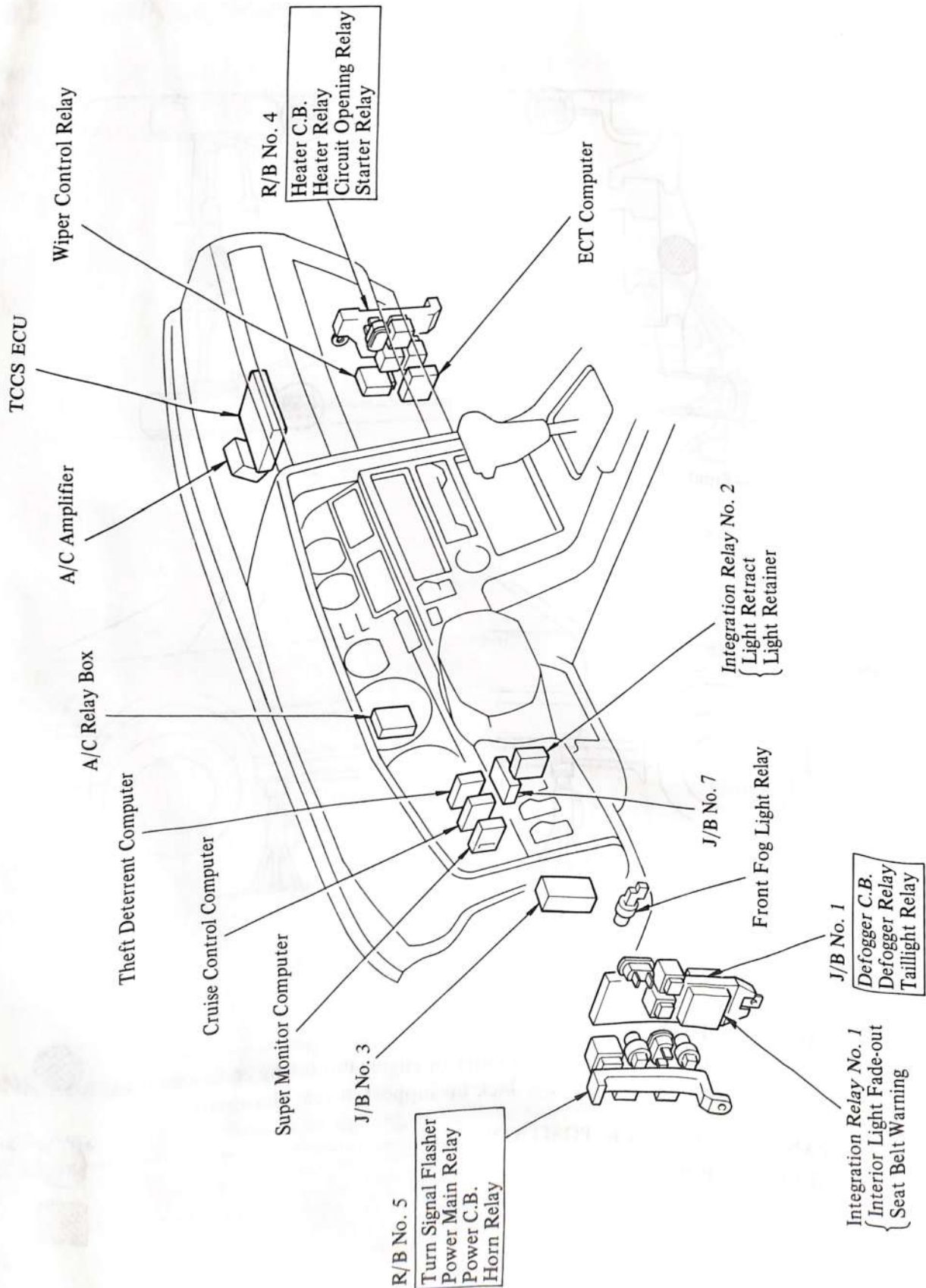


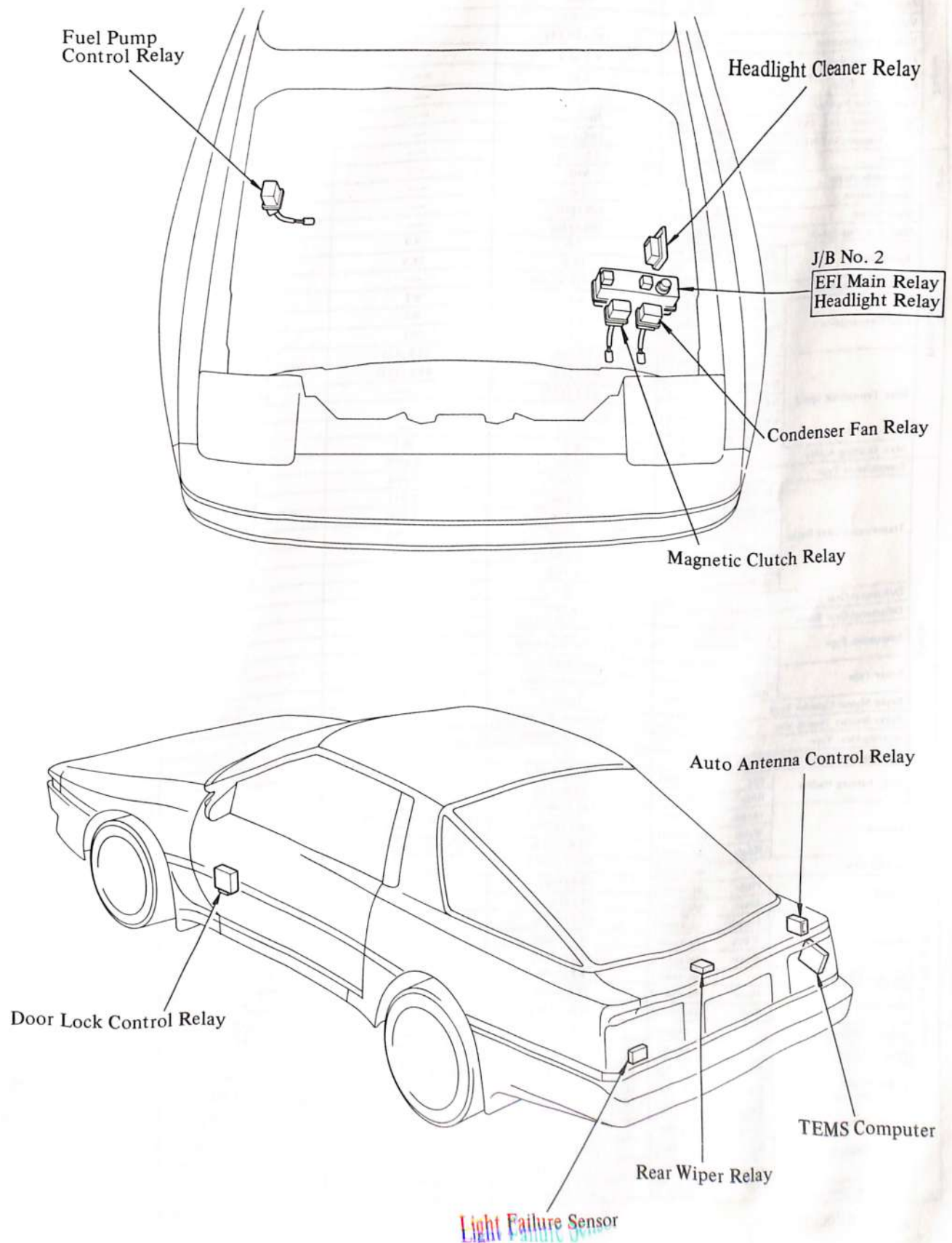
PANTOGRAPH JACK POSITION SUPPORT POSITION

Safety stand



RELAY LOCATION





MAJOR TECHNICAL SPECIFICATIONS

Item			Area	USA		CANADA	
Body Type			Liftback				
Grade			GT				
Model Code			MA70L-BLMVFA	MA70L-BLPVFA	MA70L-BLMVFK	MA70L-BLMVFK	
Engine	Engine Type		7M-GE	←	←	←	
	Valve Mechanism		D.O.H.C.	←	←	←	
	Piston Displacement cu.in. (cc)		180 (29.54)	←	←	←	
	Compression Ratio		9.2 to 1	←	←	←	
	Carburetor Type		E.F.I.	←	←	←	
	Fuel Octane Number RON		91	←	←	←	
	Max. Output (SAE-NET) Kw/rpm		200/6000	←	←	←	
	Max. Torque (SAE-NET) N-m/rpm		185/4800	←	←	←	
Engine Electrical	Battery Voltage & Amp. hr.		12 - 70	←	←	←	
	Alternator output Watts		840	←	←	←	
Performance	Starter output kw		1.4	←	←	←	
	Max. Speed mph (Km/h)		129 (210)	←	←	←	
	Max. Cruising Speed mph (Km/h)		106 (170)	←	←	←	
	Acceleration	0 to 100 Km/h sec.	7.9	8.9	7.9	8.9	
		0 to 400 m sec.	15.9	16.5	15.9	16.5	
	Fuel Tank Capacity gal. (Imp.gal.,ℓ)		18.5 (15.4, 70)	←	←	←	
	Fuel Consumption	City Mode ℓ/100km	*1	*1	—	—	
		Highway Mode ℓ/100km	*1	*1	—	—	
		Combined ℓ/100km	*1	*1	—	—	
	Max. Permissible Speed	1st gear mph (Km/h)	33.0 (53)	37.9 (61)	33.0 (53)	37.9 (61)	
		2nd gear mph (Km/h)	57.2 (92)	69.6 (112)	57.2 (92)	69.6 (112)	
		3rd gear mph (Km/h)	85.1 (137)	—	85.1 (137)	—	
		4th gear mph (Km/h)	—	—	—	—	
		5th gear mph (Km/h)	—	—	—	—	
	Max. Grading Ability tan θ		*1	*1	*1	*1	
Chassis	Transmission Type		W58	A340E	W58	A340E	
	Transmission Gear Ratio	In First	3.285	2.804	3.285	2.804	
		In Second	1.894	1.531	1.894	1.531	
		In Third	1.275	1.000	1.275	1.000	
		In Fourth	1.000	0.705	1.000	0.705	
		In Fifth	0.783	—	0.783	—	
		In Reverse	3.768	2.393	3.768	2.393	
	Differential Gear Size in.		8"	←	←	←	
	Differential Gear Ratio		4.300	←	←	←	
	Suspension Type	Front	Double Wishbone	←	←	←	
		Rear	Double Wishbone	←	←	←	
	Brake Type	Front	Ventilated Disc	←	←	←	
		Rear	Ventilated Disc	←	←	←	
	Brake Master Cylinder Type		Tandem	←	←	←	
	Brake Booster Type & Size in.		Tandem, 8" + 9"	←	←	←	
	Steering Gear Type		Rack & Pinion	←	←	←	
	Steering Gear Ratio (Overall)		16.5	←	←	←	
Min. Turning Radius	Tire ft. (m)	17.7 (5.4)	←	←	←		
	Body ft. (m)	19.0 (5.8)	←	←	←		
Overall	Length in. (mm)	181.9 (4620)	←	←	←		
	Width in. (mm)	68.7 (1745)	←	←	←		
	Height in. (mm)	51.6 (1310)	←	←	←		
	Wheel Base in. (mm)	102.2 (2595)	←	←	←		
Tread	Front in. (mm)	58.5 (1485)	←	←	←		
	Rear in. (mm)	58.5 (1485)	←	←	←		
Room	Length in. (mm)	67.7 (1720)	←	←	←		
	Width in. (mm)	55.1 (1400)	←	←	←		
	Height in. (mm)	42.1 (1070)	←	←	←		
Ground Clearance in. (mm)		5.5 (140)	←	←	←		
Overhang	Front in. (mm)	37.8 (960)	←	←	←		
	Rear in. (mm)	41.9 (1065)	←	←	←		
Angle of Approach degree		12.5	←	←	←		
Angle of Departure degree		18.5	←	←	←		
Major Dimensions & Vehicle Weights	Curb Weight (w/o OPT - Full OPT)	Front lb (kg)	1805 (819)~1845 (837)	1845 (837)~1885 (855)	1840 (834)~1845 (837)	1875 (850)~1885 (855)	
		Rear lb (kg)	1665 (755)~1705 (773)	1675 (760)~1715 (778)	1675 (760)~1705 (773)	1690 (766)~1715 (778)	
		Total lb (kg)	3470 (1574)~3550 (1610)	3520 (1597)~3600 (1633)	3515 (1594)~3550 (1610)	3565 (1616)~3600 (1633)	
	Gross Vehicle Weight	Front lb (kg)	2140 (970)	←	←	←	
		Rear lb (kg)	2320 (1052)	←	←	←	
Total lb (kg)		4460 (2022)	←	←	←		
Luggage Compartment Capacity cu.ft. (m ³)		12.8 (0.362)	←	←	←		

*1 : Undecided



TOYOTA
QUALITY SERVICE

OVERSEAS SERVICE DEPARTMENT
TOYOTA MOTOR CORPORATION
Haruhi Center

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