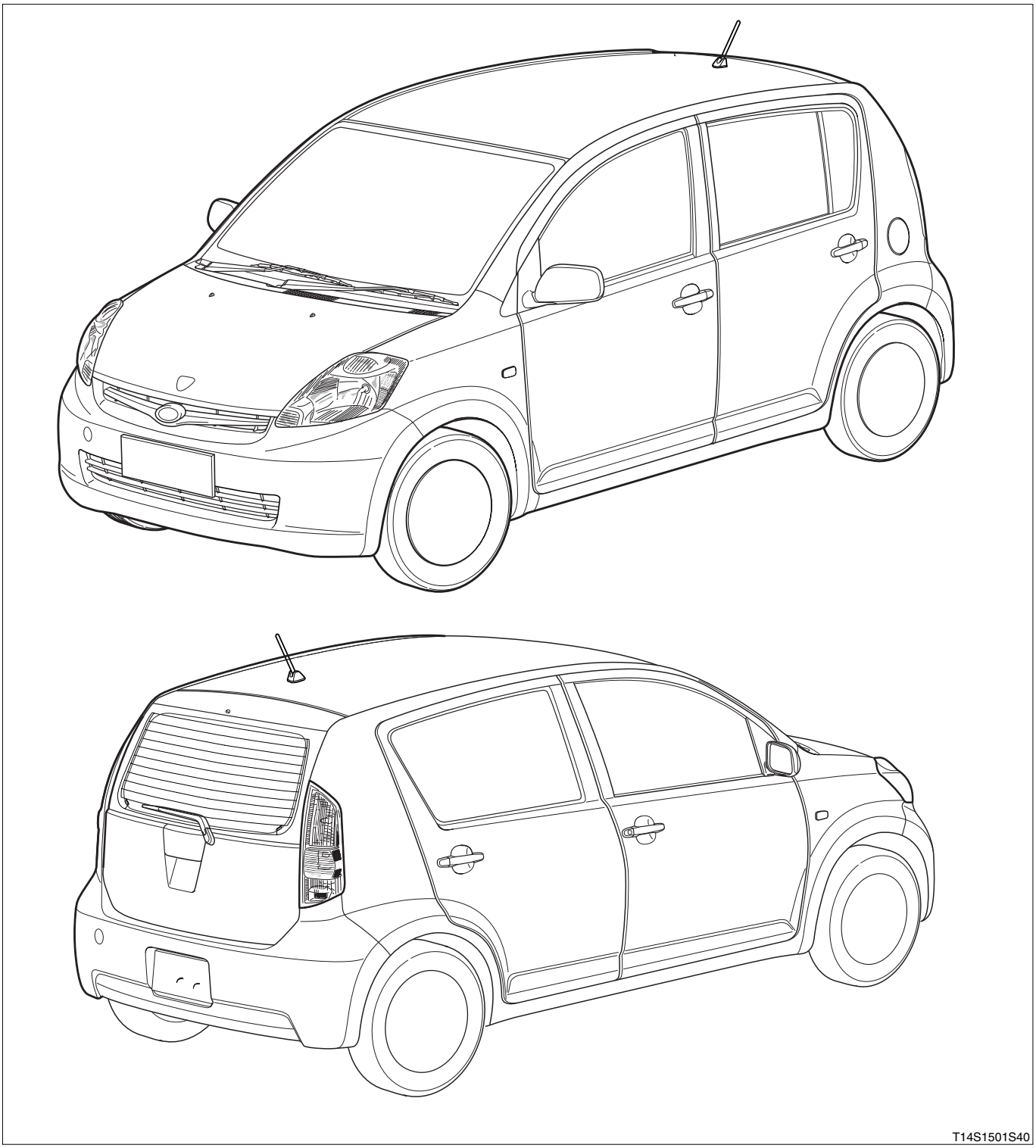
A1 GENERAL INFORMATION

1 EXTERIOR, MODEL VARIATION, VEHICLE MODEL CODE

1-1 EXTERIOR



T14S1501S40

The illustration represents a major example.

1-2 MODEL VARIATION

1-2-1 EU SPECIFICATIONS

Model code	Steering position	Engine	Drive	Transmission	Body type
M300RF－GMNEW	RHD	1KR－FE	2WD	5M/T	5－door
M300LF－GMNEW	LHD				

1-3 EXPLANATION OF VEHICLE MODEL CODE

M 3 0 0 R F － G M N E W
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

①Model M3 : JUSTY	②Drive 0 : 2WD
③Engine 0 : 1KR－FE	④Steering L : LHD R : RHD
⑤Body type S : Sedan	⑥Door G : 5－door
⑦Transmission M : 5M/T	⑧Grade N : STD(1.0L)
⑨Engine E : DVVT engine	⑩Market W : EU

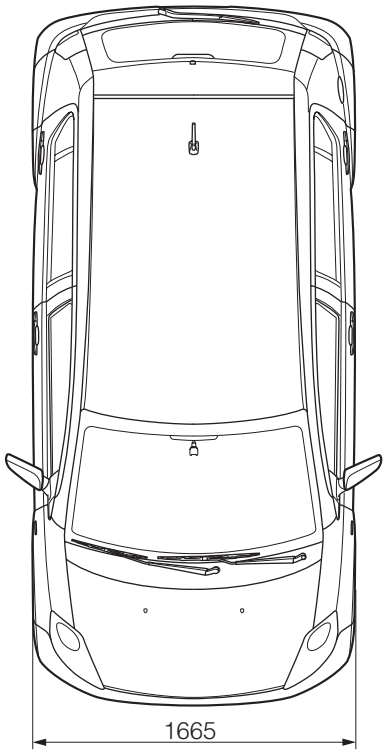
2 SPECIFICATIONS

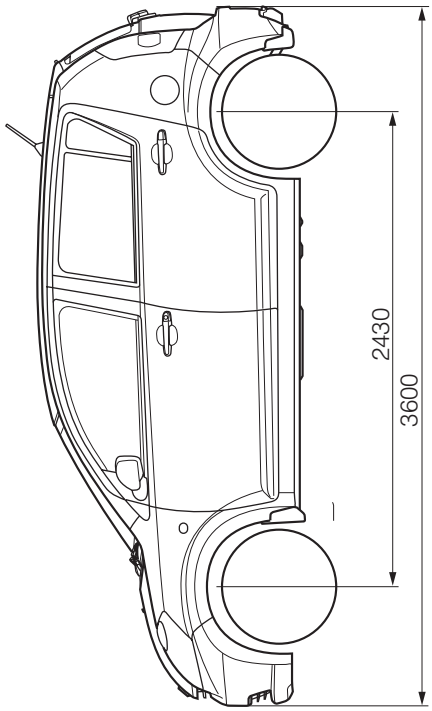
Items				M300LF/M300RF GMNEW
		Market		EU
		Transmission		5M/T
		Drive		2WD
Overall length			mm	3600
Overall width			mm	1665
Overall height			mm	1550
Interior length			mm	1830
Interior width			mm	1400
Interior height			mm	1275
Wheelbase			mm	2430
Tread	13 " tire	Front	mm	1470
		Rear	mm	1475
	14 " tire	Front	mm	1460
		Rear	mm	1465
Minimum road clearance			mm	150
Turning circle between walls	13 " tire		m	9.4
	14 " tire		m	10.2
Kerb weight			kg	890
Gross vehicle weight			kg	1390
Seating capacity			persons	Front : 2, Rear : 3
Engine type				1KR－FE, petrol, 3 cylinder, DOHC, 12 valve, DVVT
Total displacement			cc	998
Bore×stroke			mm	71.0×84.0
Max. output			kw/rpm	51.0/6000
Max. Torque			Nm/rpm	94.0/3600
Compression ratio				10.5±0.3
Fuel system				EFI (Electronic fuel injection)
Fuel tank capacity			Litres	40
Clutch				Dry single plate diaphragm
Transmission	5M/T			Forward 5-speed, manual, all synchromesh
Transmission gear ratio	1KR－FE	5M/T		1st:3.182, 2nd:1.842, 3rd:1.250, 4th:0.917, 5th:0.750, rev:3.143
Final reduction gear ratio	1KR－FE	5M/T		4.500
Steering type				Rack&Pinion
Main brakes	Front			Ventilated disk brakes with booster
	Rear			Drums, leading and trailing
Parking brake				Mechanical hand opreration
Suspension	Front			MacPherson struts with coil springs
	Rear			Semi-independent torsion axle beam with coil springs
Tires	13 " tire			155/80R13
	14 " tire			175/65R14
Trailer towing	without brake		kg	350
	with brake		kg	750
Permissible roof rack load			kg	50
Fuel Consumption *1	Combined		ℓ/100km	5.0
	Urban		ℓ/100km	6.1
	Extra-urban		ℓ/100km	4.4
CO_2 emissions *1	Combined		g/km	118

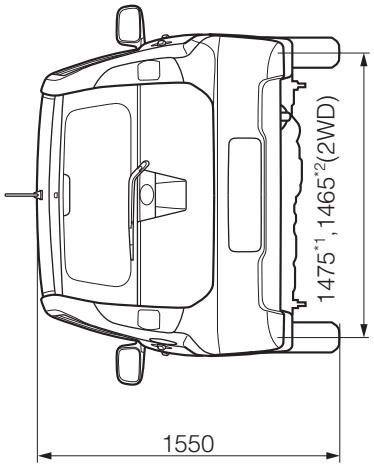
*1 : EC Directive (80/1268/EEC)

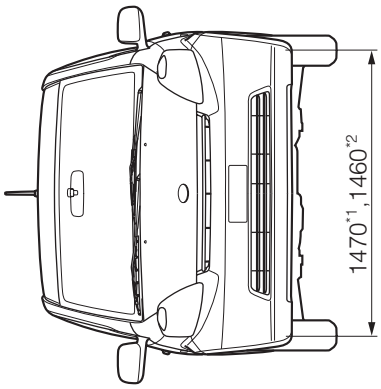
The rate of fuel consumption and CO_2 emissions are measured according to predetermined test conditions. Because the conditions (weather, road type, vehicle, driving method, state of maintenance, etc.) will differ during actual driving, the rate of fuel consumption and CO_2 emissions will vary accordingly.

3 VIEWS OF VEHICLE









Unit:mm

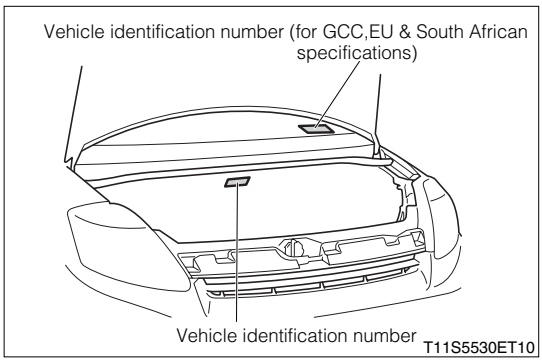
T14S1511S45

*1: 13 inch tire
*2: 14 inch tire

4 VEHICLE IDENTIFICATION

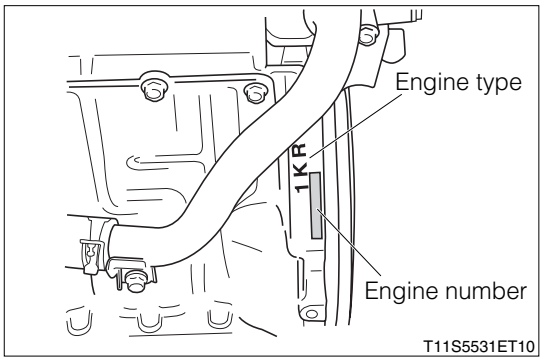
4-1 LOCATION

4-1-1 VEHICLE IDENTIFICATION NUMBER

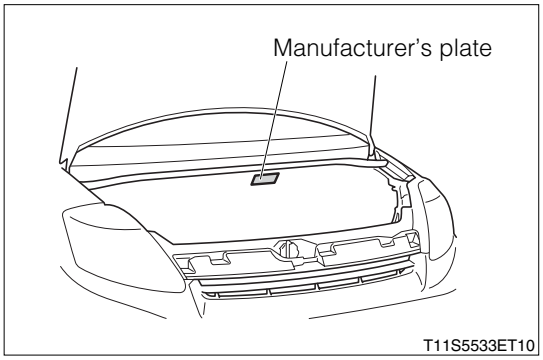


4-1-2 ENGINE TYPE AND ENGINE NUMBER

1KR－FE



4-1-3 MANUFACTURER'S PLATE POSITION



5 ABBREVIATION CODES

ABBREVIATION CODE	ORIGINAL WORD	ABBREVIATION CODE	ORIGINAL WORD
2WD	Two Wheel Drive	LHD	Left Hand Drive
4WD	Four Wheel Drive	LIN	Local Interconnect Netwark
ABS	Anti-lock Brake System	LSPV	Load Sensing Proportioning Valve
ABV	Air Bypass Valve	LWR	Lower
A/C	Air Conditioner	MIL	Malfunction Indicator Lamp
ACC	Accessory	MP	Multipurpose
API	American Petroleum Institute	M/T	Manual Transmission
A/T	Automatic Transmission	N/A	Natural Aspiration
ATDC	After Top Dead Center	NOx	Nitrogen Oxides
ATF	Automatic Transmission Fluid	OPT	Option
Ay	Assembly	O/D	Overdrive
BDC	Bottom Dead Center	O/S	Oversize
BTDC	Before Top Dead Center	PCV	Positive Crankcase Ventilation
BVSV	Bimetal Vacuum Switching Valve	PR	Ply Rating
CAN	Controller Area Network	PTO	Power Take Off
CD	Compact Disc	RH	Right Hand
CO	Carbon Monoxide	RHD	Right Hand Drive
DLC	Data Link Connector	RR	Rear
DLI	Distributor Less Ignition	S/A	Sub-Assembly
DTC	Diagnostic Trouble Code	SAE	Society of Automotive Engineers
DVVT	Dynamic Variable Valve Timing	SRS	Supplemental Restraint System
EBD	Electronic Brake force Distribution	SST	Special Service Tool
ECU	Electronic Control Unit	STD	Standard
EFI	Electronic Fuel Injection	SW	Switch
EGR	Exhaust Gas Recirculation System	T	Torque
EPS	Electronic controlled Power Steering	T/C	Turbocharger
ESA	Electronic Spark Advance	TDC	Top Dead Center
EX	Exhaust	UPR	Upper
F/L	Fusible Link	U/S	Undersize
FR	Front	VCV	Vacuum Control Valve
GND	Ground	VSV	Vacuum Switching Valve
HC	Hydro Carbon	VTV	Vacuum Transmitting Valve
IG	Ignition	W/	With
IN	Intake	WVTA	Whole Vehicle Type Approval
ISC	Idle Speed Control	Ⓑ	Bolt
ISO	International Organization for Standardization	Ⓢ	Screw
LCD	Liquid Crystal Display	Ⓝ	Nut
LED	Light Emitting Diode	Ⓦ	Washer
LH	Left Hand	Ⓒ	Clip

B1 ENGINE DESCRIPTION

■ 1KR
1 OUTLINE

On M 300 Series, a newly-designed Type 1KR-FE engine has been mounted transversely.
Type 1KR-FE engine is an in-line 3-cylinder water-cooled engine with a displacement of 0.996 liter that has been developed, aiming at excellent fuel economy, low noise level, low vibration, light weight and maintenance-free feature.
The vehicles mounted with Type 1KR engine have two different specifications, depending upon the applicable exhaust emission control standards, i.e. the general destination specification and EU destination specification. The general specification vehicles have complied with the exhaust emission control standard, ECE83-03 (the normally-called Euro2) through changing the EFI system specifications as well as the employment of the optimized control. etc. Moreover, the EU specification vehicles have complied with the exhaust emission control standard: EEC:2003/76/(70/220), EEC:R83-05 (the normally-called Euro4) through changing the EFI system specifications and employing the optimized control, etc, combined with the intelligent catalyst.
Furthermore, all the EU specification vehicles have achieved the fuel consumption standard 2004/3 (80/1268).

1. FEATURES

(1) LOW FUEL CONSUMPTION

The intake and exhaust efficiencies have been improved through the employment of a valve actuating mechanism with DOHC4 valves with a variable valve timing device and a longitudinal type straight intake port.
A higher compression ratio has been achieved through a compact combustion chamber and improved cooling around the combustion chamber. Also, the combustion efficiency has been improved.
The resistance related to the pistons has drastically been reduced through the employment of a reduced thrust load of piston due to the adoption of an offset crankshaft, the application of a new type resin coating to the pistons and reduced piston ring tensions.
The pumping loss has been reduced through the employment of DVVT equipment and the introduction of EGR gas in the medium and low loading ranges.

(2) LOW VIBRATION AND LOW NOISE LEVEL

The engine vibration has been reduced and joint rigidity has been improved by adopting a high rigidity aluminum block and a high rigidity aluminum oil pan.
The tapping noise and bending vibration have been reduced by employing a forged individually balanced crankshaft.
The engine mount vibration has been reduced by integrating the engine mount bracket with the chain cover.

(3) COMPACT SIZE AND LIGHT WEIGHT

The cylinder head-related components have been designed compactly with reduced weight by employing a direct-tapping type DOHC.
The weight has been reduced by employing resin intake manifold, throttle body and head cover.

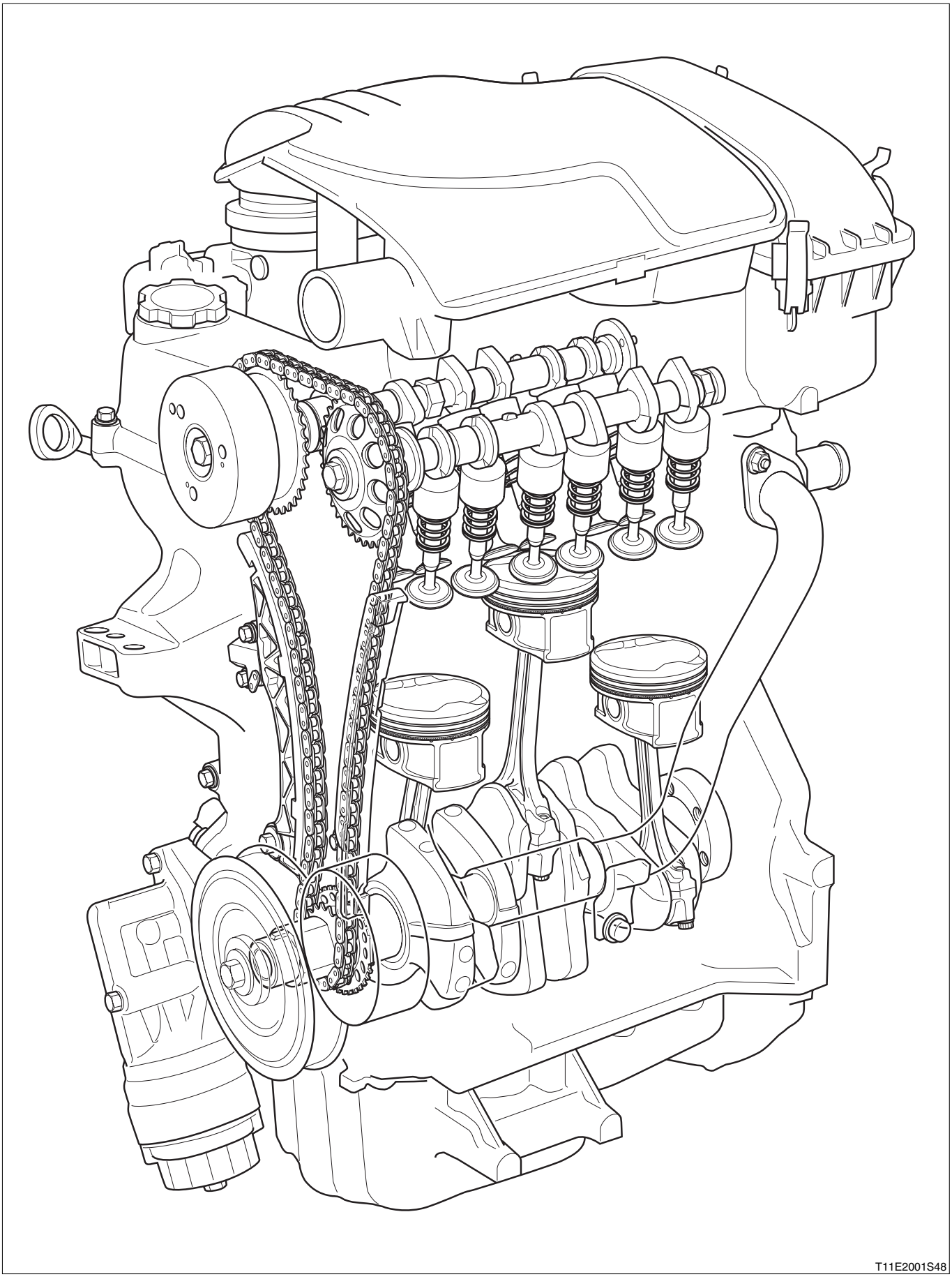
(4) MAINTENANCE

The maintenance-free feature has been achieved by employing a timing chain equipped with an auto tensioner.

The employment of an element replacement type oil filter has reduced the environmental load substance during the recycling period.

A method using CAN communication has been employed for communication with the diagnostic tester.

Engine perspective view



T11E2001S48

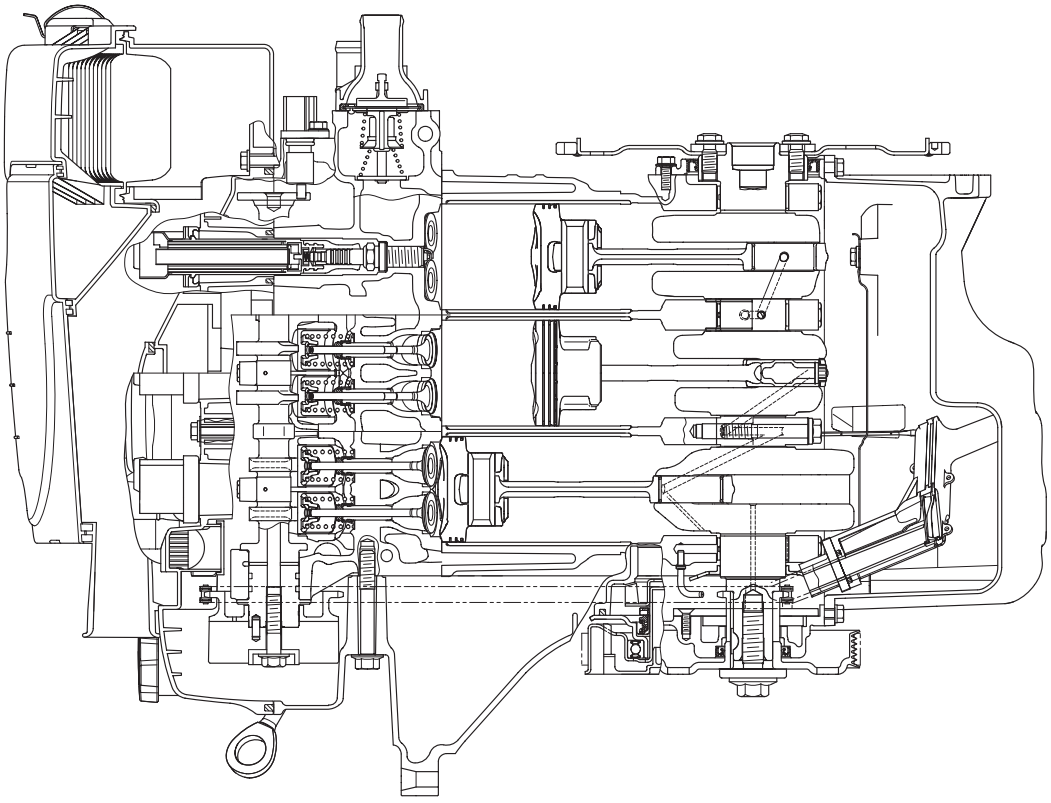
2 SPECIFICATIONS

Engine specificatons

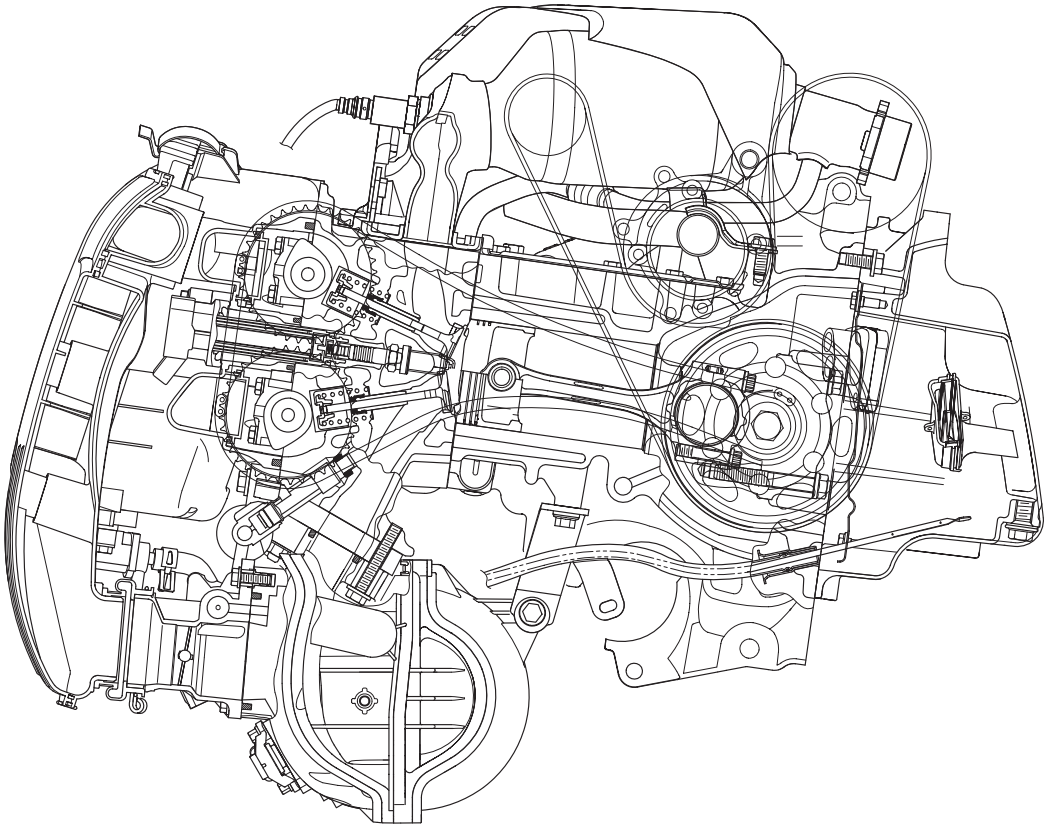
Engine type			TYPE 1KR-FE
Kind			Gasoline-fueled, water-cooled 4-cycle
Number of cylinders and arrangement			3-cylinder in line, transversely mounted
Valve mechanism			Chain driven, DOHC (IN2, EX2)
Combustion chamber			Pent roof
Intake and exhaust layout			Cross-flow type
Total displacement (cc)			998
Bore × Stroke (mm)			71.0×84
Compression ratio			10.5±0.3
Maximum output (kW) [rpm]			51.0/6000
Maximum torque (N·m) [rpm]			94.0/3600
Valve Timing	Intake	Open	40°-−5° BTDC
		Close	10°-55° ABDC
	Exhaust	Open	40° BBDC
		Close	2° ATDC
Fuel supplying device			Electronically controlled fuel injection system (EFI)
Ignition method			Full-transistorized DLI type battery ignition
Idle revolution speed			800±50
Lubricant used			SAE 0W-20 or 5W-30 API SG or higher

3 SECTIONAL VIEW

Engine cross-section view



<Longitudinal cross-section>



<Transverse cross-section>

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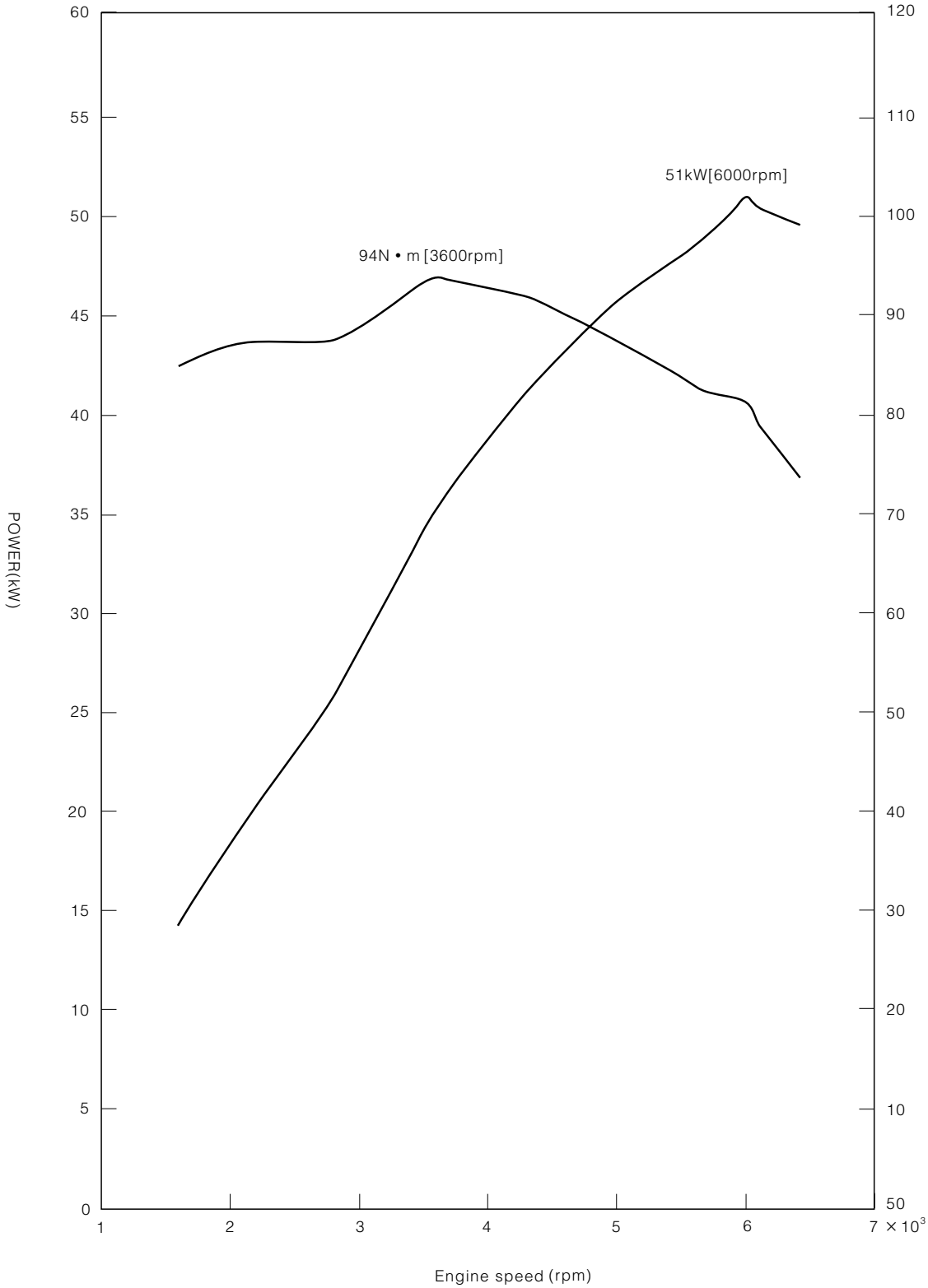
4 PERFORMANCE CURVE

Engine performance diagram



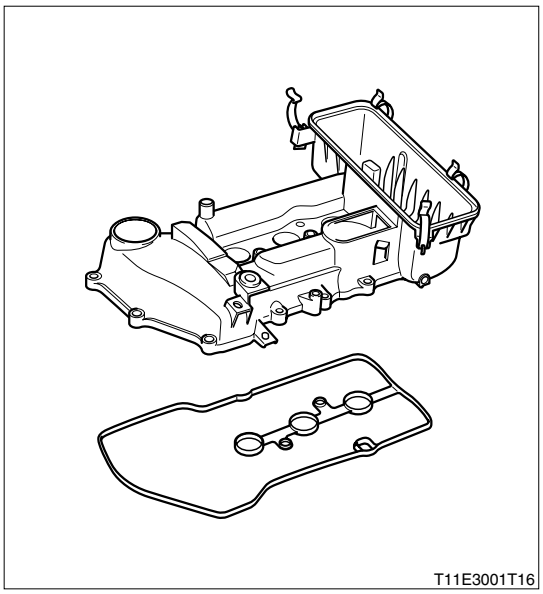
Type 1KR-FE Engine

T11E2007ES48

B2 ENGINE MECHANICAL

■ POWER TRAIN (1KR)
1 CONSTRUCTION AND OPERATION
1-1 CYLINDER HEAD COVER

In order to achieve a light weight, a resin cylinder head cover integral with the air cleaner case has been employed. The blow-by chamber and PCV chamber are provided. Furthermore, as for the cylinder head cover gasket, for easier servicing, the gasket for the outer periphery has been integrated with the gasket at the plug tube section.



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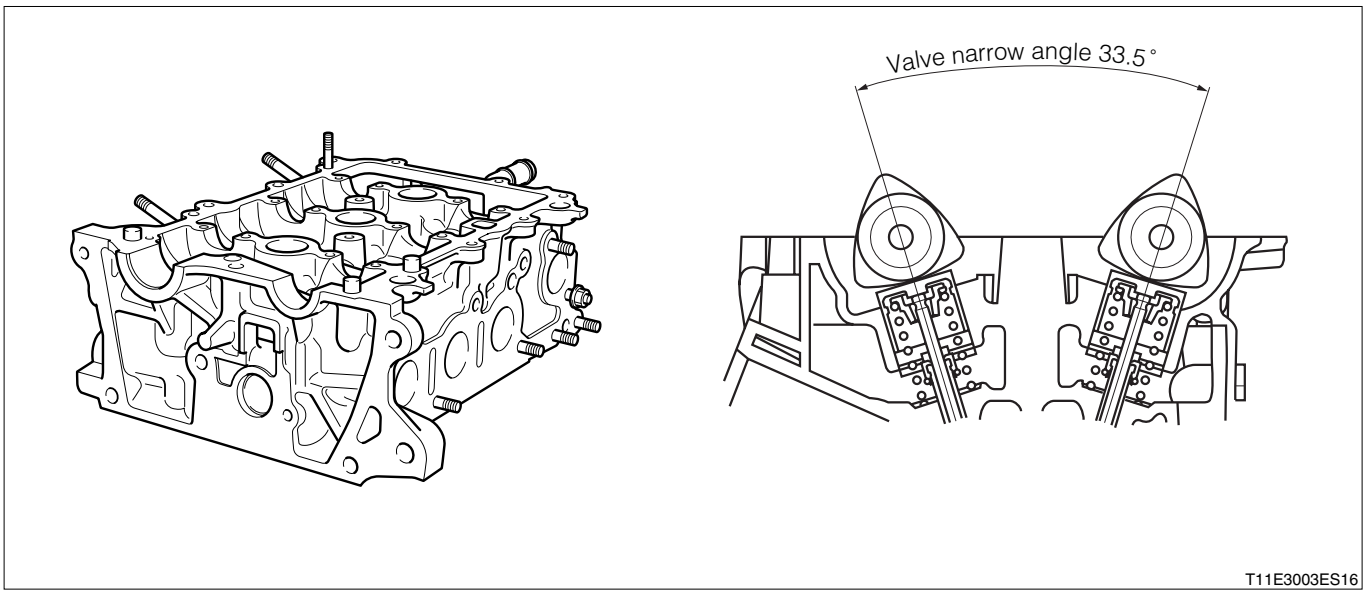
1-2 CYLINDER HEAD

A compact combustion chamber featuring an excellent S/V ratio has been employed and an oblique squish is adopted. Moreover, for improved knock limit, long reach plugs have been employed, thus conforming to the shape of the water jacket of the cylinder head. Furthermore, for enhanced combustion due to the generation of an optimum tumble in the combustion chamber, the shape of the intake port in the cylinder head has been optimized. In order to improve fuel consumption, a passage for EGR gas is provided at the rear of the cylinder head in such a way that it is in contact with the water jacket, thus lowering the EGR gas temperature.

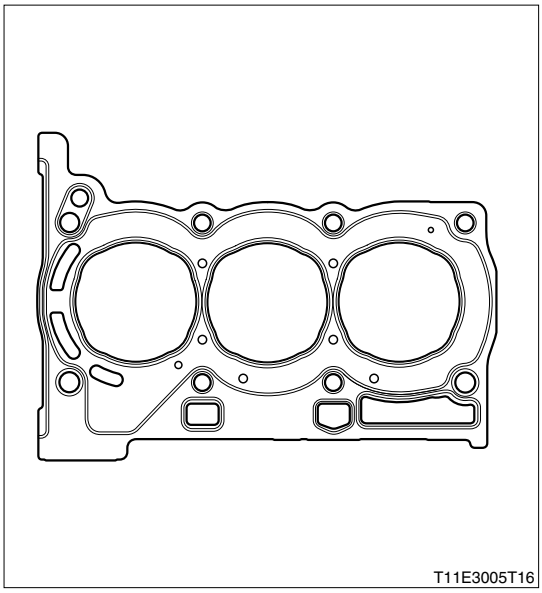
For enhanced auxiliary resonance frequency characteristics, an alternator flange has been integrated.



T11E3003ES16

1-3 CYLINDER HEAD GASKET

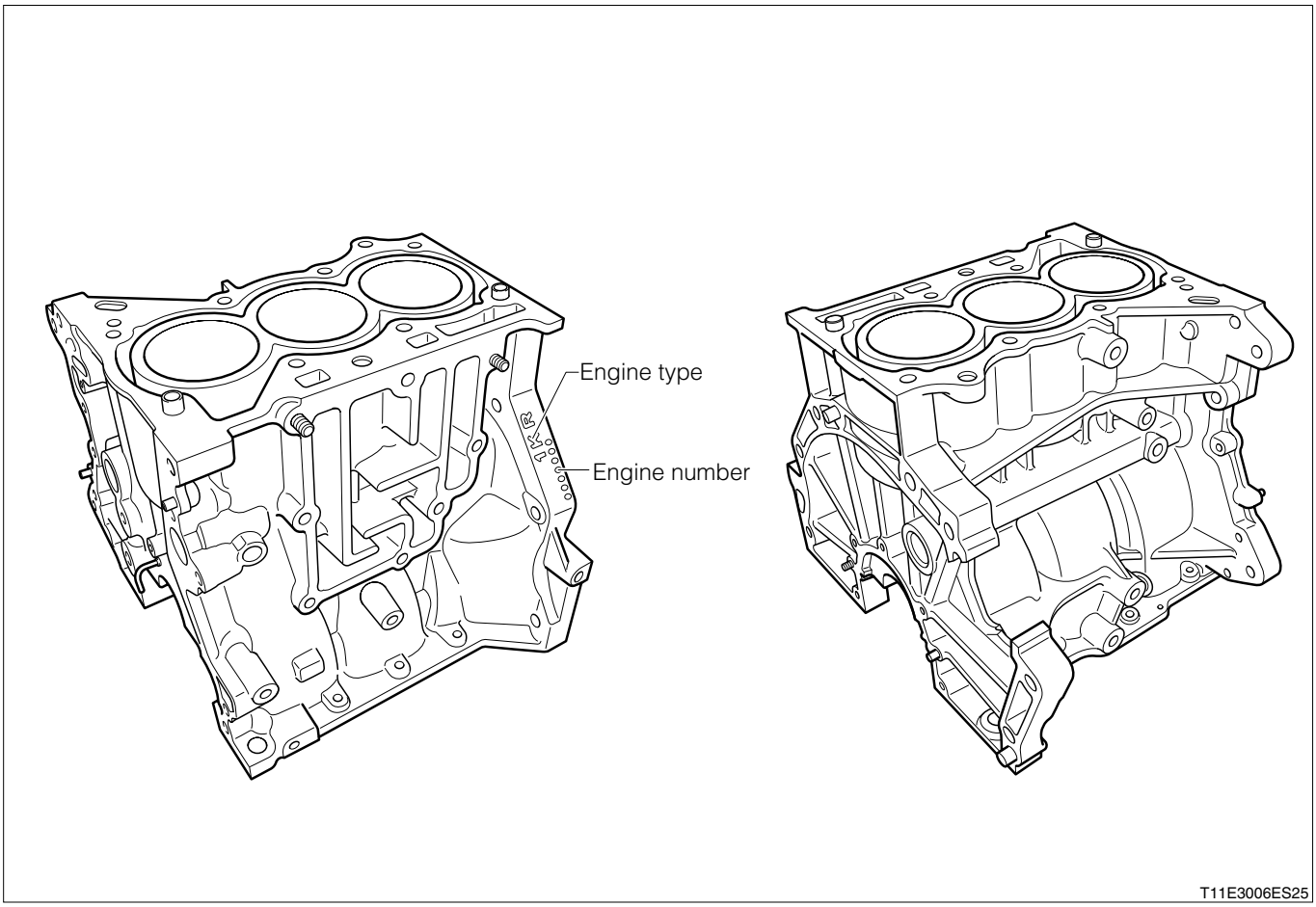
A stainless cylinder head gasket is adopted. The surface of the gasket is coated with NBR rubber. For improved sealing ability, the bead shape at each section has been optimized, thus ensuring the surface pressure.



T11E3005T16

1-4 CYLINDER BLOCK

In order to achieve a lighter weight, an aluminum cylinder block has been employed, featuring a compact shape with a bore-to-bore distance of 7 mm. For reduced friction around the piston, the roundness of the bore has been improved by using a spiral liner. For enhanced rigidity, the starter flange has been integrated with the cylinder block, thus improving the joint of the chain cover.



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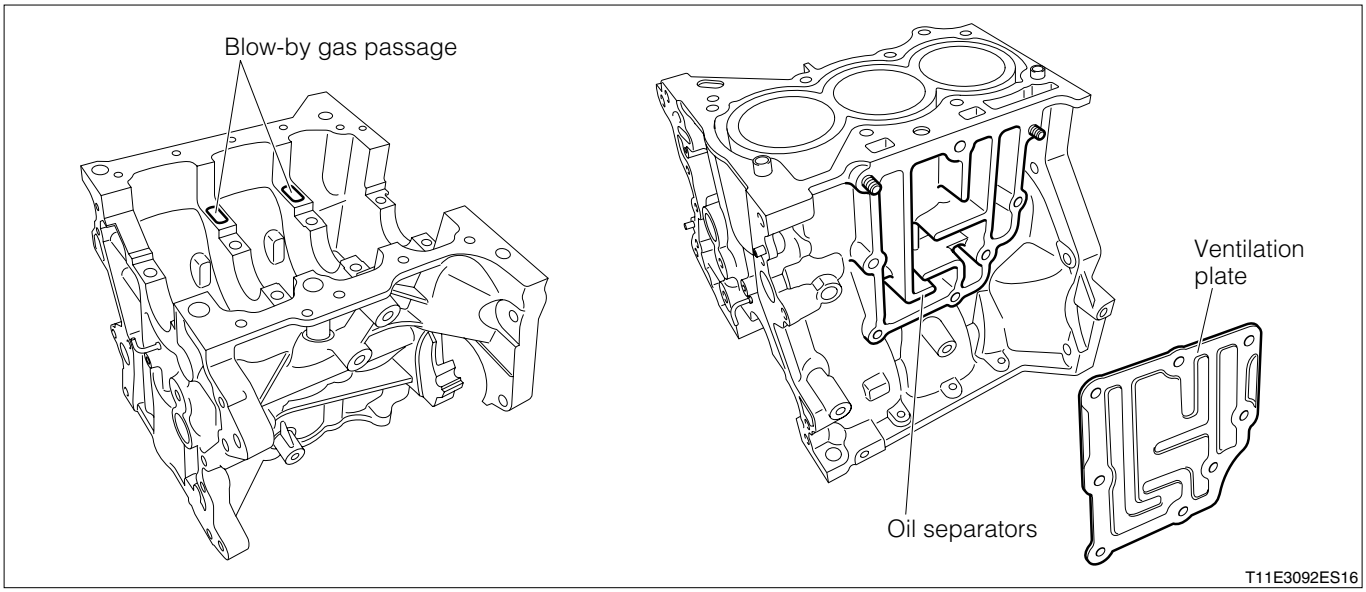
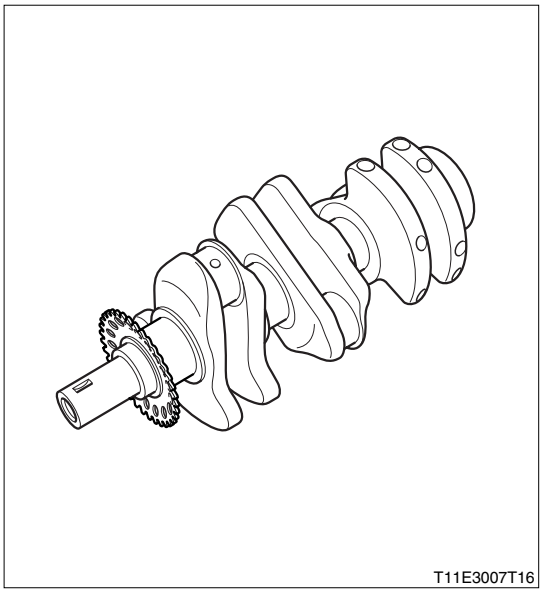
The oil separator is provided to the cylinder block in order to improve the ventilating ability in the crank case and to prevent oil deterioration.



1-5 CRANKSHAFT

For reduced tapping sound and bending vibration, forged (steel) individually balanced crankshaft has been employed. Furthermore, an offset crankshaft is adopted in which the crankshaft center is in offset position toward the cylinder bore center. As a result, the thrust load and friction have been reduced. Moreover, for enhanced heat efficiency, the piston speed has been changed between the compression stroke and the expansion stroke.

The crankshaft drives the oil pump built in the chain cover.

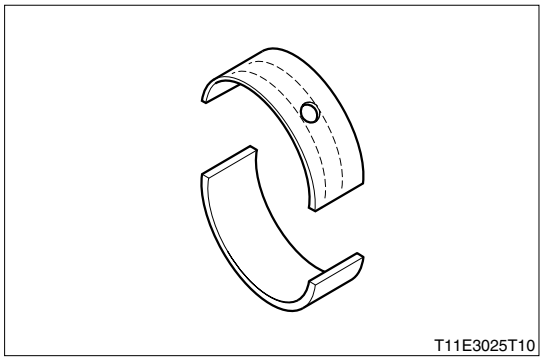


Specifications

Journal diameter(mm)	44.0 Dia.	
Journal width(mm)	#1J	17.5
	#2J	21.4
	#3J	21.8
	#4J	21.4
Crank pin diameter(mm)	40.0 Dia.	
Crank pin width(mm)	18.1	

1-6 CRANKSHAFT BEARING

For improved initial bedding-in and retention of oil, the striation treatment (referring to treatment in which linear treatment is made on the bearing sliding surface) has been made on the lining surface. Consequently, the oil clearance has been shortened and the metal tapping sound has been reduced. Moreover, the pawl for positioning has been abolished.



Crankshaft bearing specifications

Identification code	Bearing thickness (mm)
2	1.992−1.995
3	1.995−1.998
4	1.998−2.001
5	2.001−2.004

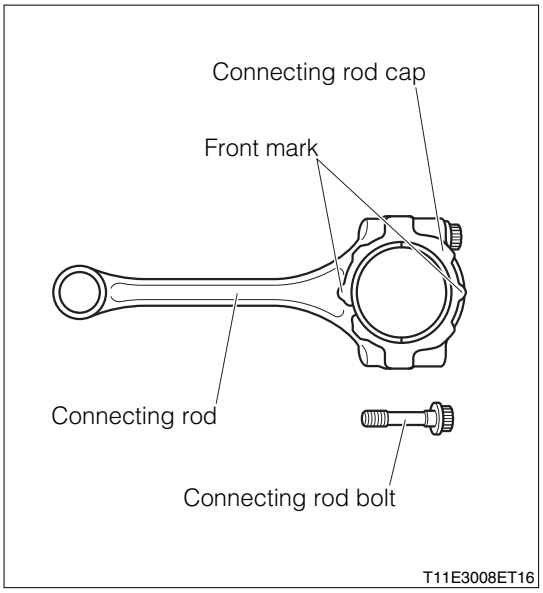
1-7 CONNECTING ROD

For lighter weight, the high-strength vanadium steel is employed.

For lighter weight and stabilized big end shape, the connecting rod bolt uses no nut and is tightened in the plastic area.

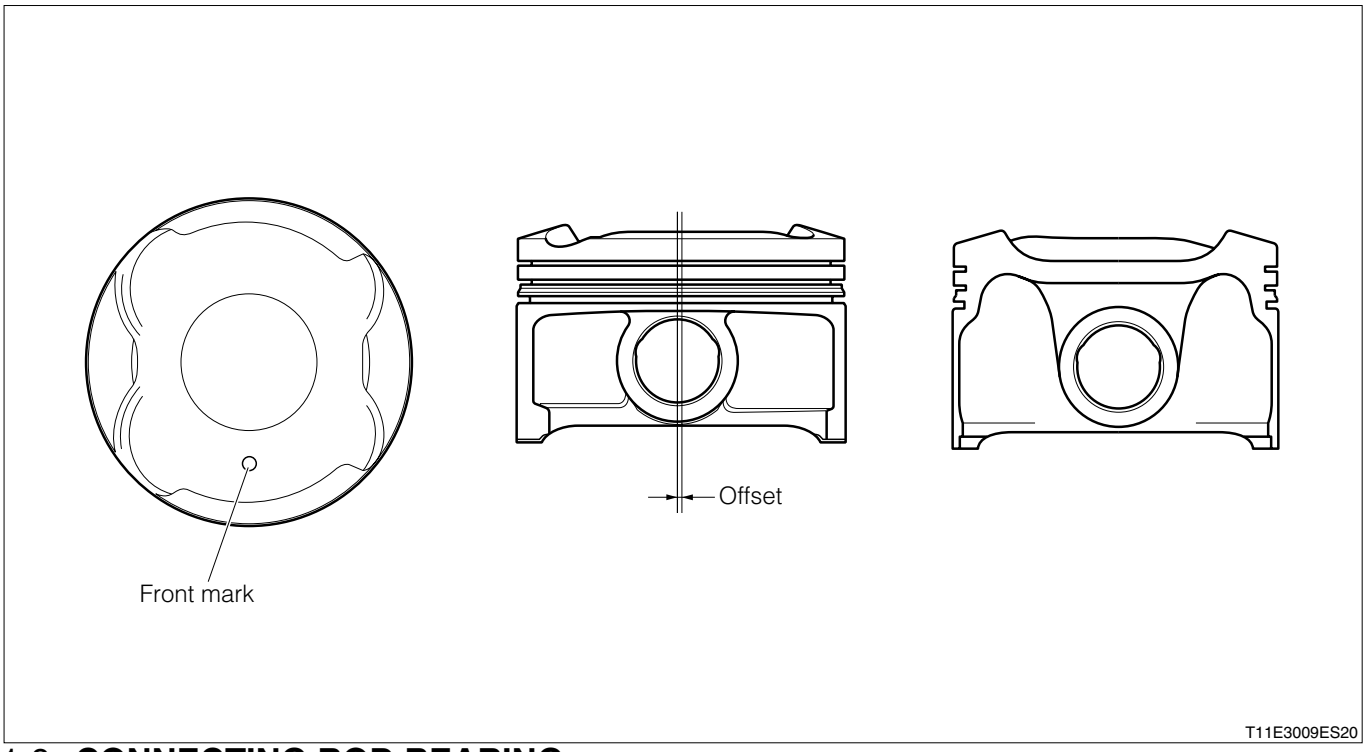
Specifications

Small end inner diameter (mm)	18.0 Dia.
Big end inner diameter (mm)	43.0 Dia.
Center-to-center distance of the big and small ends (mm)	140.88



1-8 PISTON

A new type resin coat is adopted. The external diameter size of the piston is available in one rank.



1-9 CONNECTING ROD BEARING

The bearing is selected for use in accordance with the big end diameter of the connecting rod.

Connecting rod bearing specifications

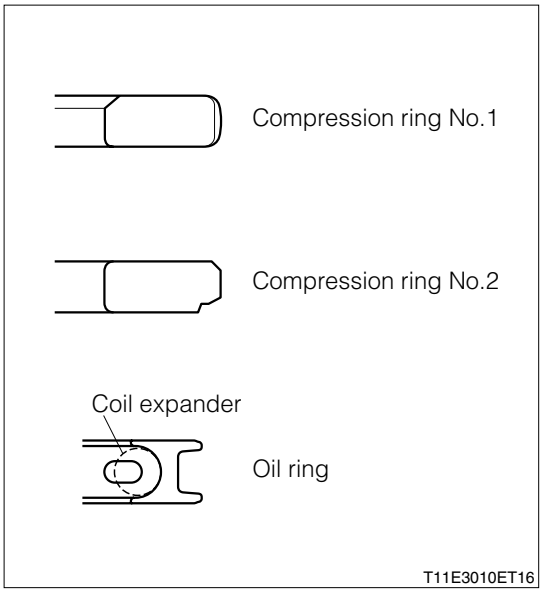
Identification code	Bearing thickness (mm)
1	1.492−1.495
2	1.495−1.498
3	1.498−1.501

1-10 PISTON RING

For reduced friction and enhanced fuel consumption, a low-tension piston ring has been adopted.

Piston ring specifications

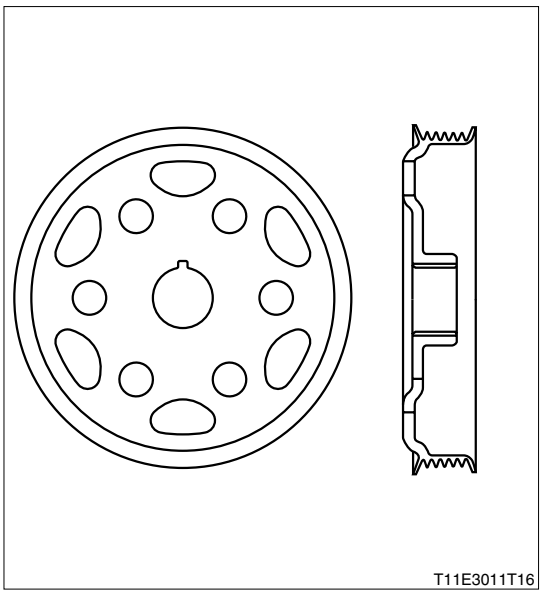
Compression ring No.1	Material	Steel
	Thickness (mm)	2.3
	Width (mm)	1.0
	Top surface code	T1
Compression ring No.2	Material	Steel
	Thickness (mm)	2.3
	Width (mm)	1.0
	Top surface code	T2
Oil ring	Material	Steel
	Thickness (mm)	1.65 (Combined thickness is 2.05)
	Width (mm)	1.5
	Top surface code	—



1-11 CRANKSHAFT PULLEY

A 6-groove pulley is adopted to correspond to the 6-rib belt. By achieving a lighter weight, the torsional resonance frequency characteristics of the crank system have been improved.

Moreover, the timing mark for checking the ignition timing is provided. A yellow paint is applied to the mark.



1-12 V BELT

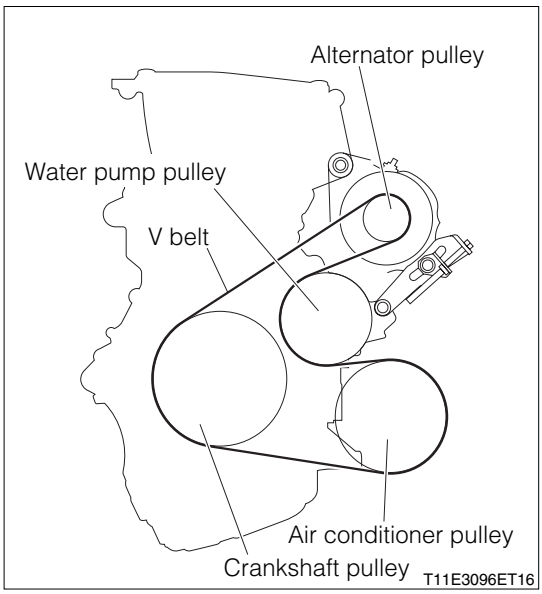
For easier servicing during the belt check and tension adjustment, the serpentine drive layout has been adopted, in which one belt drives the auxiliary machine.

Pulley specifications

Pulley	Pulley diameter (mm)
Crankshaft	139 mm Dia.
Alternator	52.5 mm Dia.
Water pump	95 mm Dia.(Back face)
Air conditioner compressor	108 mm Dia.

Belt specifications

	Belt length (mm)	The number of ribs
with A/C	1200	6
without A/C	860	6

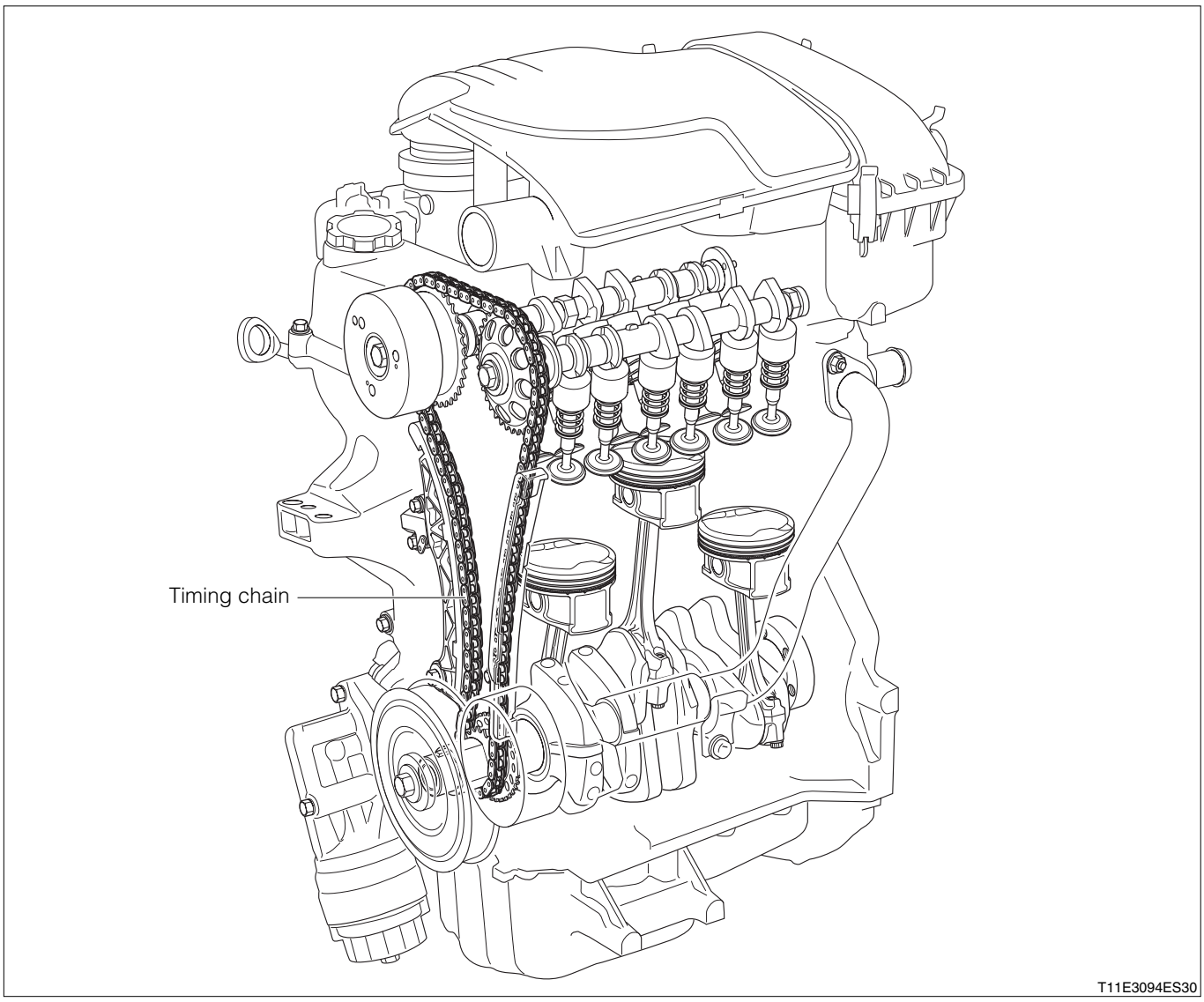


■ CAM, VALVE MECHANISM (1KR)

1 OUTLINE

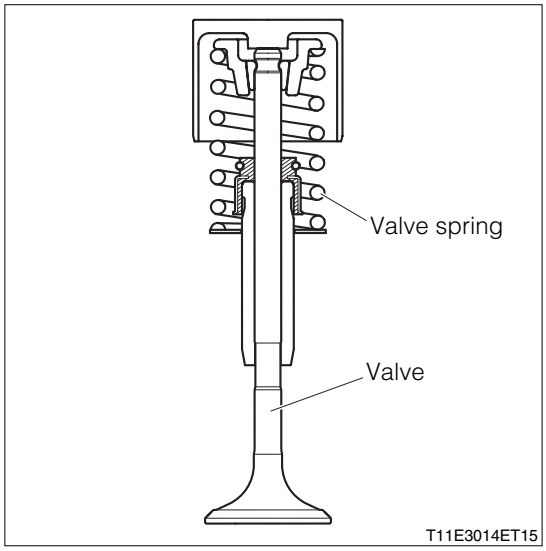
1-1 DESCRIPTION

A single stage chain is used, in which a single chain drives the intake and exhaust cam shafts.
Direct valve actuating, DOHC, 4-valve (two intake valves, two exhaust valves) has been employed. Also, DVVT (Dynamic Variable Valve Timing) mechanism has been adopted, in which the valve timing is controlled to an optimum timing according to the operating condition of the engine.



2 CONSTRUCTION AND OPERATION

2-1 VALVE AND VALVE SPRING



The valves have employed heat-resistant steel for both the intake side and exhaust side. The nitriding treatment has been performed for all surfaces (except the valve face section). Furthermore, for reduced mechanical loss, a smaller diameter of the stem section has been employed.

For the valve spring, special carbon steel for the valve spring has been used and it has undergone the shot peening. The common parts have been used for both the intake side and exhaust side and the valve spring has adopted a variable pitch spring featuring an excellent valve following-up characteristics. For reduced friction loss, the maximum load has been reduced by decreasing the equivalent mass of the valve system.

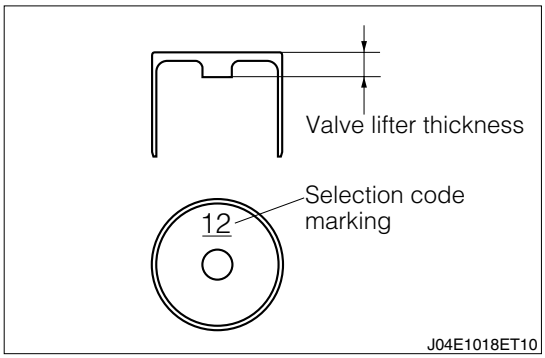
Valve specifications

	Intake valve	Exhaust valve
Overall length (mm)	88.39	89.11
Diameter of head section (mm)	27.5 Dia.	23.6 Dia.
Diameter of stem section (mm)	5 Dia.	5 Dia.

Valve spring specifications

Coil diameter (mm)	2.5 Dia.
Coil inner diameter (mm)	16.0
Total winding number	8.84
Free length (mm)	51.63

2-2 VALVE LIFTER AND VALVE ADJUSTING SHIM



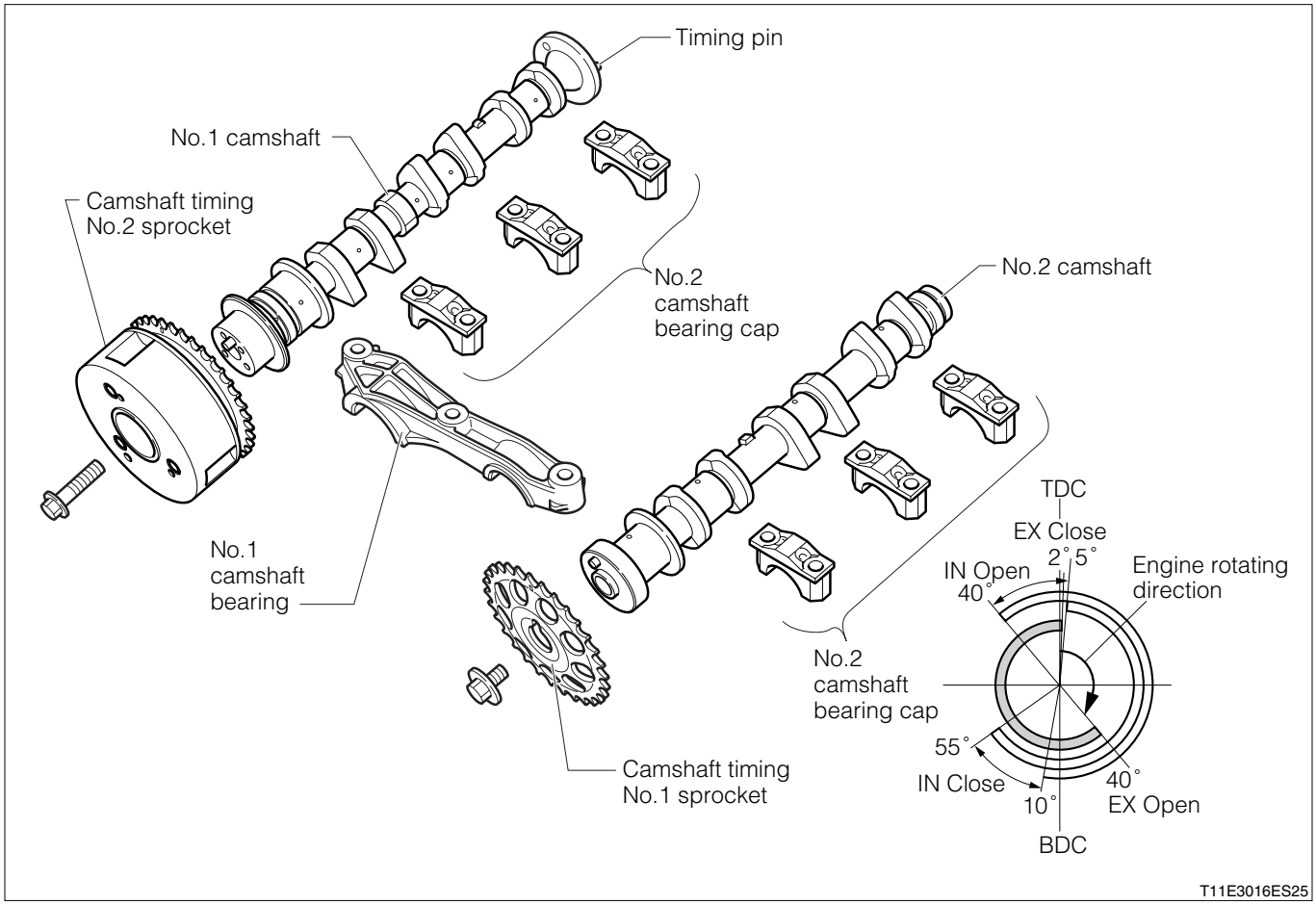
For reduced weight, shim-less lifters have been adopted. The valve clearance is adjusted by changing the surface thickness at the top of the lifter. The surface thickness at the top of the lifter comes in 29 kinds between 5.12 mm and 5.68 mm in increments of 0.02 mm. The lifter thickness is identified by the number stamped on the back of the lifter. The stamped number indicates the dimension of the top surface thickness below the decimal point.

2-3 **CAMSHAFT**

It is made of alloy cast iron. The camshaft No.1 (intake side) and camshaft No.2 (exhaust side) are hollow.

To obtain compact design of the cylinder head, the camshaft is driven by the chain.

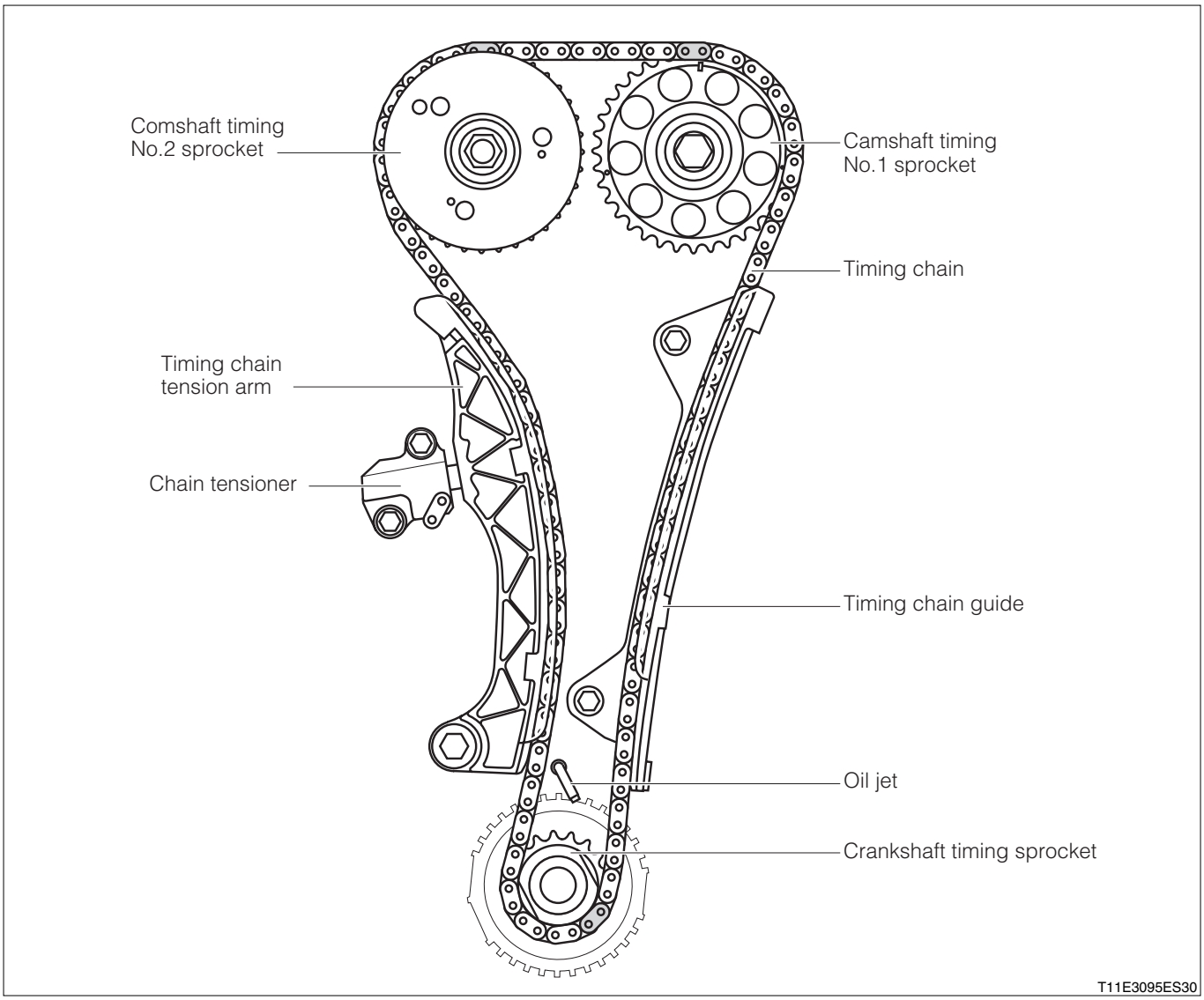
The DVVT controller integral with the sprocket is mounted to the front end of camshaft No.1. Also, the timing pins (3 pins) are mounted to the rear end to detect the cam position of the DVVT.



2-4 TIMING CHAIN MECHANISM

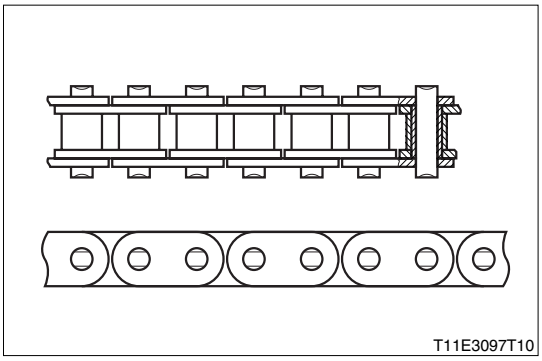
2-4-1 DESCRIPTION

This is the single-stage chain in which the intake and exhaust camshafts are driven by a single chain.



2-4-2 TIMING CHAIN

A roller chain with a pitch of 8.00 mm is adopted. As the marks for assembling the chain, a yellow mark plate and 2 orange mark plates are provided.

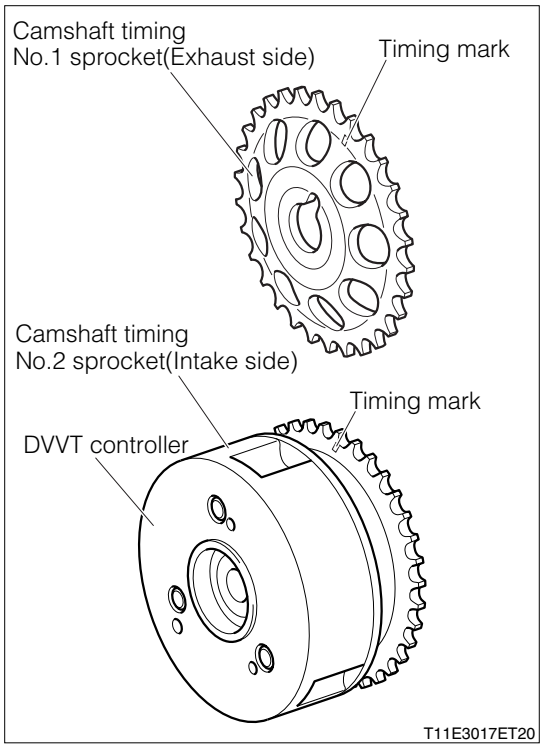


2-4-3 CAMSHAFT TIMING NO.1 SPROCKET,CAMSHAFT TIMING NO.2 SPROCKET

A timing mark is provided as a mating mark for assembling the timing chain.

Sprocket specifications

	Camshaft timing No.1 sprocket	Camshaft timing No.2 sprocket
Material	Hot-rolled steel	Sintered alloy
Tooth profile	Involute	Involute
Number of teeth	36	36
Pitch (mm)	8.00	8.00
Pitch circle diameter (mm)	91.98 Dia.	91.98 Dia.
Roller diameter (mm)	5.65	5.65
Width (mm)	4.2	4.2

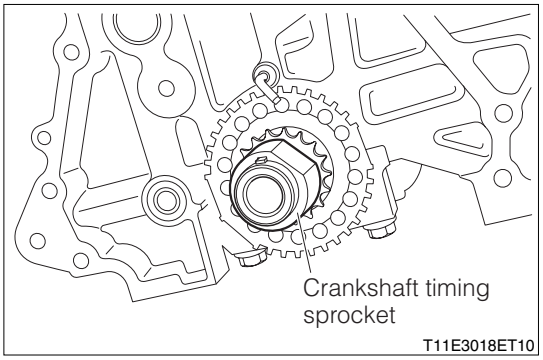


2-4-4 CRANKSHAFT TIMING SPROCKET

A timing mark is provided as a mating mark for assembling the timing chain.

Crankshaft timing sprocket specifications

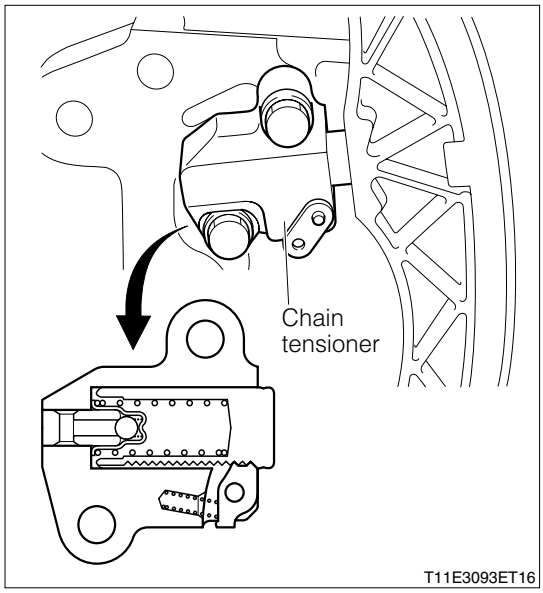
Material	Sintered alloy
Tooth profile	Involute
Number of teeth	18
Pitch (mm)	8.00
Pitch circle diameter (mm)	46.07 Dia.
Roller diameter (mm)	5.65
Width (mm)	4.2



2-4-5 CHAIN TENSIONER PLUNGER

In order to assure the durability and quietness, an optimum tension is always given to the timing chain, using the hydraulic pressure in combination with the spring force.

Moreover, the service holes have been provided on the timing chain cover, so that the initial setting can be performed for the ratchet mechanism during the servicing.

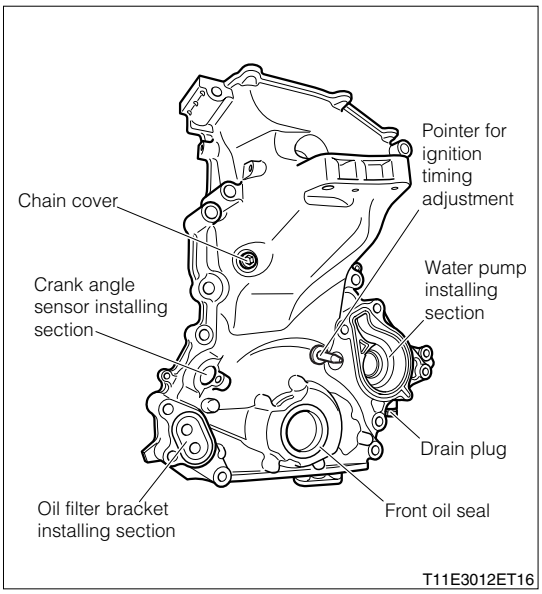


2-4-6 OIL JET

An oil jet is provided to lubricate the meshing section of the crank shaft timing sprocket and the chain.

2-4-7 **TIMING CHAIN COVER**

It is made of aluminum and incorporates an oil pump, and it is so constructed that the oil strainer, water pump, and oil filter bracket are mounted. Moreover, for reduced mount vibration, the mount bracket (right) has been integrated. Furthermore, service holes for adjusting the chain tension and pointers for adjusting the ignition timing are provided.



2-5 **DVVT SYSTEM**

2-5-1 **DESCRIPTION**

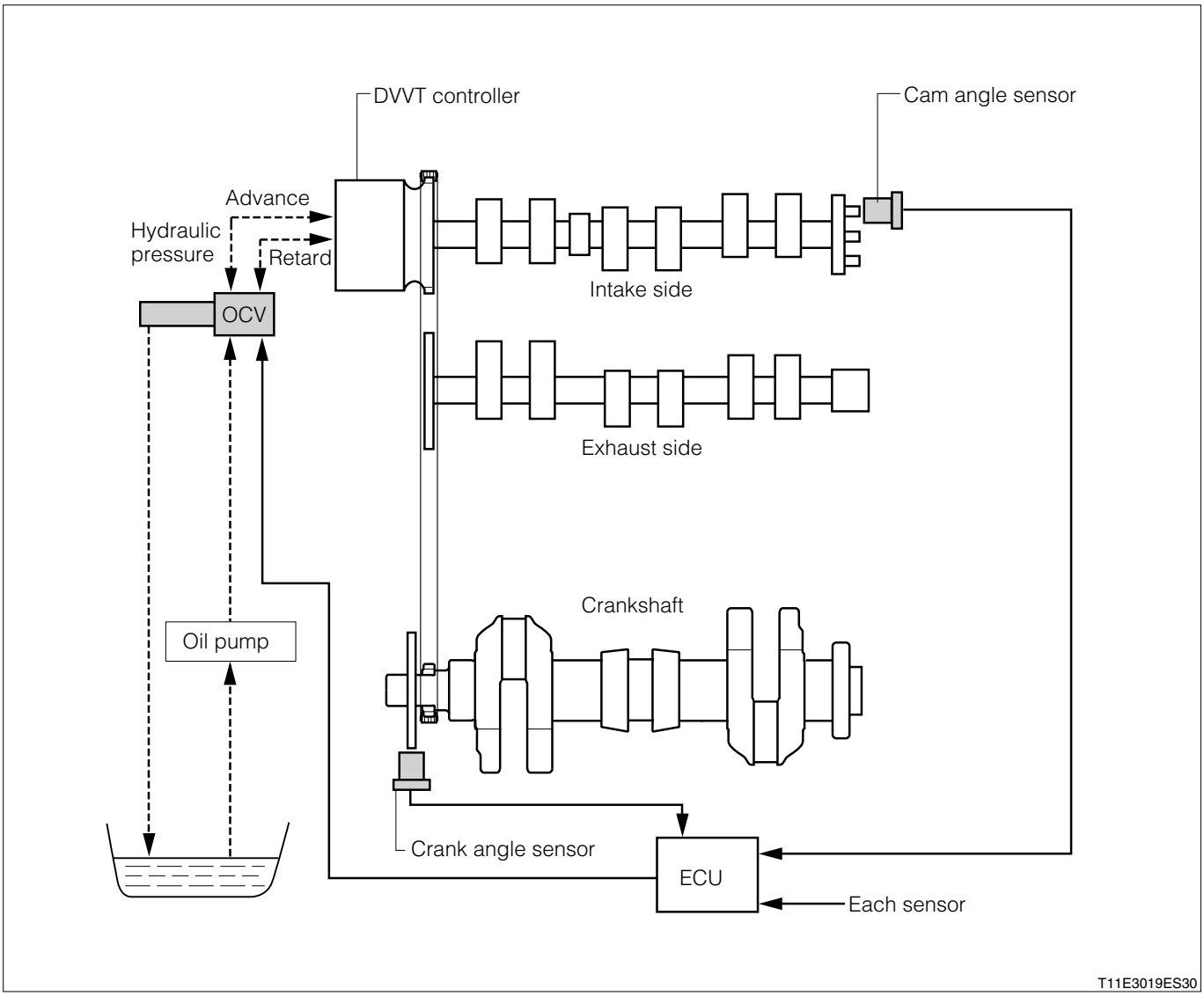
1. The DVVT (Dynamic Variable Valve Timing) capable of controlling the valve timing to an optimum condition at all times from the idling to the high-speed driving has been employed. Thus, low fuel consumption and high output have been achieved.
   (1) During the idling period, mixture is prevented from passing through to exhaust gas by eliminating the valve overlap. As a result, fuel economy is enhanced.
   (2) When the valve overlap is expanded, the inner EGR amount increases and the negative pressure in the intake manifold is reduced. Consequently, the pumping loss of the piston is reduced and fuel consumption enhances. Furthermore, by this inner EGR effect, inactive gas is inhaled again, thus lowering the combustion temperature. Consequently, NO_x emission is reduced. Moreover, since unburnt gas is combusted again, the HC emission is reduced.
   (3) In the high-load driving range, the output and torque are increased through the valve timing according to the required air amount.

2-5-2 **SYSTEM**

(1) **Description**

The engine control computer controls the OCV (oil control valve) according to the engine speed, pressure in the intake manifold, etc. In this way, the phase of the camshaft No.1 (intake side) is controlled to an optimum condition by applying the engine hydraulic pressure to the front and rear of the vane of the DVVT controller mounted to the camshaft No.1 (intake side).

(2) **Schematic diagram**



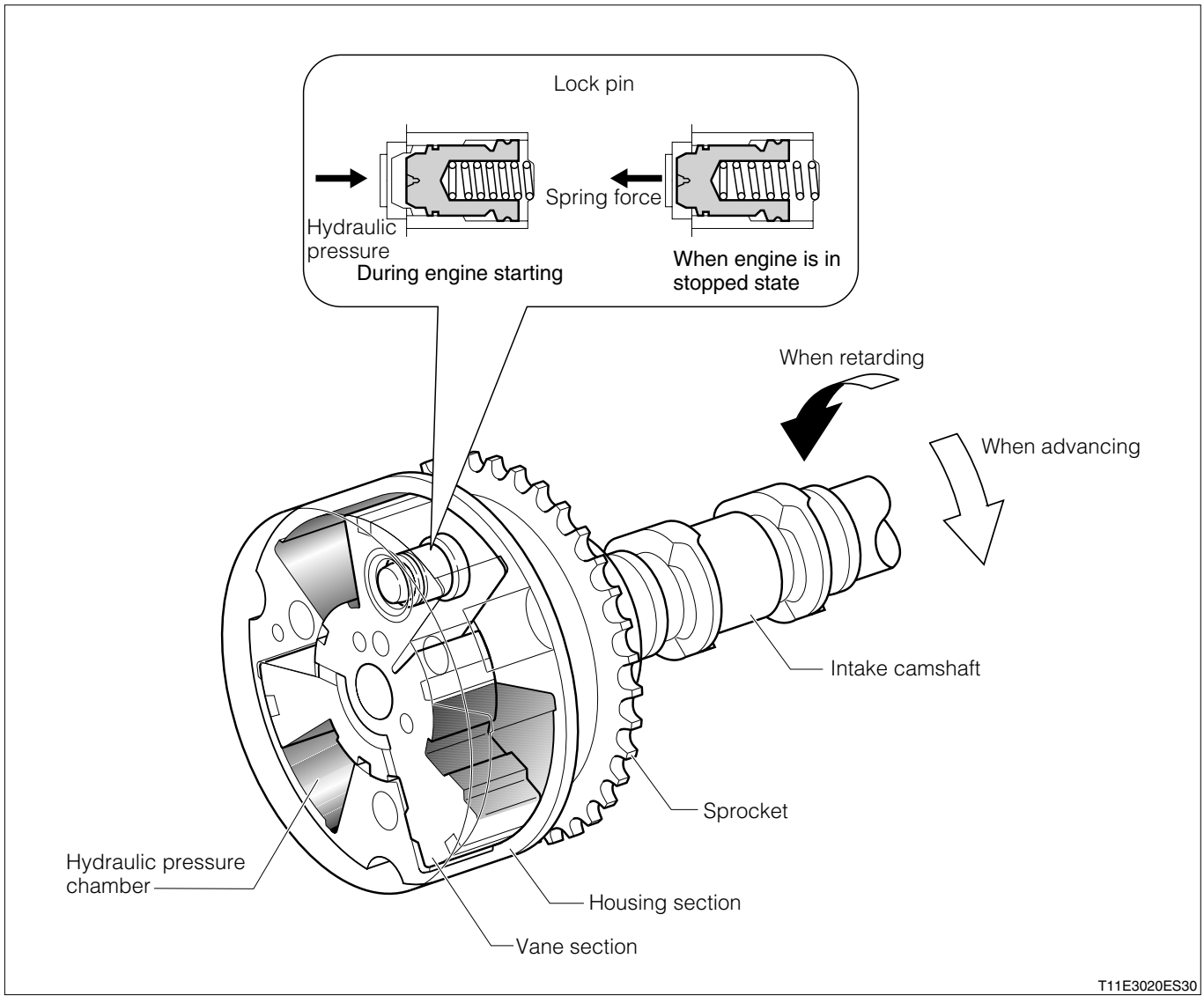
2-5-3 **COMPONENTS**

(1) **DVVT Controller**

It consists of the housing section secured on the sprocket driven by the timing chain and the vane section secured on the camshaft No.1 (intake side).

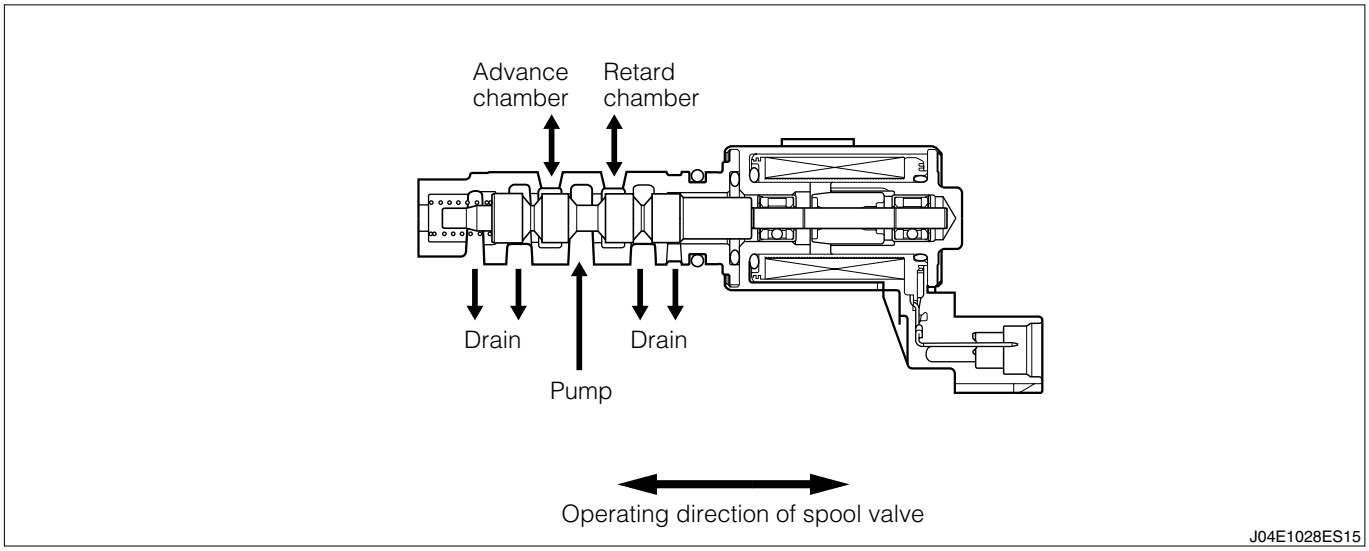
The vane section rotates in the circumference direction in relation to the housing by controlling the hydraulic pressure of the two hydraulic pressure chambers (advance chamber and retard chamber) consisting of the housing and vane. Thus, the phase of the camshaft No.1 is varied continuously. Consequently, the valve timing is controlled optimally.

During the engine starting period, the vane is pushed against the most retard angle side by the turning of the housing. Then, the vane is locked by the pin. After the engine has started, the pin will be released automatically by the control hydraulic pressure.



(2) **OCV(Oil Control Valve)**

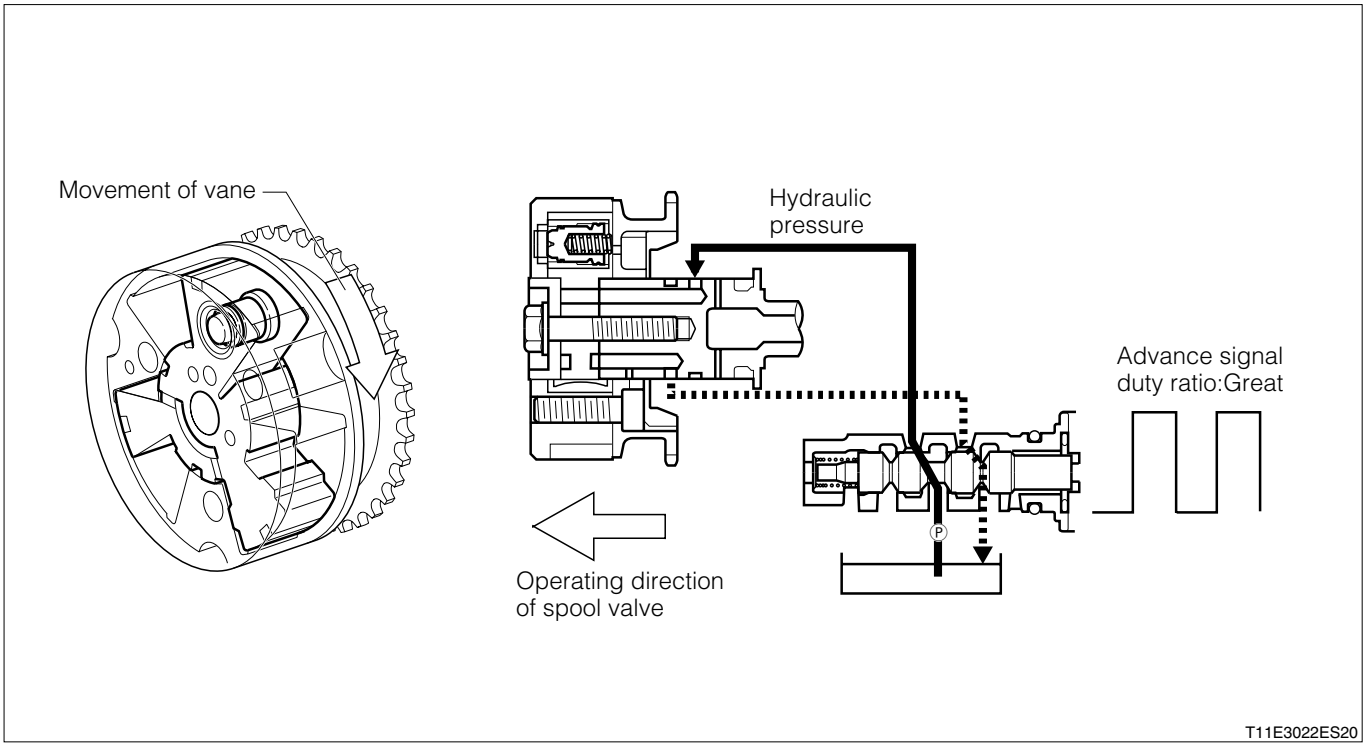
The spool valve position is moved by means of the duty signal from the engine control computer. Thus, the oil passage to the DVVT controller is switched.



2-5-4 **OPERATION**

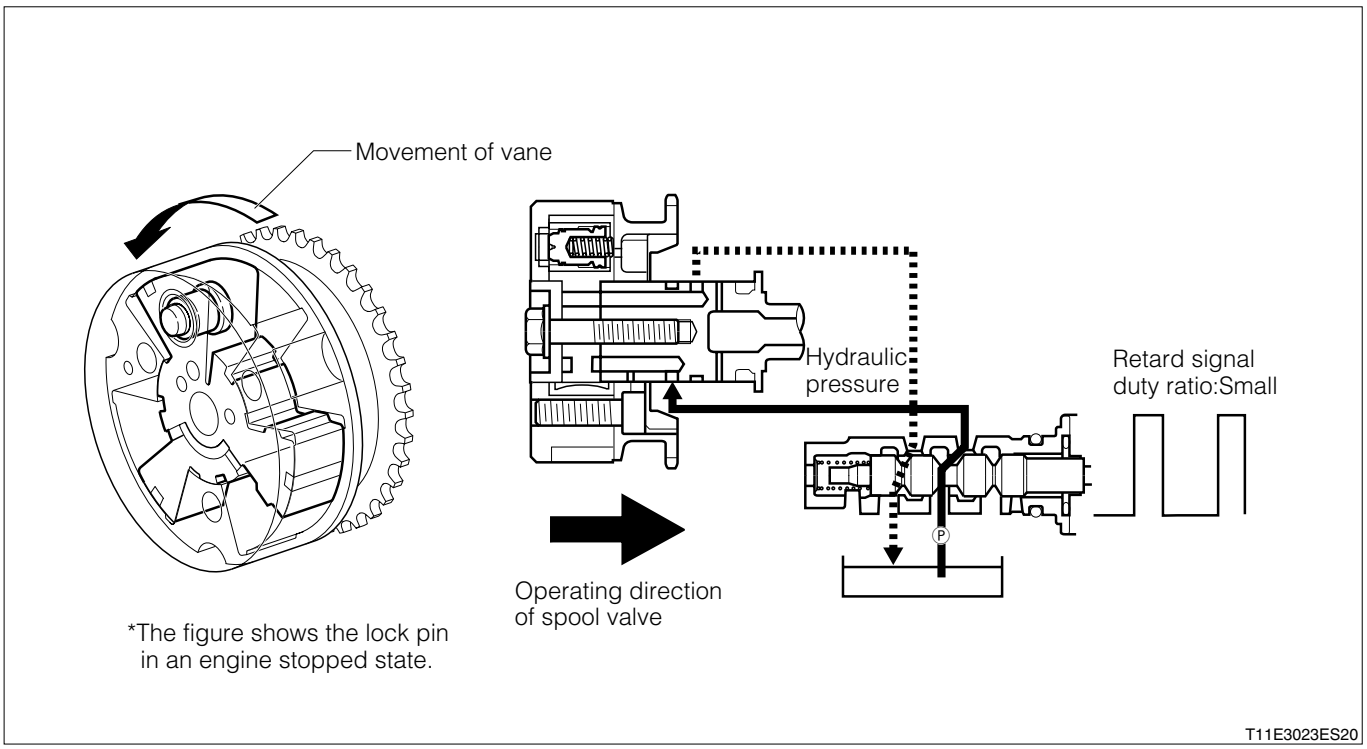
(1) **Timing advance operation**

The OCV operates by the signal sent from the engine control computer so that the engine hydraulic pressure may be applied to the vane chamber at the advance side. As a result, the camshaft No.1 is turned to the advance side in relation to the housing.



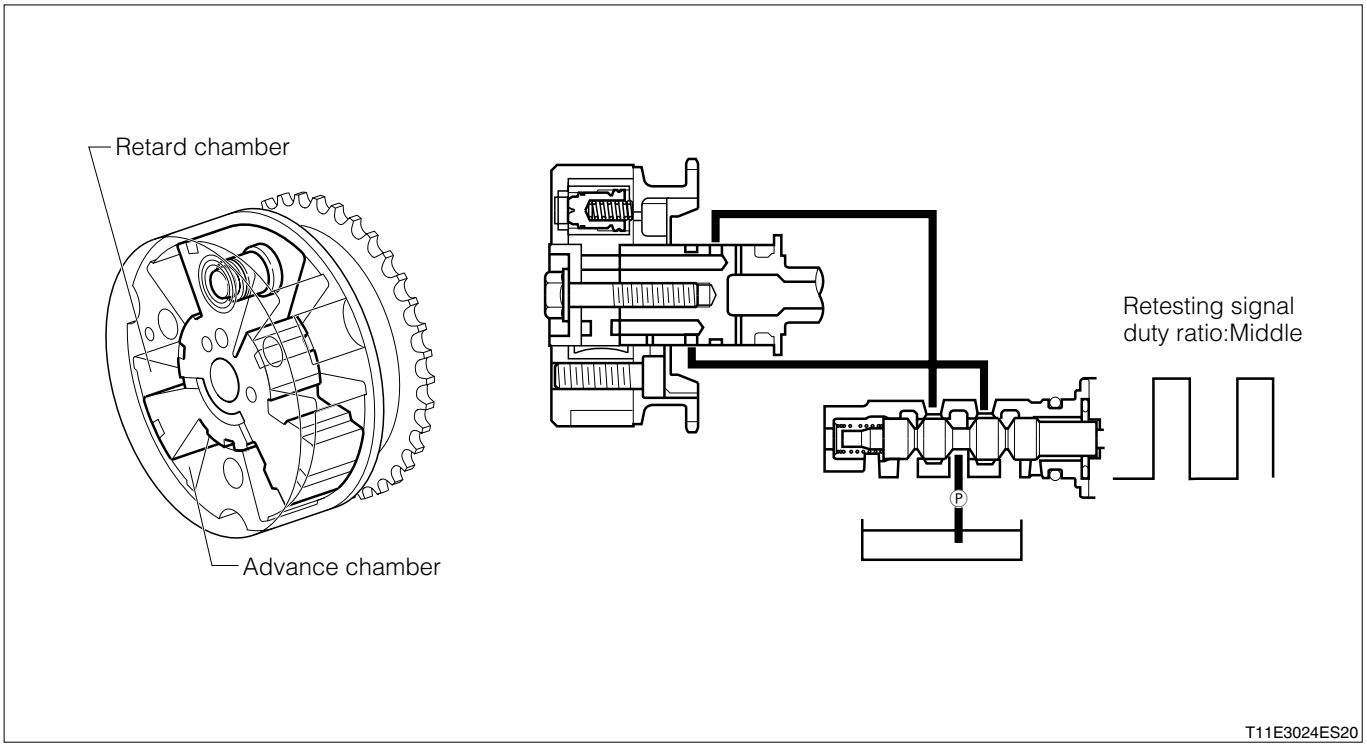
(2) **Timing retard operation**

The OCV operates by the signal sent from the engine control computer so that the engine hydraulic pressure may be applied to the vane chamber at the retard side. As a result, the camshaft No.1 is turned to the retard side in relation to the housing.



(3) **Retention operation**

After completion of the control of the target timing, the OCV shuts off the oil passages leading to the DVVT controller, unless the running condition of the vehicle changes, thus retaining the valve timing.



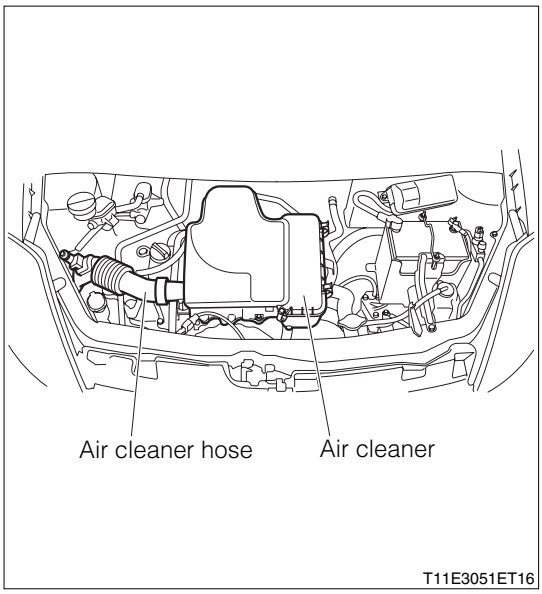
B3 INTAKE SYSTEM

■ 1KR

1 OUTLINE

1-1 DESCRIPTION

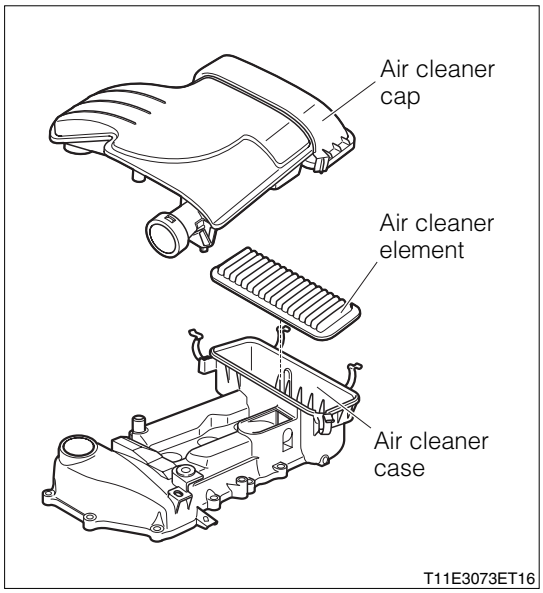
The air intake system consists of an air cleaner hose, air cleaner (integral with the cylinder head cover), throttle body, intake manifold and intake manifold insulator. The air cleaner is arranged directly above the engine, and the air cleaner and throttle body are mounted directly, thus reducing the air intake resistance and engine radiation noise.



2 CONSTRUCTION AND OPERATION

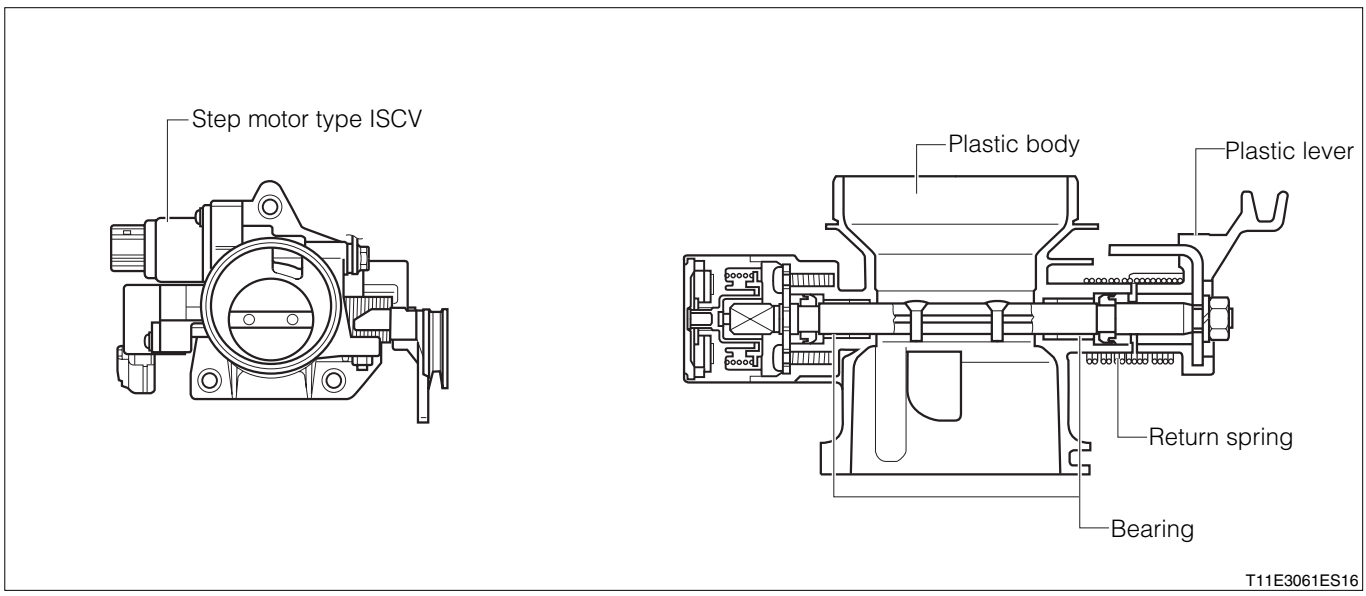
2-1 AIR CLEANER

The resin cylinder head cover is integrated with the resin air cleaner case. Moreover, for reduced weight, the air cleaner cap integral with the cool air duct/engine cover is employed.



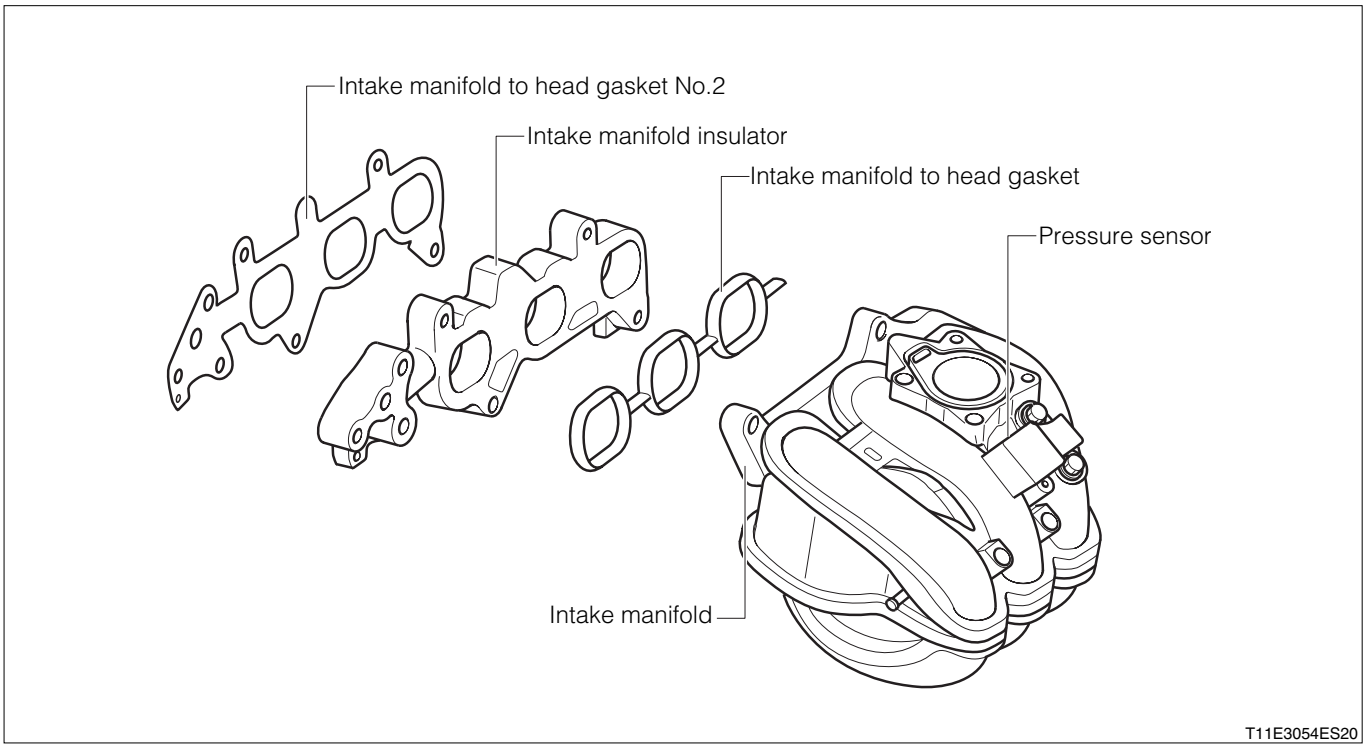
2-2 THROTTLE BODY

For reduced weight, a resin-made throttle body is adopted.
Moreover, for reduced weight, a stepper motor type is adopted for the ISCV.

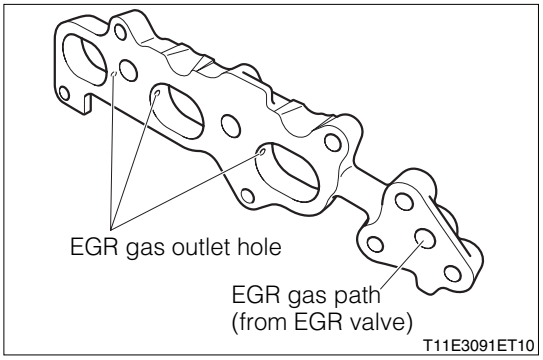


2-3 INTAKE MANIFOLD, INTAKE MANIFOLD INSULATOR, INTAKE MANIFOLD GASKET

An excellent roughness of the port inner surface obtained by a resin die form reduces the intake resistance, thus improving the volumetric efficiency. Furthermore, the intake air temperature is lowered by the employment of resin parts, thus enhancing the filling efficiency. Moreover, the manifold absolute pressure/intake air temperature integral type sensor, that is an integral sensor of the manifold absolute pressure sensor and the intake air temperature sensor, is installed to the intake manifold serge tank.



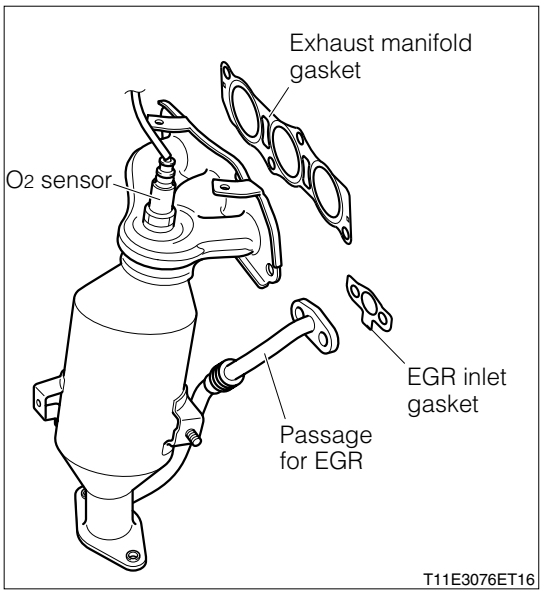
An EGR gas outlet hole to the each cylinder is provided to the aluminum intake manifold insulator that is mounted between the intake manifold and the cylinder head.



B4 EXHAUST SYSTEM

■ 1KR
1 CONSTRUCTION AND OPERATION
1-1 EXHAUST MANIFOLD AND EXHAUST MANIFOLD GASKET

As for the exhaust manifold, thanks to the employment of the stainless steel pipe thin wall structure integrated with the catalyst, the heat capacity has been reduced, thus improving the warm-up performance to correspond to the exhaust emission standard.
A gas takeoff pipe for EGR is provided to circulate the exhaust gas to the intake side.
The exhaust manifold gasket is made of stainless steel.

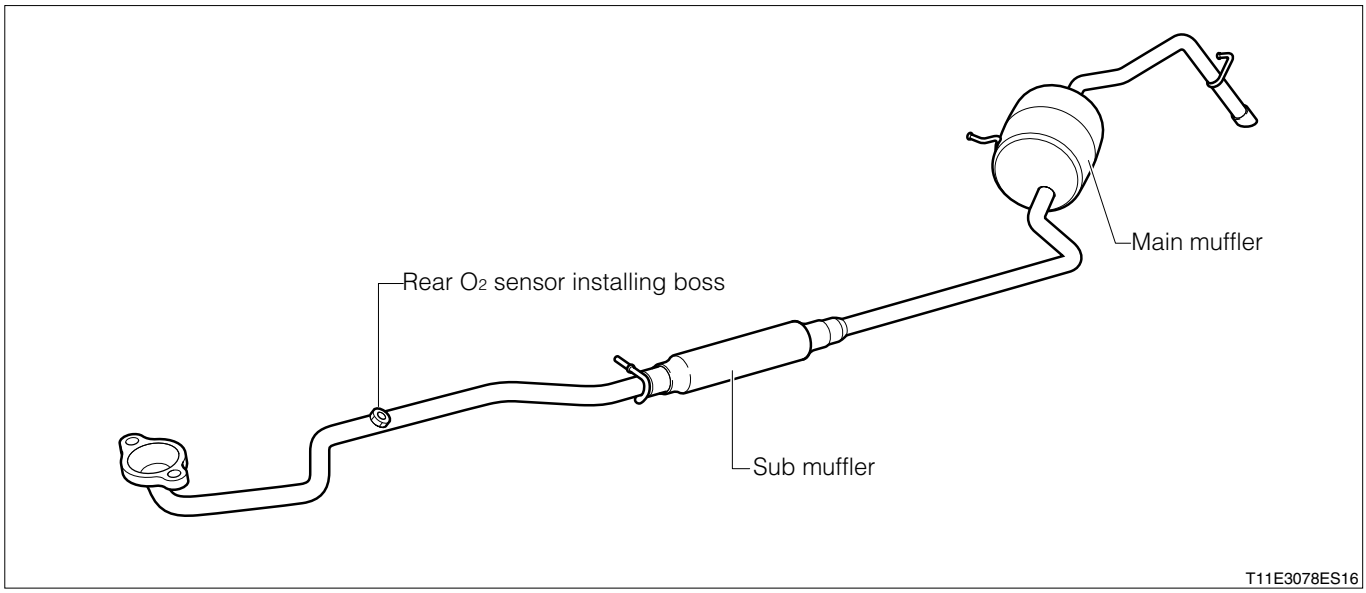


1-2 EXHAUST PIPE

The sub muffler and main muffler are integrated. The two-piece type laser welding muffler is adopted to the main muffler. The muffler capacity has been lessened by optimizing the muffler structure to realize weight saving. The rear O_2 sensor mounting boss is provided to the front of the sub muffler.

Muffler specifications

	Sub muffler	Main muffler
capacity (ℓ)	0.9	6.0

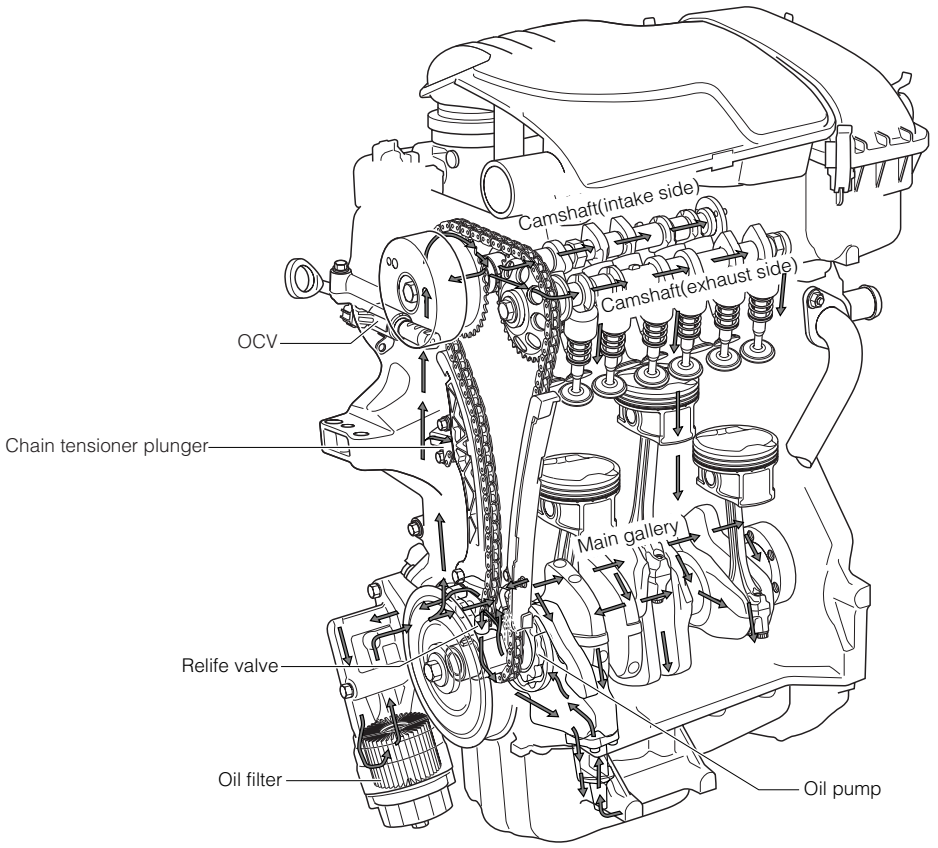


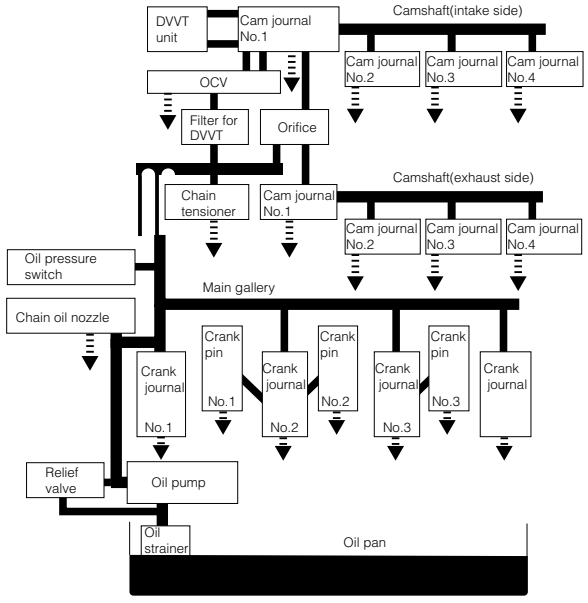
B5 LUBRICATION SYSTEM

■ 1KR
1 OUTLINE
1-1 DESCRIPTION

The lubrication method is a full pressure feeding filtering type. The oil stored in the oil pan is sucked up by the oil pump driven by the crankshaft, and filtered by the oil filter. Then the oil lubricates main gallery to crankshaft, around the piston, and the timing chain. On the other hand, the oil also lubricates the chain tension plunger, OCV of the cylinder head, DVVT, and the camshaft.

1-2 ENGINE INTERNAL LUBRICATION SYSTEM





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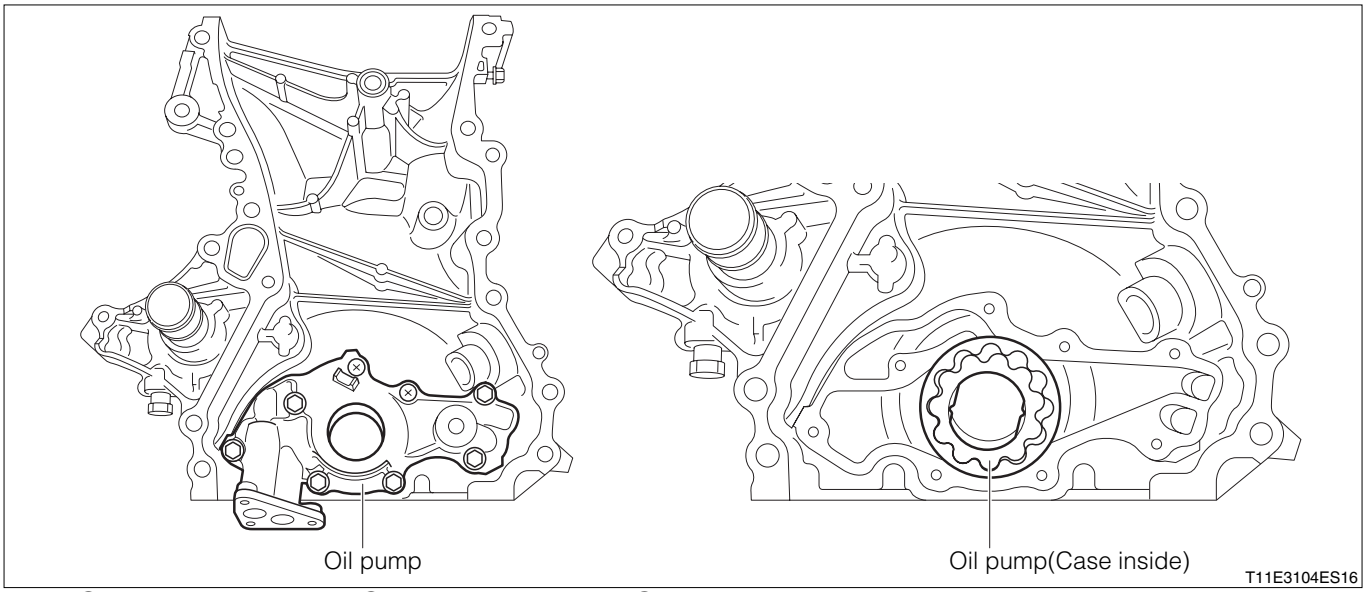
2 CONSTRUCTION AND OPERATION

2-1 OIL PUMP

A trochoid gear is adopted. The oil pump is built in the timing chain cover and driven by the crankshaft. Directly driven by the crankshaft, the auxiliary layout is downsized. The pressure loss of the oil path is reduced to optimize the discharge rate, resulting in the reduction of the mechanical loss and improved fuel consumption.

Oil pump specifications

Delivery output [at time of 6,000rpm/200kPa] (ℓ/min)	19.7 or more
Relief valve opening pressure at 3,000 rpm (kPa)	370

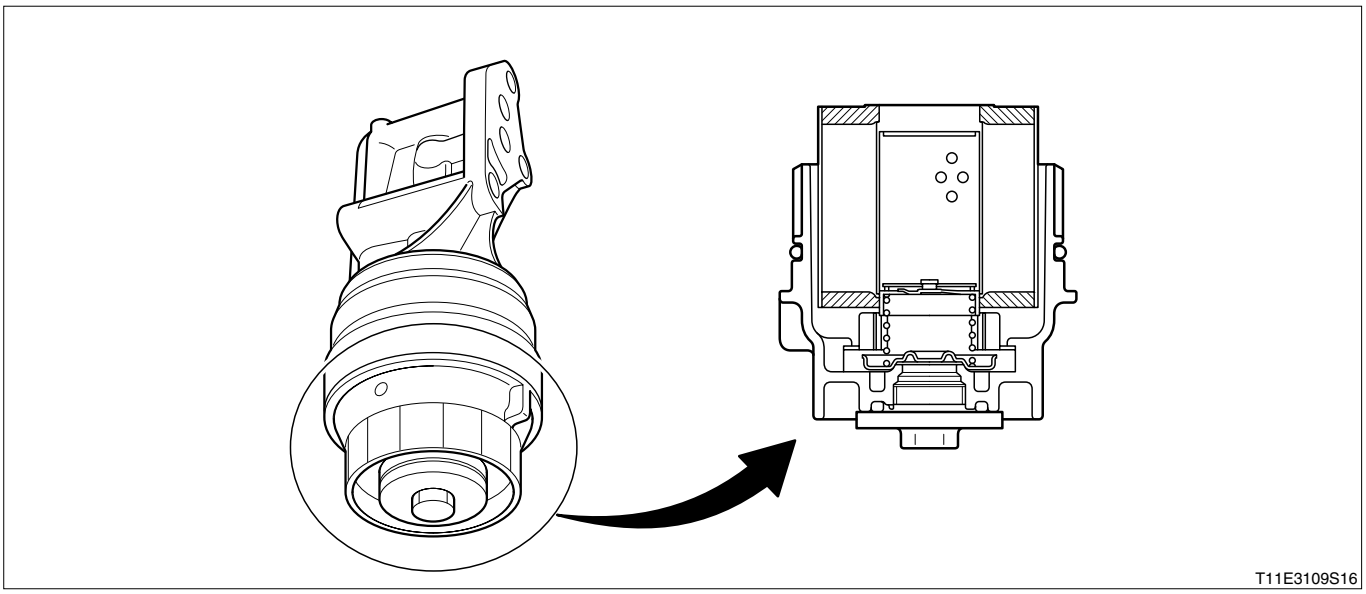


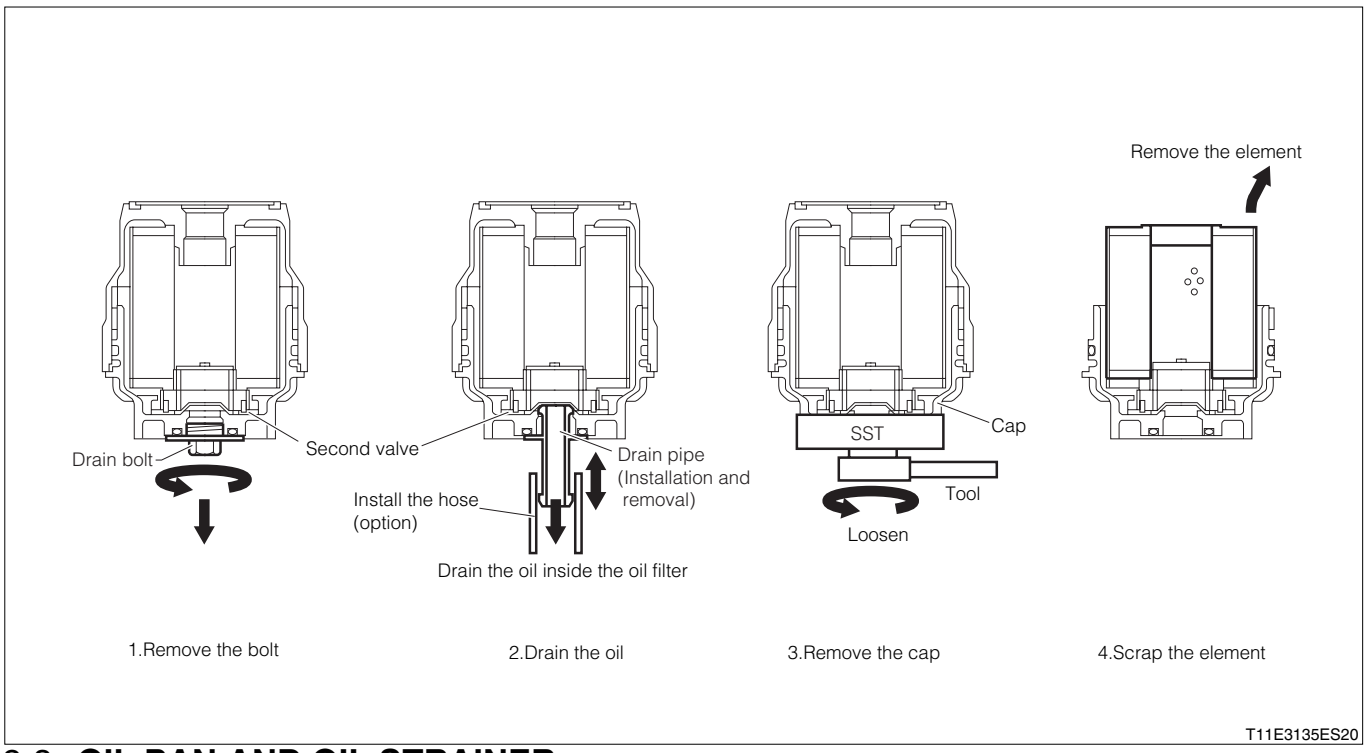
2-2 OIL FILTER AND OIL FILTER BRACKET

The element replacement type is adopted to be environment friendly. For easy operation, the structure is made so that the oil does not splash on the hands when replacing.

Oil filter specifications

Type	Full flow
Effective filtration area (cm^2)	630

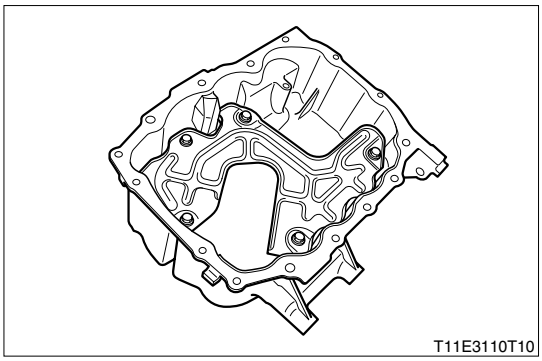




2-3 OIL PAN AND OIL STRAINER

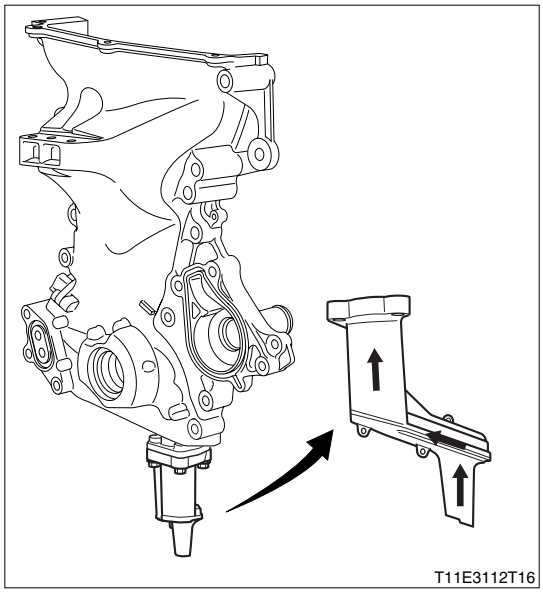
2-3-1 OIL PAN

By adopting high rigid aluminum oil pan and connecting with the transmission, joint rigidity of the power plant has been improved.



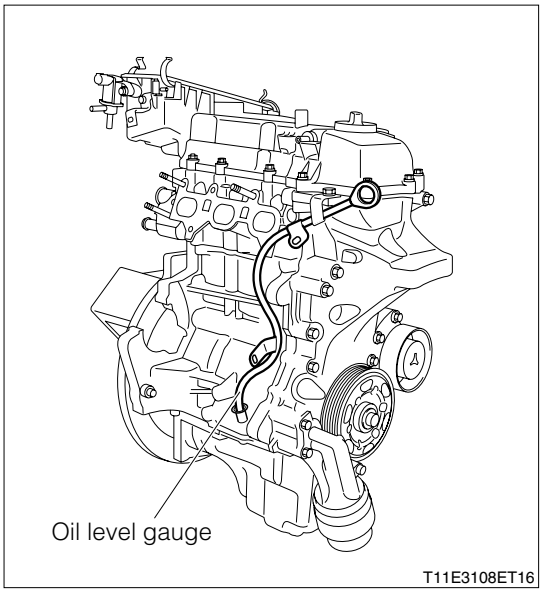
2-3-2 OIL STRAINER

Plastic oil strainer is adopted to realize weight saving. It is mounted to below the oil pump built in the timing chain cover.



2-4 **OIL LEVEL GAUGE**

The pipe for guide is taken out of the cylinder block. Mounting position is set to the front of the intake side.



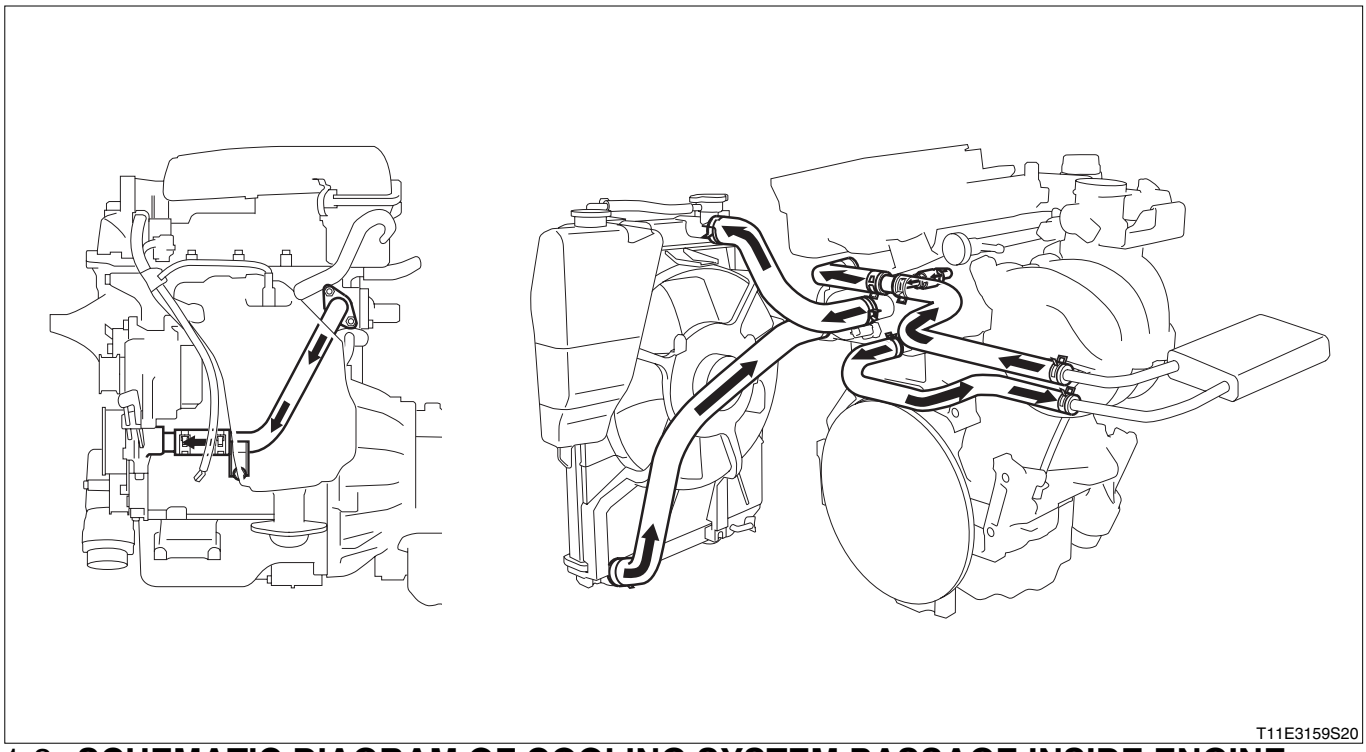
2-5 **ENGINE OIL**

Engine oil specifications

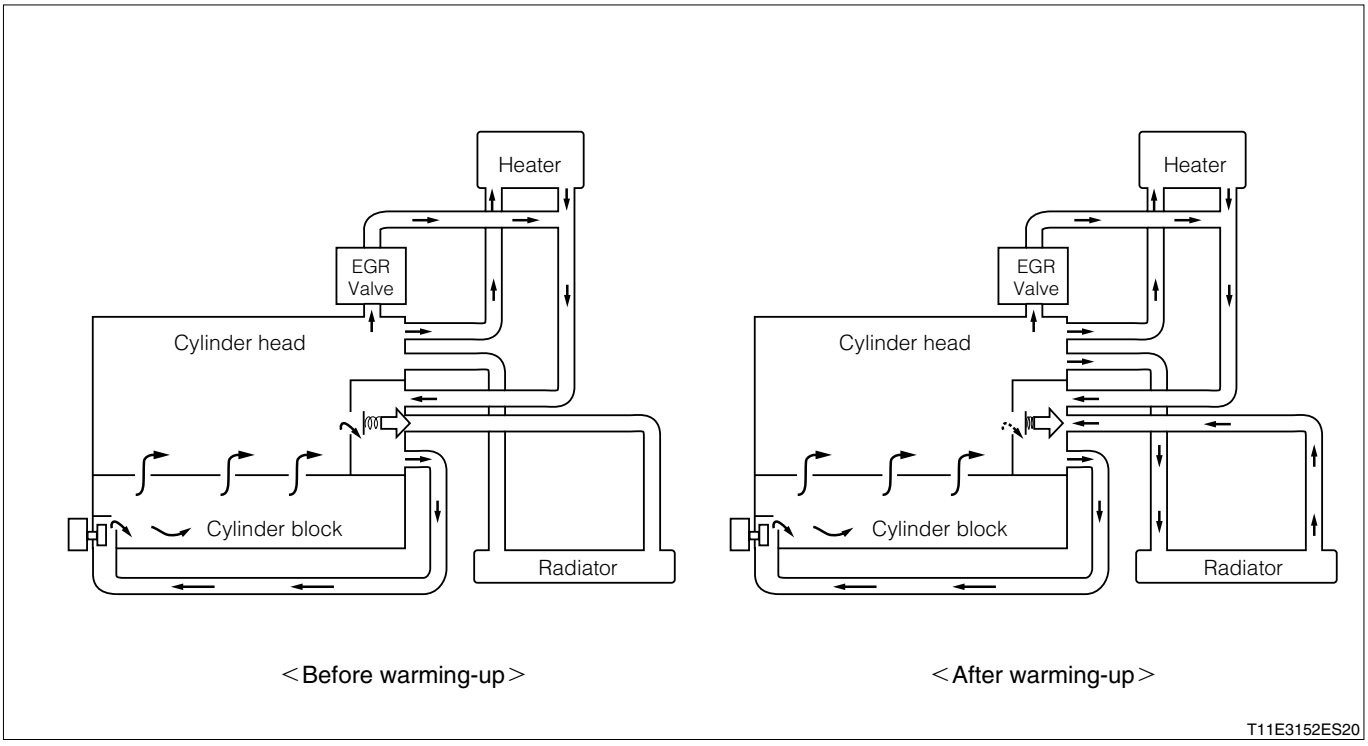
Kind	SAE classification		0W−20 or 5W−30
	API classification		SG or higher
Capacity	Total capacity (ℓ)		3.4
	Oil pan capacity	FULL(ℓ)	3.0
		LOW(ℓ)	1.5
	Change capacity [FULL]	Except for filter (ℓ)	2.9
		Including filter (ℓ)	3.1

B6 COOLING SYSTEM

■ 1KR
1 OUTLINE
1-1 DESCRIPTION
The cooling method is the water-cooled pressure forced circulation type. The thermostat with bypass valve is adopted to improve heater performance by feeding total volume when cooling the machine.
The cooing water is circulated from the cylinder head water jacket through the water bypass pipe of the external piping to the water pump.
The cooling water is also circulated to the stepper motor type EGR valve.
The drain cock is provided to the chain cover.
1-2 COOLING SYSTEM LAYOUT



T11E3159S20
1-3 SCHEMATIC DIAGRAM OF COOLING SYSTEM PASSAGE INSIDE ENGINE



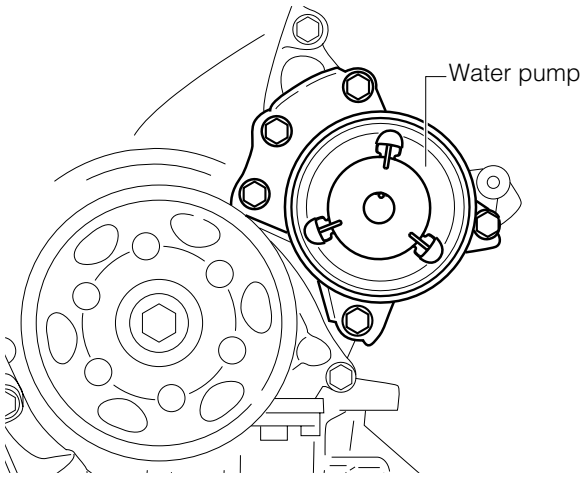
＜Before warming-up＞ ＜After warming-up＞

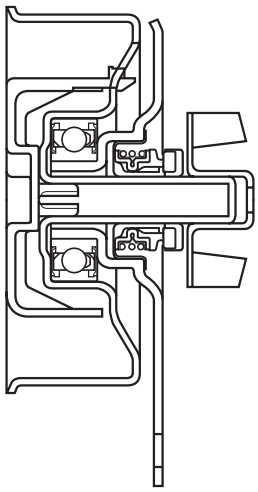
T11E3152ES20

2 CONSTRUCTION AND OPERATION

2-1 WATER PUMP

A steel water pump is adopted. For a light weight and compact design, the press body is employed, the pulley and shaft are integrated by press, and the single row bearings for heavy load are adopted. To prevent water or dust from entering, a plastic cover is provided at the center of the pulley. The swirl chamber is integrated with the chain cover.





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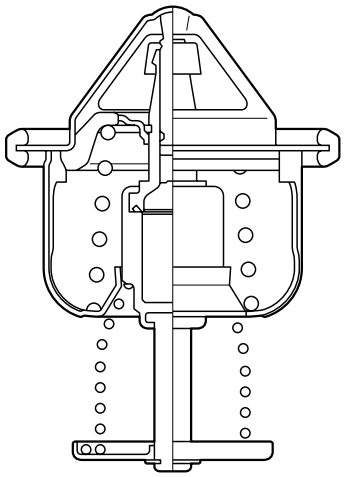
2-2 THERMOSTAT

The thermostat with differential pressure regulating valve, that allows the bottom bypass by a differential pressure, is adopted.

When cold, both the thermostat and differential pressure regulating valve are closed, so the total volume flows to the heater. When the engine revolution speed becomes high and the amount of cooling water increases, the differential pressure regulating valve opens to allow bypassing. Even when warm, if the large amount of fluid flows, the differential pressure regulating valve opens to reduce cavitations.

Thermostat specifications

Installation position	Water inlet
Valve opening temperature (℃)	82±2.0
Full opening lift amount (mm)	8.5mm or more (at 95℃)



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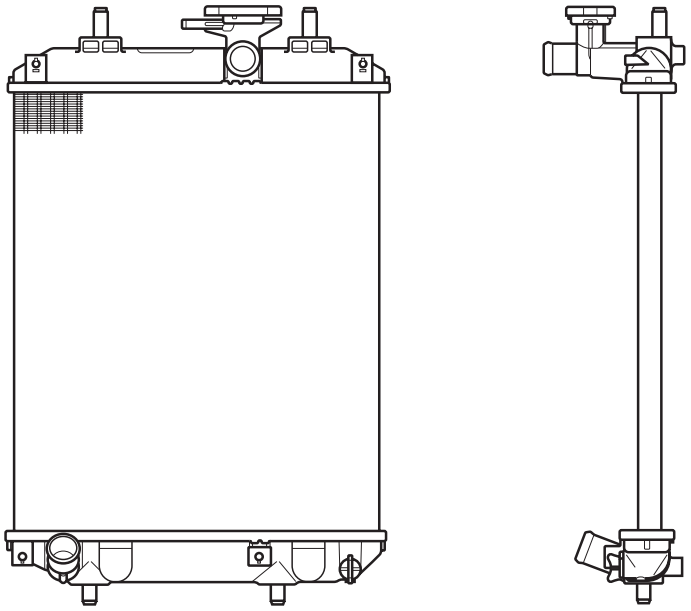
2-3 **RADIATOR**

A aluminum core radiator with plastic upper and lower tanks is employed to realize weight saving.

Radiator specifications

		EUspec.
Radiator	Heat radiating rate (kW)	21.5
	Core type	EAR
	Core dimensions [width × height × depth](mm)	330.6 × 399.2 × 21
	Fin pitch	1.25
	Coolant capacity (ℓ)	0.95
Radiator cap opening pressure (kPa)		108

EU Spec.



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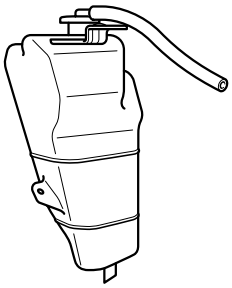
2-4 RESERVE TANK

The reserve tank is mounted to the fan shroud.

Coolant specifications

Diluting water			Tap water
Capacity (ℓ)	Total capacity (except reservoir tank)		3.3
	Reservoir tank capacity	FULL	0.6
		LOW	0.15



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2-5 COOLANT

Coolant specifications

Diluting water			Tap water
Capacity (ℓ)	Total capacity (except reservoir tank)		3.3
	Reservoir tank capacity	FULL	0.6
		LOW	0.15

2-6 FORCED COOLING DEVICE

2-6-1 DESCRIPTION

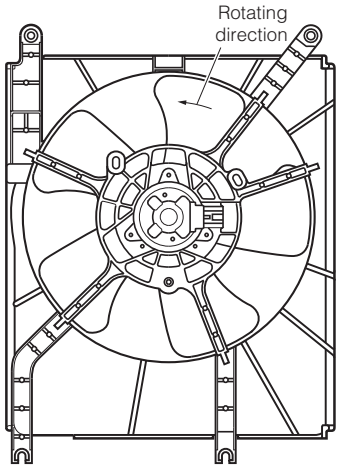
The radiator fan motor is controlled by the signal from the engine control computer.

2-6-2 RADIATOR FAN

A sucking type powered fan is adopted. The reserve tank is mounted to the fan shroud.

Radiator fan specifications

		EU spec.
Motor	Type	Direct current ferrite
	Rated voltage (V)	12
	Output(W)	80
Fan	Outer diameter(mm)	300 Dia.
	Number of blades	5



80W spec.

T11E3175ES16

B7 FUEL SYSTEM

■ 1KR

1 OUTLINE

1-1 DESCRIPTION

The EFI type fuel supply device employs the fuel returnless system. The fuel is injected to each intake port.

2 CONSTRUCTION AND OPERATION

2-1 FUEL TANK

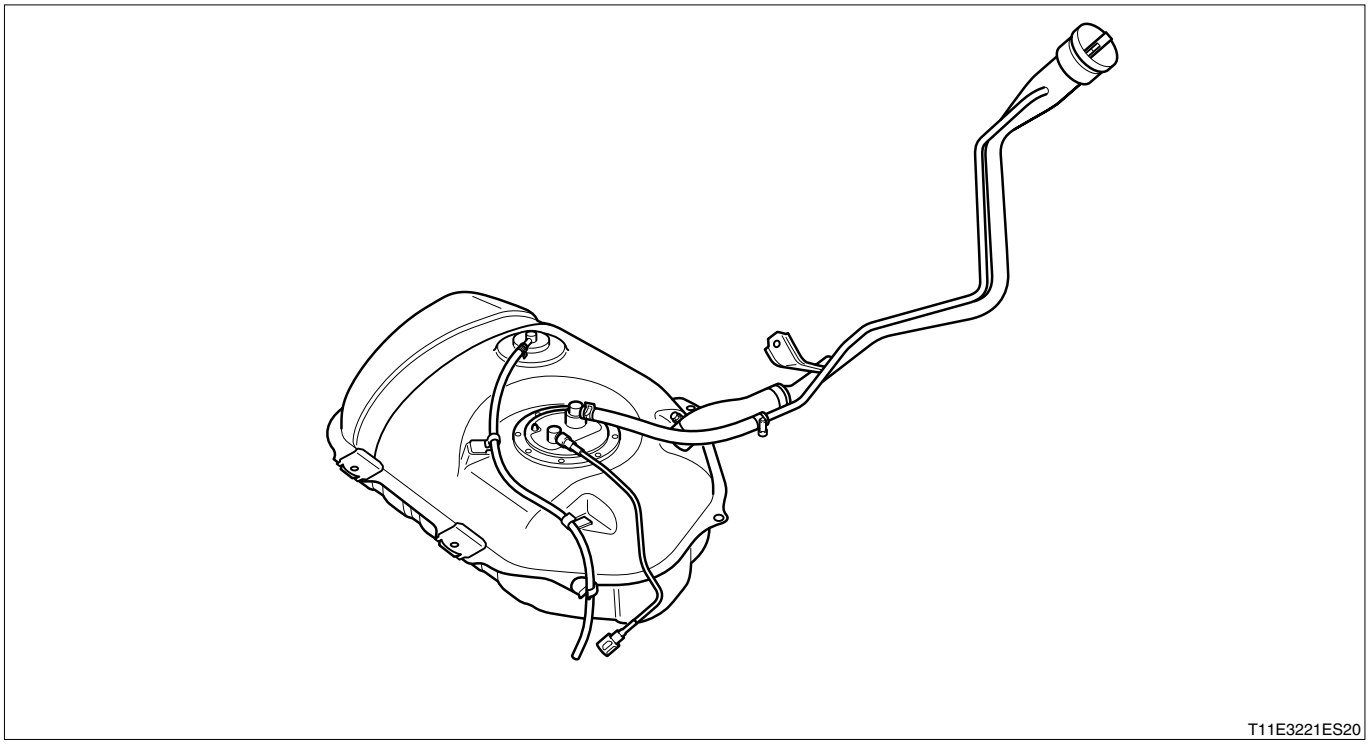
In consideration of safety when the vehicle is overturned or fuel is filled, a cut-off valve is provided to prevent fuel from flowing out and a fuel check valve is provided in the fuel inlet.

Furthermore, the fuel inlet mounting section is located in the upper back of the fuel tank to consider safety when a rear end collision or side collision occurs.

The full capacity of the fuel tank is 40 ℓ.

Considering the environment, using lead and hexad chrome for material of the fuel tank has been discontinued. A recycle mark is set to improve dismantling.

The fuel can be drained through the service hole on the body that is above the fuel tank. The drain plug has been discontinued.



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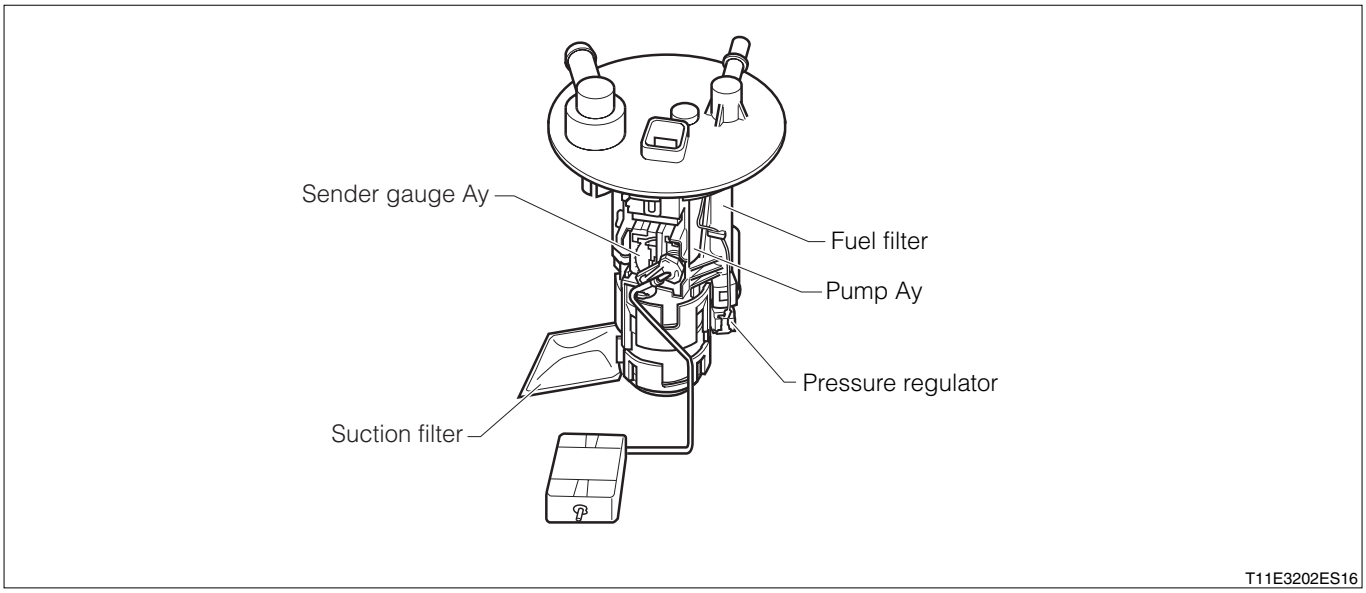
2-2 **FUEL PUMP**

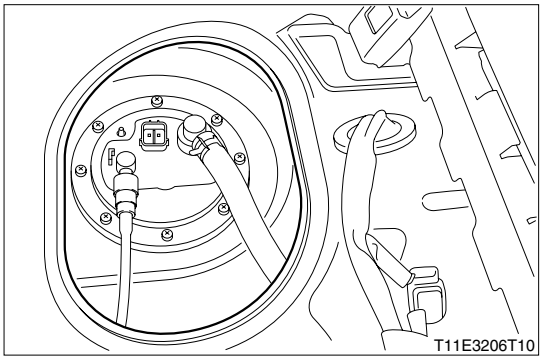
The fuel pressure regulator and high pressure filter are integrated with the fuel pump to return fuel in the fuel tank.
The fuel sender gauge is also integrated with the fuel pump.
The fuel pump is the in-tank type. A quick connector is adopted to connect with the fuel tube.



Fuel pump specifications

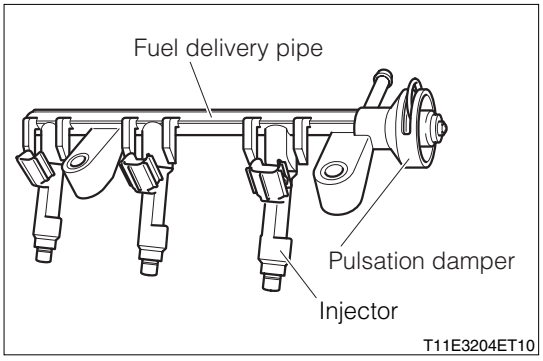
Discharge amount (ℓ/h) (Voltage 12V, discharge pressure 294 kPa)	46.5 or more

A service hole is provided at the rear floor of the vehicle for mounting and removing the fuel pump or draining fuel so that workability is improved.



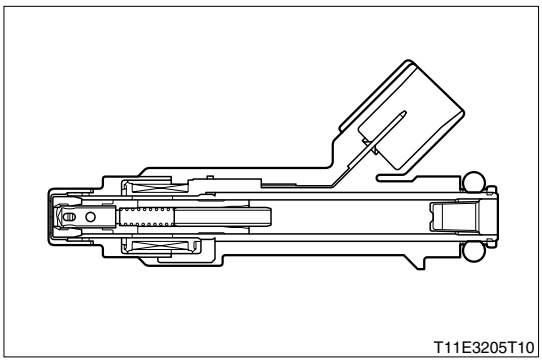
2-3 **FUEL DELIVERY PIPE**

Due to adoption of the fuel returnless system, there is only a fuel inlet, but no outlet.
Plastic has been employed to realize weight saving.
A pulsation damper is provided to absorb fuel pulsation and improve accuracy of the fuel injection.



2-4 **INJECTOR**

The injector with 4 injection holes and injector hole diameter of 0.25mm, is adopted. By promoting atomization of fuel and reducing fuel stuck to the intake port, fuel consumption is improved and emission is reduced.



Injector specifications

Flow rate [fuel pressure 250kPa](cm^3/min)	185.0
Coil resistance [20℃](Ω)	12.0

2-5 **FUEL CUT CONTROL SYSTEM**

In order to prevent fuel leakage and fuel fire in the event of a vehicle collision, a safety mechanism is provided by which, upon receiving a signal from the air bag computer, the engine control computer forcibly stops the fuel pump.

B8 ENGINE CONTROL SYSTEM

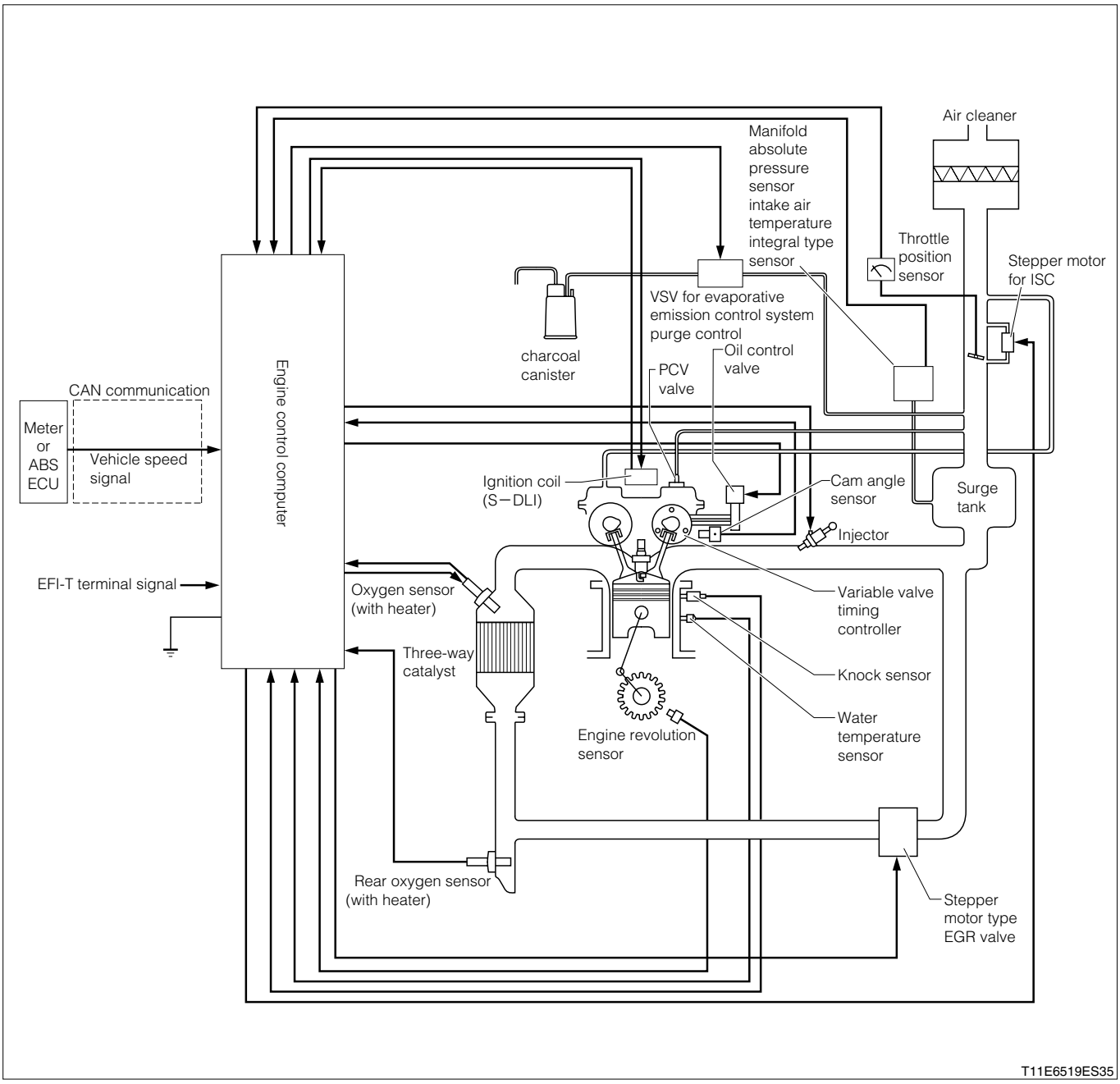
■ 1KR

1 OUTLINE

1-1 DESCRIPTION

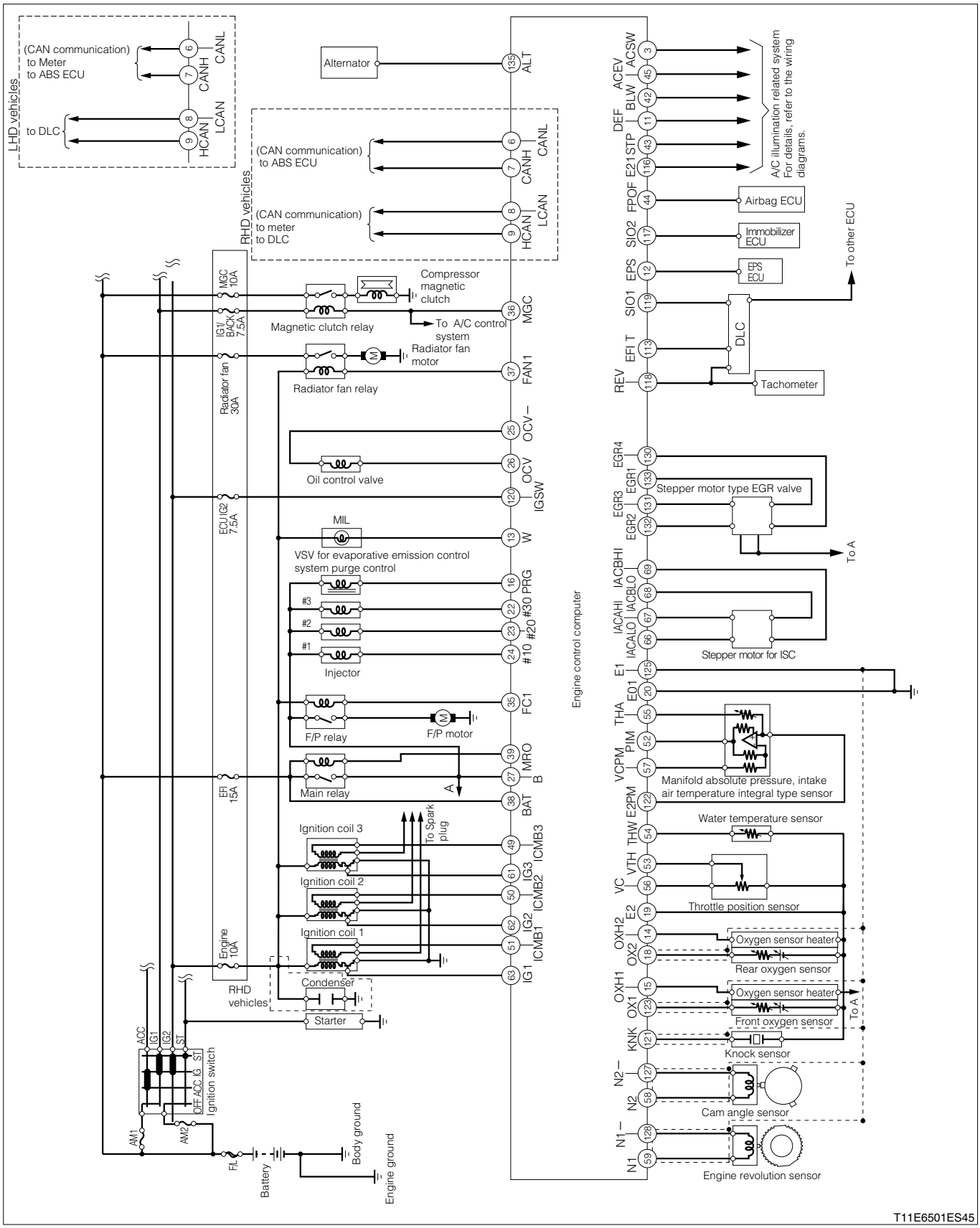
1. Engine control system of the 1KR− FE type engine uses the engine control computer to totally control the electronic fuel injection system (EFI), electronic spark advance (ESA), variable valve timing control, and idol speed control (ISC).
2. The system conducts serial communication with the following ECU's.
   (1) Airbag ECU
   (2) Immobilizer ECU (Immobilizer system-equipped vehicle only)
3. The system conducts CAN communication with the following ECU's.
   (1) Meter ECU
   (2) ABS ECU (ABS-equipped vehicle only)
4. A method using CAN communication has been employed for communication with the diagnostic tester.
5. Fuel consumption data has been added to the CAN communication information. The meter ECU receives this data and the fuel consumption data is displayed on the meter.

1-2 SYSTEM DRAWING



※1: Ion current detection device built-in for only EU specifications
※2: For only EU specifications

1-3 SYSTEM WIRING DIAGRAM



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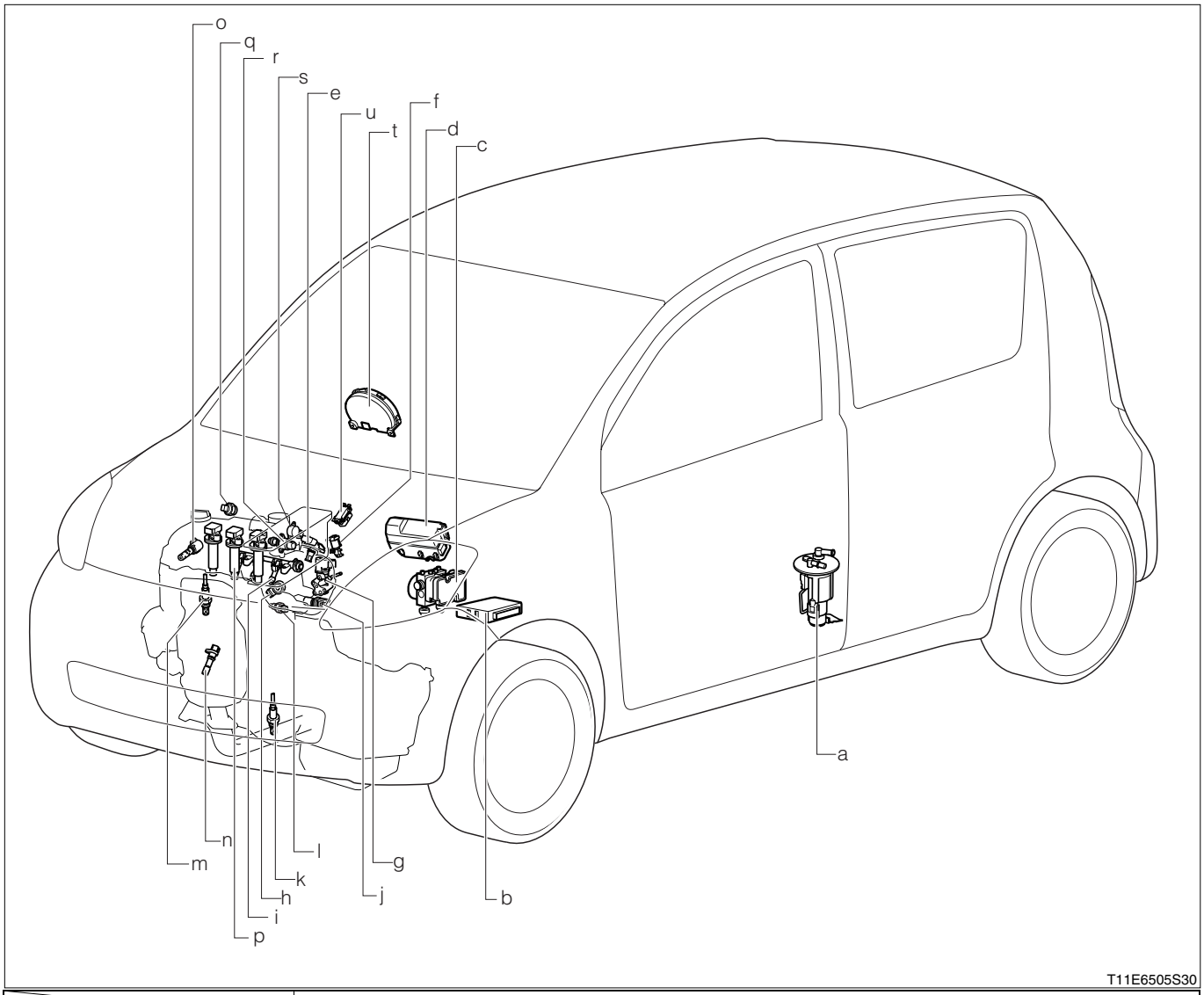
1-4 LOCATION OF COMPONENTS



T11E6505S30

	Part name
a	Fuel pump
b	Engine control computer
c	ABS actuator
d	Relay block
e	Manifold absolute pressure/ intake air temperature integral type sensor
f	VSV for evaporative emission control system purge control
g	Stepper motor type EGR valve
h	Knock sensor
i	Injector
j	Cam angle sensor
k	Rear oxygen sensor
l	Engine water temperature sensor
m	Oxygen sensor
n	Engine revolution sensor
o	Oil control valve
p	Ignition coil
r	Stepper motor for ISC
s	Throttle position sensor
t	Combination meter
u	DLC

2 CONTROL

2-1 EFI SYSTEM

2-1-1 DESCRIPTION

The electronic fuel injection system detects the driving condition through sensor signals from the amount of intake air calculated from the intake manifold pressure and the engine speed. And it controls injection quantity (amount of time that the injector is energized) to ensure proper air-fuel ratio for the driving condition.

The electronic fuel injection system employs an intermittent injection that is synchronized with the engine revolution speed, performing independent injection for each cylinder.

As the fuel injection method, there are synchronous injection and asynchronous injection. The synchronous injection is an injection that is synchronized with the engine revolution signal. On the other hand, the asynchronous injection is an independent injection that is not synchronized with the engine revolution signal. This asynchronous injection takes place, for example, at the time of rapid acceleration. Also, to protect the engine and catalyst, fuel cutting is performed according to the driving condition.

2-1-2 INJECTION SYSTEM

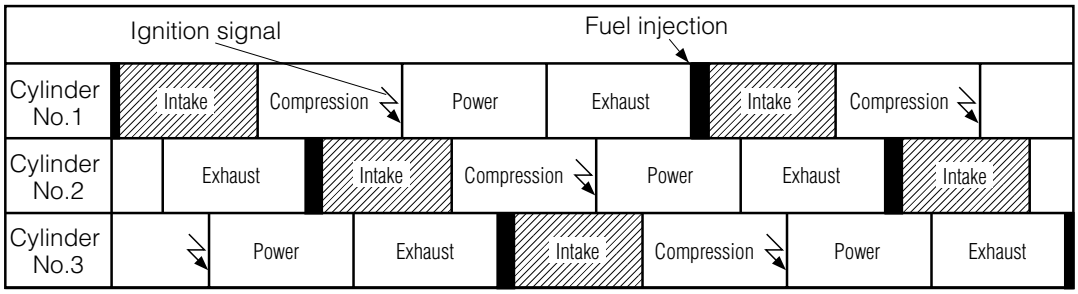
(1) Synchronous injection

The synchronous injection is an injection that is synchronized with the engine revolution signal. There are two methods for synchronous injection: One is the injection during starting period; and the other is the injection after starting period.

The judgment as to whether it is the starting period or after starting period is carried out, based on the engine revolution speed.

① Injection during starting period

A cylinder is identified based on the signal (cylinder identification signal) from the engine speed sensor. After the cylinder is identified, independent injection is performed in each cylinder in accordance with the information obtained from the sensor.



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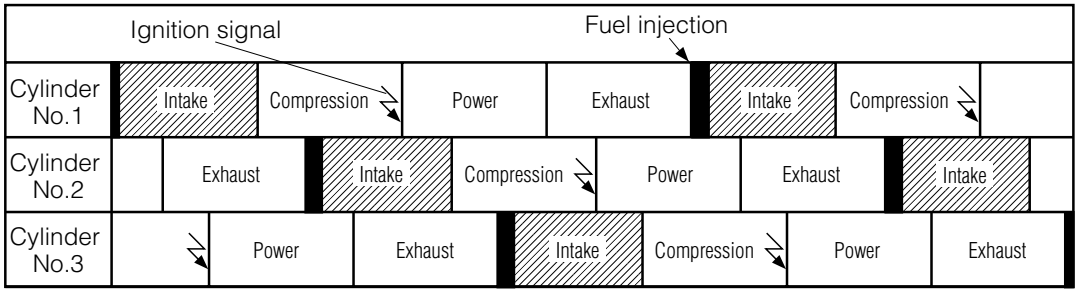
② Injection after starting period

Independent injection is performed, respectively, for each cylinder, based on the cylinder information by the revolution signal (N signal)



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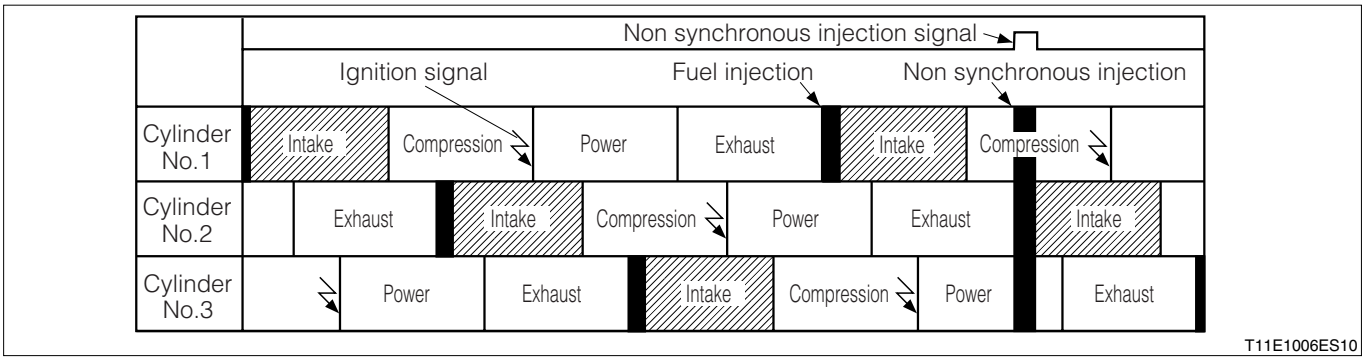
(2) Asynchronous injection

Injection is performed immediately when conditions are satisfied. The injection of this type occurs without synchronizing with the engine revolution signal.



2-1-3 DETERMINATION OF INJECTION AMOUNT (INJECTION TIME DURING SYNCHRONOUS INJECTION)

(1) Injection time during starting period

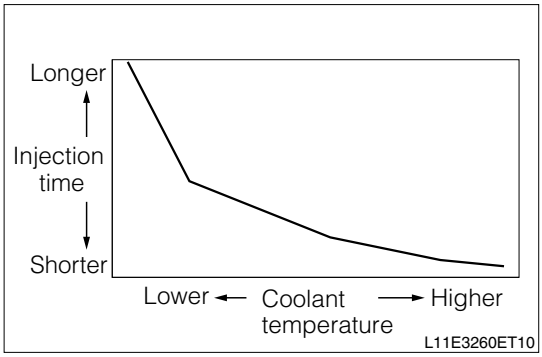
The injection time is determined by the basic injection time during starting period, which is determined by coolant temperatures, various compensation coefficients, and invalid injection time.

Injection time during starting period = Basic injection time during starting period × Various compensation coefficients + Invalid injection time

When the coolant temperature is below the set value, injection is performed into several injections.

① Basic injection time during starting period

The basic injection time is determined by the coolant temperature. When the engine is in a cold period, gasoline adhered to the intake valves and inner walls of the intake ports becomes difficult to evaporate. Therefore, the injection amount during cold period has been set to a greater value.



② Coefficient of compensation for revolution speed during starting period

When the coolant temperature is low, compensation suited for the engine speed is performed so that startability may be improved.

③ Coefficient of compensation for atmospheric pressure during starting period

Compensation suited for the atmospheric pressure is provided to improve startability.

④ Coefficient of compensation for the number of injections during starting period

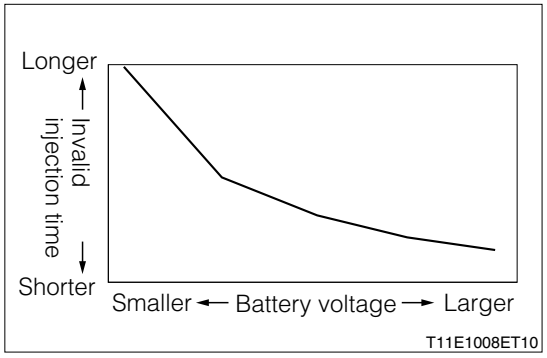
The number of injections during starting period is counted so that the injection time can be properly reduced based on the number of injections.

⑤ Coefficient of intake air temperature compensation

This coefficient is used to rectify the difference in the air density, which is caused by the difference in intake air temperatures.

⑥ Invalid injection time

The injector valve does not open at the moment of energizing and requires some time period for injection to start. This time period is referred to as invalid injection time. Invalid injection time will vary with the battery voltage, with a higher battery voltage resulting in a shorter invalid time, while a lower battery voltage resulting in a longer invalid time. For this reason, the injector energizing time is calculated by adding the invalid injection time, which is based on the constantly measured battery voltage, to the actual injection time.



(2) Injection time after starting period

The injection time is determined by the basic injection time after starting period, various compensations and invalid injection time.

Injection time after starting period = Various compensation time based on basic injection time after starting period + Invalid injection time

① Basic injection time after starting period

This is a time determined by the intake manifold pressure and engine revolution speed.

② Coefficient of intake air temperature compensation

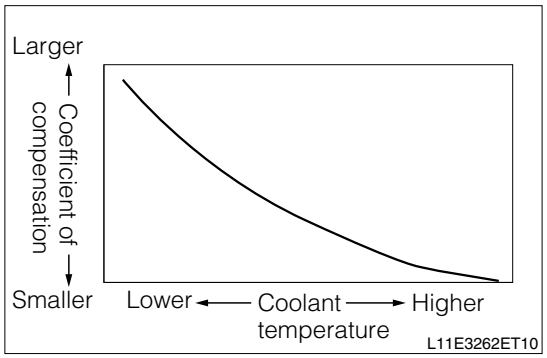
This coefficient rectifies the difference in the air density, caused by the difference in intake air temperatures.

③ Compensation coefficient during resuming period after fuel cut

The injection amount is reduced according to the reduced number of rotations during resuming period after fuel cut in order to improve drivability.

④ Coefficient of compensation for increase of engine warming-up

This is an increase compensation for the engine cold period determined by the coolant temperature. This compensation is carried out, until the warming-up is completed.



⑤ Coefficient of increase compensation after starting period

In order to achieve the stabilization of engine revolution speed immediately after the engine has started, the initial value for the coefficient of increase is determined according to the coolant temperature during the engine starting period. Then, the value is reduced at every time when the injection takes place after the engine starting.

⑥ Time of compensation for air-to-fuel ratio during transient time

This is for the compensation of the air-to-fuel ratio during transient time. This time is determined based on the coolant temperature, etc.

⑦ Coefficient of air-to-fuel ratio feedback compensation

Rich or lean condition in the air-fuel mixture is detected by the signal from the O_2 sensor and the rear O_2 sensor* during the engine running after warm-up. The injection quantity is adjusted accordingly so that the air-fuel ratio is controlled in the narrow range near the theoretical air-fuel ratio where the three-way catalyst exhibits high performance.

NOTE

- *: Rear O_2 sensor is for the EU-specification vehicle only.

⑧ Coefficient of power increase compensation

During a high load driving, the amount of injection is increased according to the intake manifold pressure and engine revolution speed.

⑨ Coefficient of compensation for increase after re-starting

The initial value is determined according to the coolant temperature at time of re-starting. The injection amount is reduced for each injection.

⑩ Coefficient of atmospheric pressure compensation

Compensation according to the atmospheric pressure is performed.

⑪ Idling stabilization compensation advance

During idling, the injection amount is compensated based on the engine revolution signal to stabilizing the revolution speed.

⑫ Water temperature compensation advance

During a high load, high revolution driving, the advance value is compensated according to the coolant temperature.

⑬ Coefficient of low-rotation compensation

The injection amount is increased during low-rotation period.

⑭ Compensation coefficient during knock feedback

Injection quantity is increased when the ignition timing is too retarded during knock feedback.

⑮ Invalid injection time

(See the section of the invalid injection time of the injection time during starting period.)

2-1-4 DETERMINATION OF INJECTION AMOUNT (INJECTION TIME DURING ASYNCHRONOUS INJECTION)

(1) Asynchronous injection during change in idle switch

When the throttle valve is changed from the closed state (idling condition) to the opened state, injection occurs once for all cylinders simultaneously for a certain length of time.

(2) Asynchronous injection during change in intake manifold pressure

Injection occurs once for all cylinders simultaneously for a certain length of time according to the increase ratio of the intake manifold pressure.

(3) Asynchronous injection during resuming period after fuel cutting

If the engine revolution speed drops drastically during the resuming period after fuel cutting, injection occurs for a certain length of time.

(4) Asynchronous injection when the air-conditioner is ON

When the air-conditioner is switched from OFF"→"ON"

(5) Asynchronous injection when the power steering is "ON".

When a request signal is sent from EPS ECU during steering wheel operation, injection occurs for a certain length of time.

2-1-5 FUEL CUTTING

(1) Fuel cutting during deceleration

When the engine revolution speed exceeds the specified value and the throttle valve is closed, fuel cut occurs.

(2) Fuel cutting during catalyst overheated period

Fuel is cut off according to the engine revolution speed and the intake manifold pressure, thus preventing the catalyst from overheating.

(3) Fuel cutting at high engine revolution speed

When the engine revolution speed exceeds the specified value, fuel cut occurs.

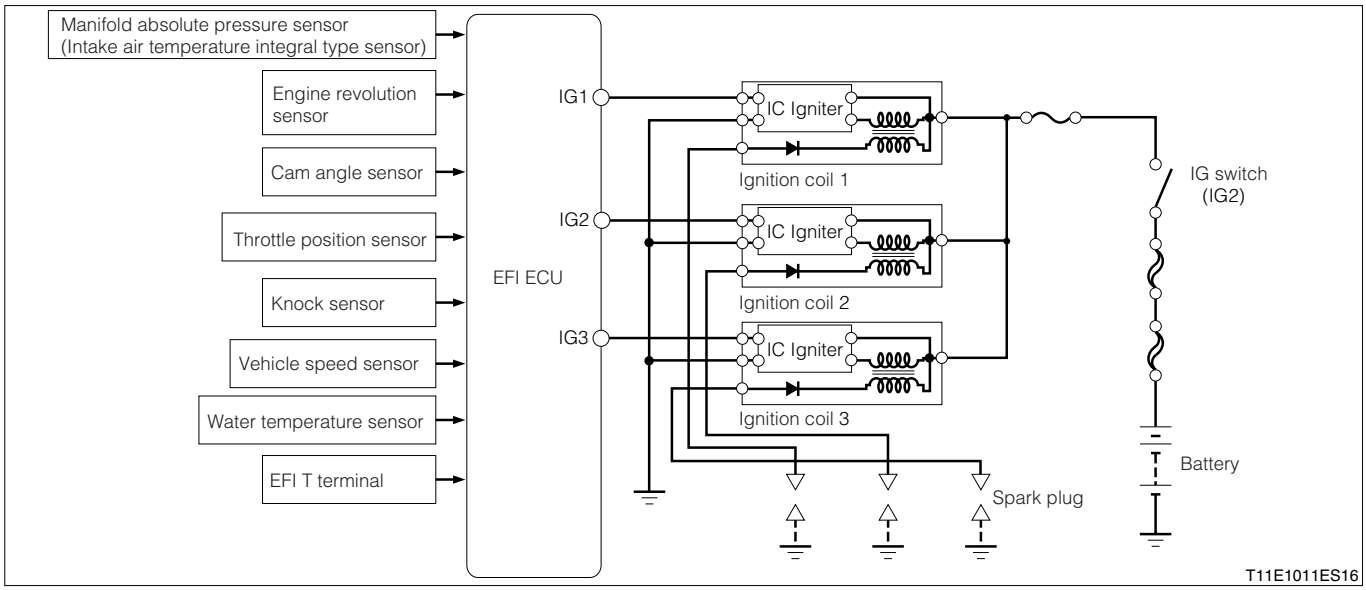
2-2 ELECTRONIC SPARK ADVANCE SYSTEM

2-2-1 DESCRIPTION

ESA (electronic spark advance system) uses the engine control computer to calculate and control the optimal ignition timing according to the engine conditions after the cylinder has been identified by the engine speed sensor signal.

In addition, the ion current combustion control system detects the ion current in the combustion chamber and controls ignition timing for optimal combustion.

The electronic spark advance system can be classified into two modes: One is a fixed spark advance synchronized with the engine revolution signal, and the other is a calculation spark advance determined by the engine revolution speed and intake manifold pressure.



2-2-2 DETERMINATION OF IGNITION TIMING

(1) Fixed advance

BTDC10˚ fixed spark advance synchronized with the engine revolution signal occurs during start-up or short circuit condition at the EFI-T terminal.

(2) Calculation advance

Under conditions other than the fixed advance, the ignition timing is determined by engine conditions, such as the intake manifold pressure and engine revolution speed.

Ignition timing advance = Basic advance ± Various compensation advances

① Basic advance

This is the ignition timing determined by the engine revolution speed and intake manifold pressure.

② Water temperature compensation advance

The advance value is compensated according to the coolant temperature.

③ Idling stabilization compensation advance

In cases where the idling speed drops during the idling period, the timing is advanced. Conversely, in cases where the idling speed rises, the timing is retarded.

④ Transient compensation advance

The advance value is compensated in accordance with sharp fluctuations of the intake manifold pressure during running.

⑤ Control of energizing time

Energizing time of the ignition coil is controlled in accordance with the engine revolution speed and power supply voltage to the ignition coil.

⑥ Knock compensation advance

When knocking is detected by the output signal of the knock sensor, ignition timing will retard immediately. When knocking does not occur for a given length of time, ignition timing will be advanced gradually until knocking occurs again. In this way the optimal ignition timing can be maintained at all times. Compensation value is limited to prevent adverse influence to the engine.

⑦ Acceleration surging compensation advance

The ignition timing advance is compensated when the intake manifold pressure changes beyond a set amount during acceleration at a low speed after the engine has warmed up.

⑧ Inner EGR compensation advance

The ignition timing advance is compensated according to the variable valve timing..

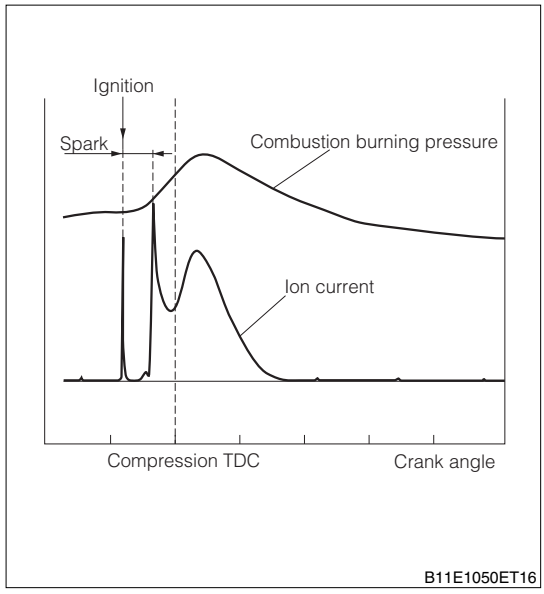
⑨ External EGR compensation advance

The ignition timing advance is compensated according to the amount of external EGR.

2-2-3 ION CURRENT COMBUSTION CONTROL SYSTEM

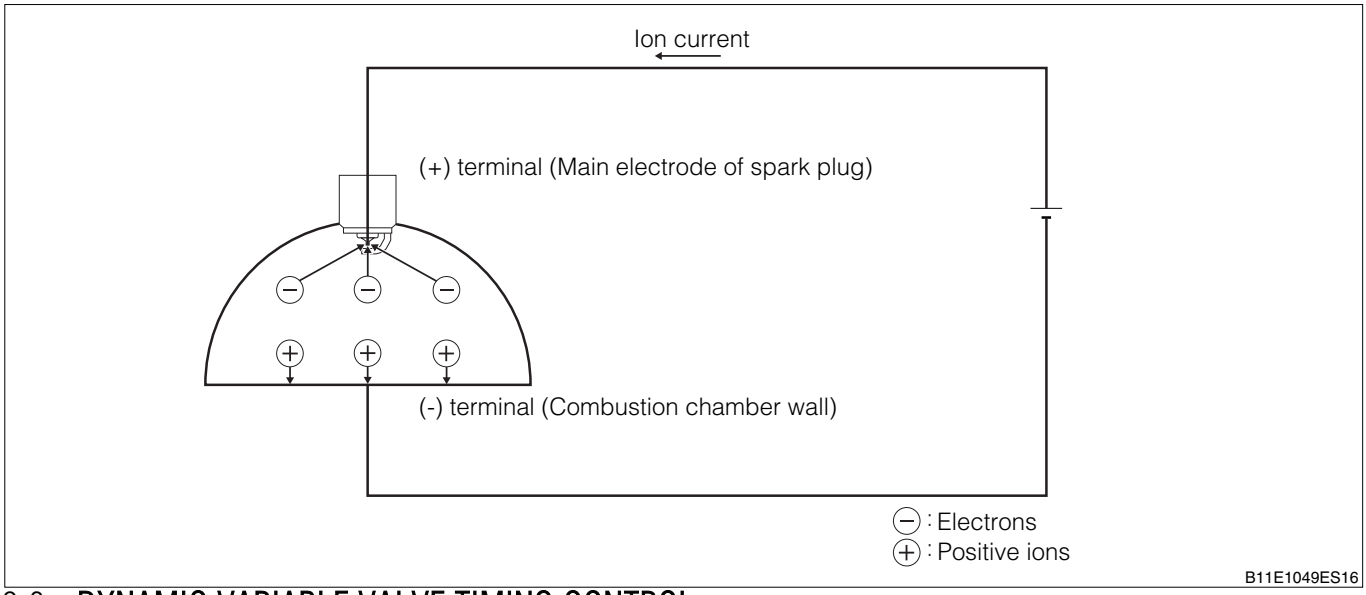
(1) DESCRIPTION

The engine control computer uses the spark plug to detect ion current generated during combustion burning, thereby detecting combustion burning condition in the cylinder.
This allows detection of misfire and combustion limit, thus controlling ignition timing for optimal combustion.



(2) Principle

1. Positive ions and electrons are generated in the flame during combustion.
2. When the charge voltage on the primary side of the ignition coil is applied to the main electrode of the spark plug after the arc discharge ignition, ion current will be produced in the flame.
3. The detected ion current, as being a minute output, is subject to noise. Therefore, ion current waveform is converted into a rectangular wave in the ion current detection circuit, which is built into the ignition coil, and the signal is sent to the engine control computer to determine combustion and misfire.
4. Ion current is not created when engine misfire occurs. Therefore, when the input voltage of the engine control computer falls below the standard value, it determines that misfire has occurred.

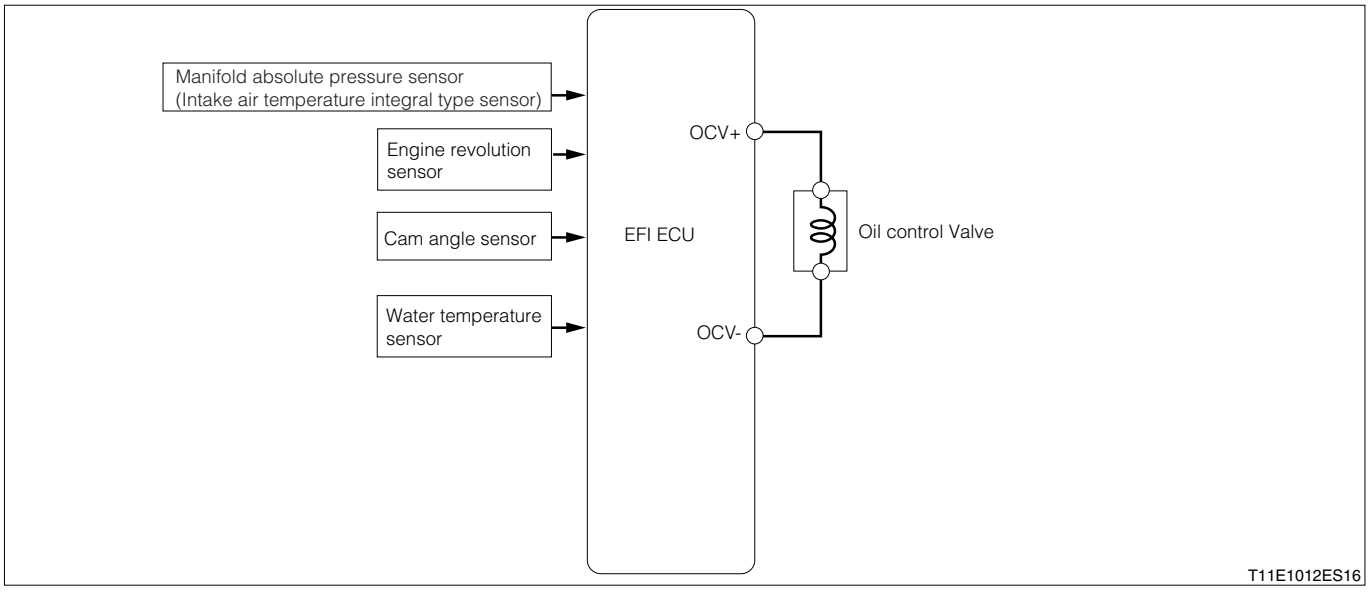


2-3 DYNAMIC VARIABLE VALVE TIMING CONTROL

2-3-1 DESCRIPTION

The engine control computer turns ON and OFF the oil control valve according to the signals from the manifold absolute pressure sensor, coolant temperature sensor and engine revolution speed so as to regulate the hydraulic pressure applied to the variable valve timing controller. This way, the opening/closing timing of the intake air valve can be controlled to the target timing. The opening/closing timing of the intake air valve is detected by the camshaft position sensor. Any deviation, when encountered, will be corrected.

The valve timing is controlled by the engine control computer in three control modes.



(1) Forced most-retarded angle mode

This is the mode that forces the No. 1 camshaft to rotate till maximum retard in the intake valve open/close timing . This mode is used to regulate the oil control valve when starting and when battery voltage falls below the set value.

(2) 0˚retention mode

The retention mode is used, when a target displacement is 0˚. (Refer to the following section on feedback mode for the target displacement angle.)

(3) Feedback mode

① Determination of target displacement angle

The target displacement angle is determined according to the throttle valve opening degree, intake manifold pressure, atmospheric pressure, engine revolution speed, and coolant temperature.

② Determination of oil control valve driving duty ratio

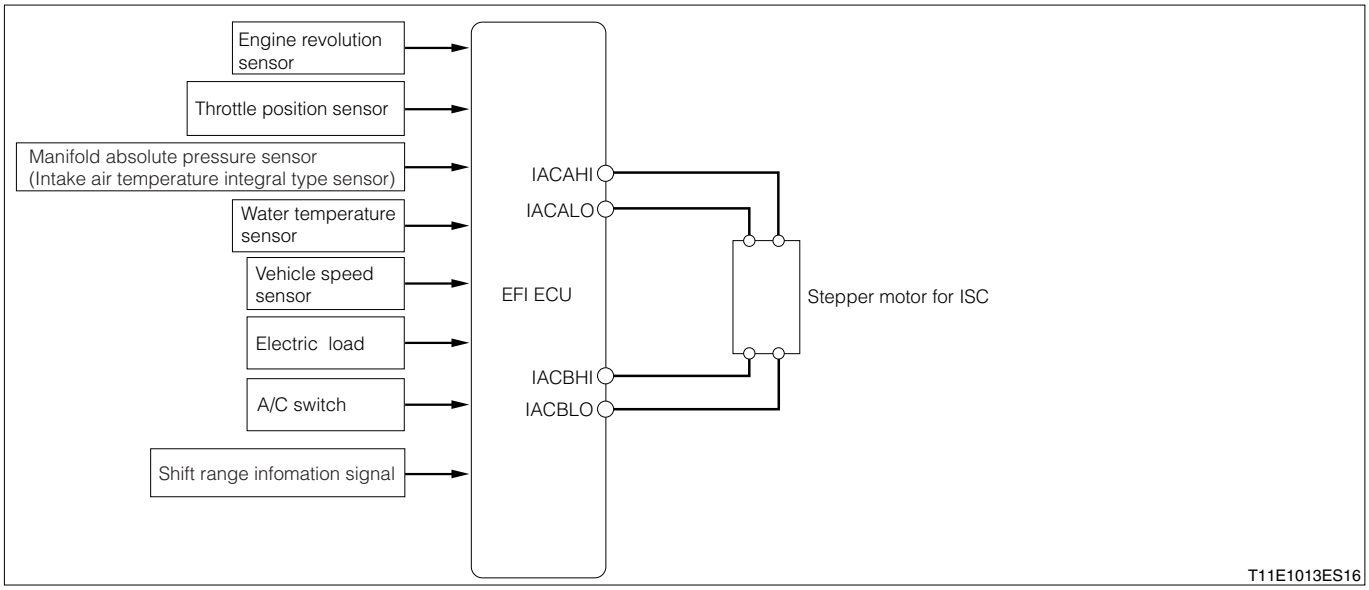
The duty ratio is determined based on the signal from the target displacement angle and camshaft position sensor according to the engine revolution speed and coolant temperatures.

2-4 IDLE SPEED CONTROL SYSTEM (ISC)

2-4-1 DESCRIPTION

The idle speed control (ISC) controls the engine idle speed to prevent engine stall that occurs due to the load applied to the engine during idling.

The engine control computer activates the ISC stepper motor by the signal sent from the sensors, which then controls the pass way area that bypasses the main passage, where the throttle valve is located, in order to control the intake air during idling.



2-4-2 DETERMINING AMOUNT OF DRIVE

The engine control computer determines the opening angle of the ISC valve by the signal from sensors and outputs the amount of drive to the ISC stepper motor based on the valve opening angle.

(1) Water temperature compensation amount

During the period from the engine starting through the end of warming-up, the opening degree of the ISC valve is compensated according to the coolant temperature.

(2) Compensation amount during starting period

During the engine starting period and for several seconds after the starting, the ISC valve is opened to increase intake air in order to improve the engine startability.

(3) Compensation amount for feedback

The opening angle of the ISC valve is changed according to the difference between the idle speed and the target revolution speed to achieve the target revolution speed.

(4) External load compensation amount

1. When changes occur in the air conditioner load, electric load, radiator fan load and so forth, the opening angle of the ISC valve changes according to respective loads, thereby controlling the engine revolution speed.
2. The engine revolution speed is controlled by the power steering load (when the steering wheel is operated with the vehicle in a stationary state) during idling period.

(5) Compensation amount by engine revolution load

The ISC valve opens once, and then gradually closes, in order to obtain better converge into the target revolution speed when the engine revolution speed drops.

(6) EGR compensation amount

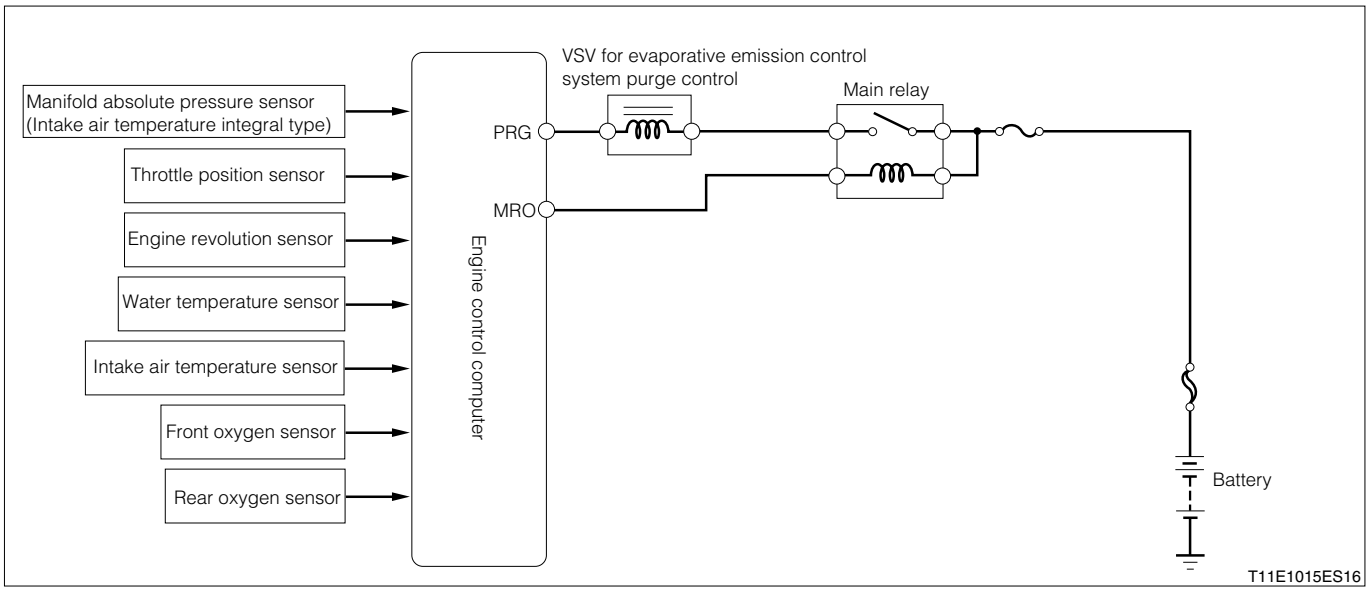
When the throttle valve closes suddenly, the ISC valve opens to allow new charge, thus increasing the quantity of air.

2-5 VSV CONTROL FOR EVAPORATOR PURGE

2-5-1 DESCRIPTION

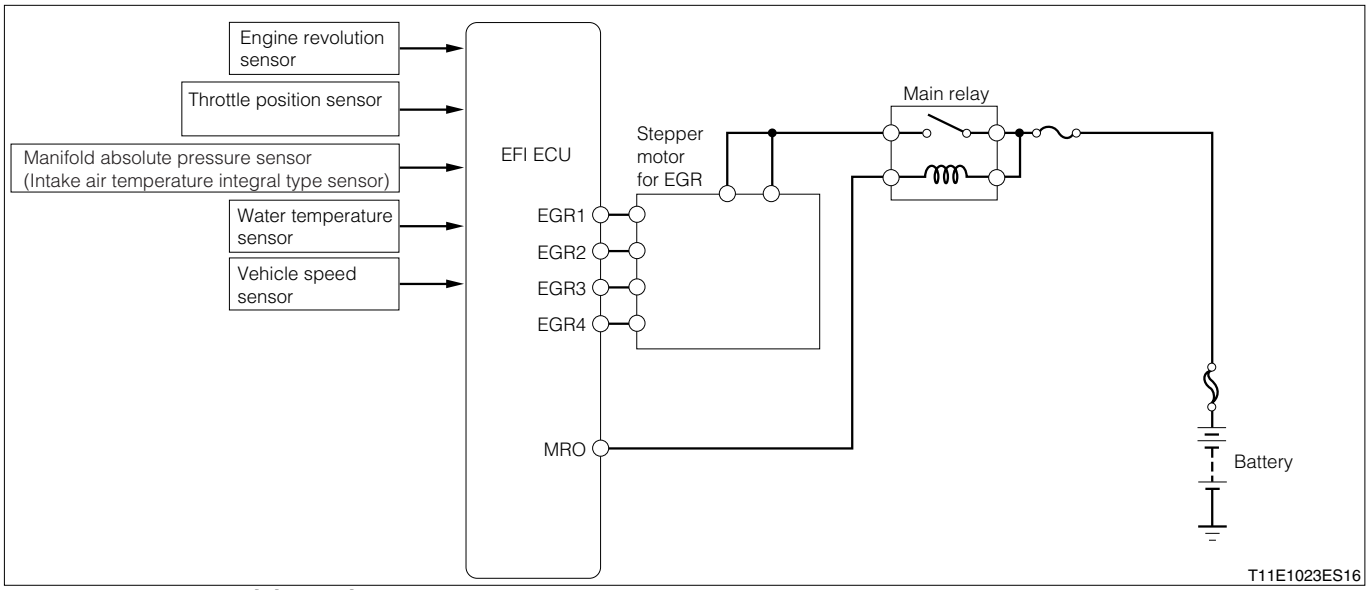
When all of the following conditions are satisfied, the engine control computer turns ON the VSV for evaporative emission purge (duty control), thus purging the fuel evaporative emissions to the combustion chamber.

1. After engine has warmed up
2. During the air-to-fuel ratio feedback
3. When the accelerator pedal is depressed:
4. When the engine control computer is not in a learning mode:



2-6 EGR STEPPER MOTOR CONTROL

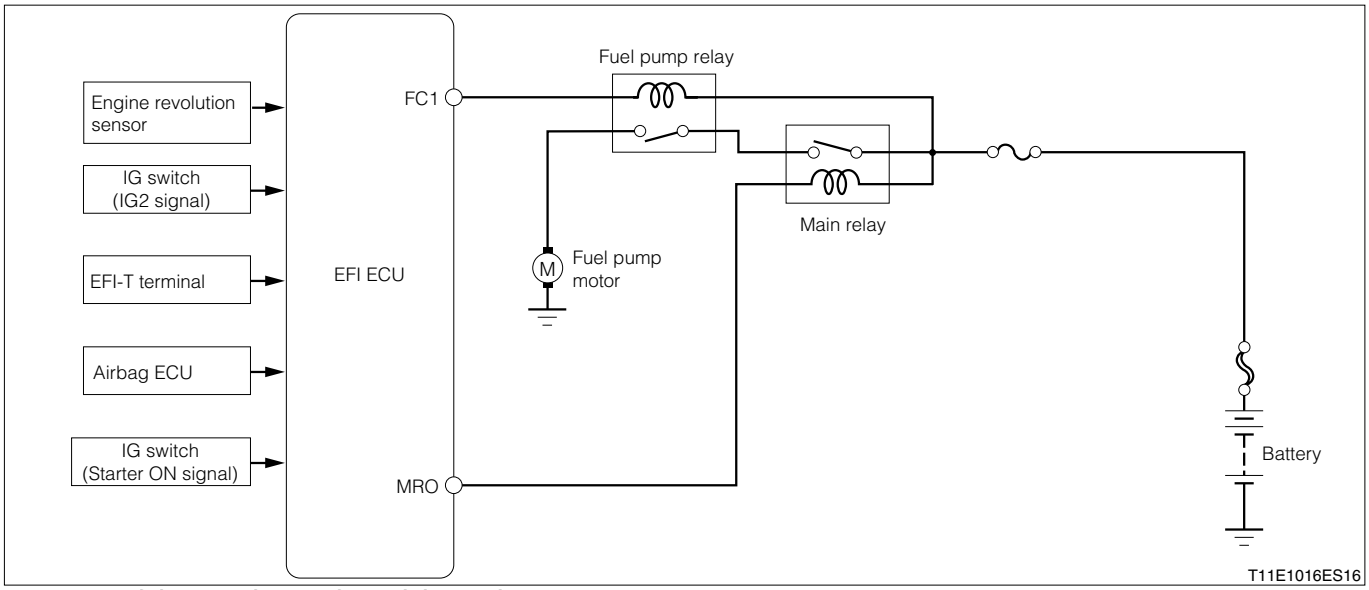
The engine control computer activates the EGR stepper motor according to the engine revolution speed, throttle position sensor, manifold absolute pressure sensor (with the intake air temperature sensor), and the coolant temperature sensor, thereby regulating the opening angle of the EGR valve to achieve an optimum amount of EGR.



2-7 FUEL PUMP CONTROL

When any of the following 4 conditions is satisfied, and no fuel pump stop signal is sent from the airbag ECU, the engine control computer will turn ON the fuel pump relay to activate the fuel pump.

1. For two seconds after the IG switch ON (with the terminal EFI-T turned OFF):
2. For eight seconds after the IG switch ON (with the terminal EFI-T turned ON):
3. After identifying the cylinder and for two seconds after the revolution signal is inputted (The pump is continued to be driven when the engine revolution speed is more than 20 rpm.):
4. Three seconds after starter is switched from OFF → ON



2-8 AIR CONDITIONER CUT CONTROL

2-8-1 DESCRIPTION

When the following conditions for the air conditioner cutting are satisfied, the engine control computer turns OFF the air conditioner relay and the compressor magnet clutch, thereby cutting the air conditioner.

(1) Air conditioner cut by coolant temperature

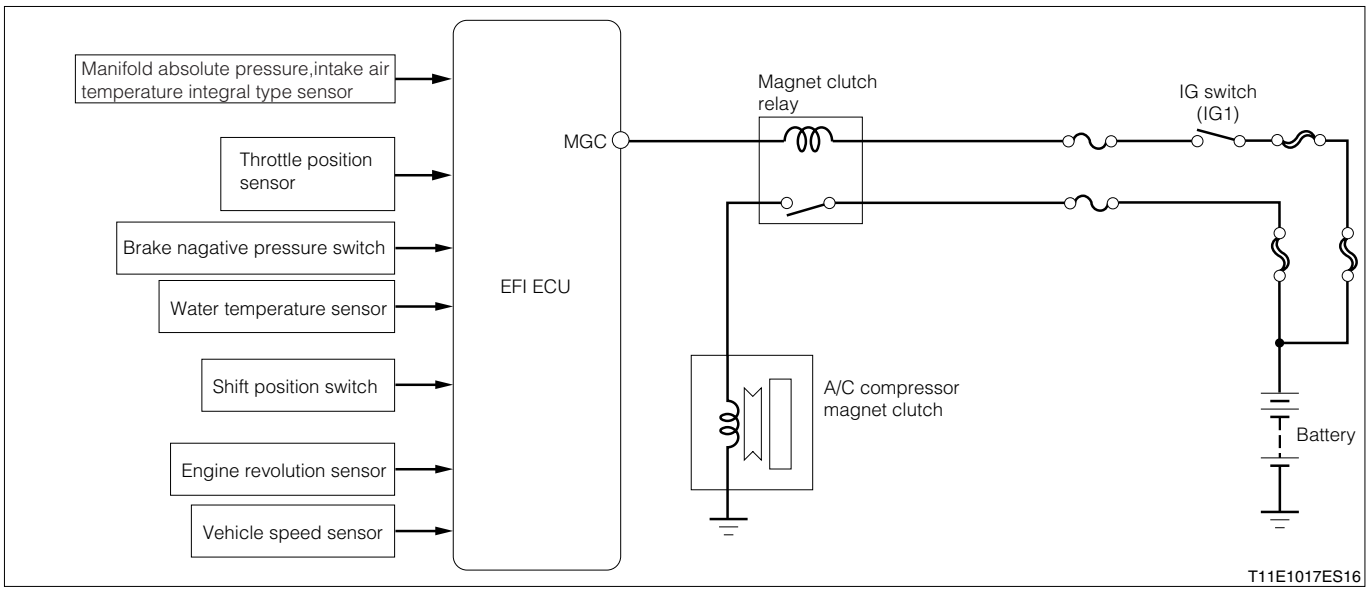
When the following conditions are satisfied, the air conditioner is cut.

1. When the coolant temperature becomes above the set value:

(2) Air conditioner cut in running area

When at least one of the following conditions is satisfied, the air conditioner is cut.

1. When the throttle valve opening degree and the manifold absolute pressure exceed the set value:
2. When the throttle valve opening degree exceeds the set value by the vehicle speed:



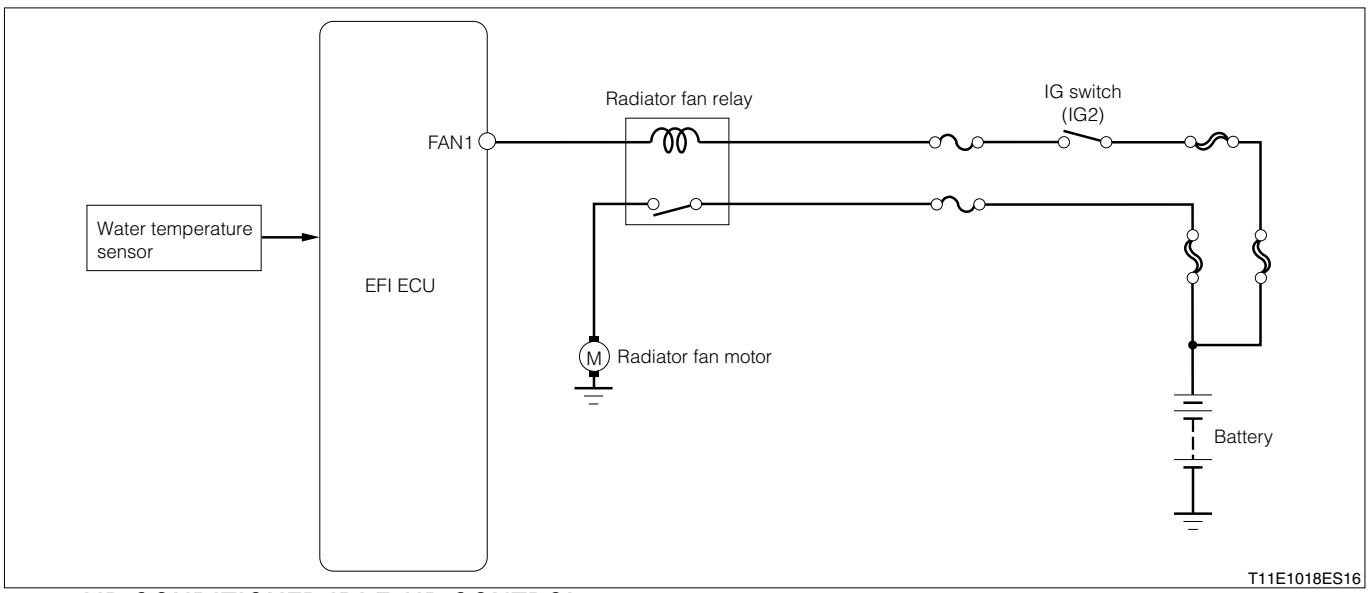
2-9 RADIATOR FAN MOTOR CONTROL

2-9-1 DESCRIPTION

When the preset condition is satisfied, the radiator fan relay is turned ON, and the radiator fan motor is operated. If not satisfied, the radiator fan relay is turned OFF.

NOTE

- When an abnormality occurs in the coolant temperature sensor system, the radiator fan motor rotates all the time by the fail-safe function.



2-10 AIR CONDITIONER IDLE-UP CONTROL

2-10-1 DESCRIPTION

When all of the following conditions are satisfied, the engine idle speed is increased.

1. When the air conditioner switch is ON:
2. When the blower switch is ON:
3. When the air conditioner cutting control is not performed:
4. When the air conditioner evaporator temperature exceeds the set value:

2-11 MAGNET CLUTCH CONTROL

2-11-1 DESCRIPTION

When all of the following conditions are satisfied, the magnet clutch is turned ON.

1. When the air conditioner idle-up control is performed:

2-12 ALTERNATOR CONTROL

2-12-1 DESCRIPTION

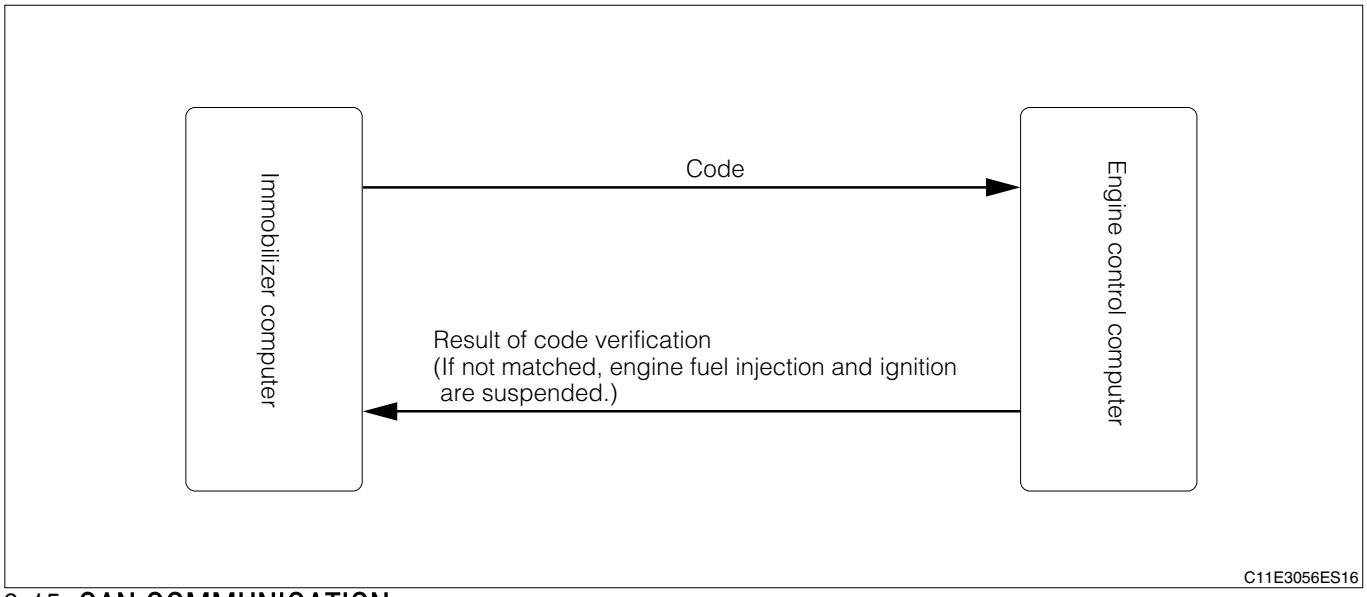
When the preset condition is satisfied, the alternator stops charging .

2-13 AIRBAG ECU COMMUNICATION

When the signal from the airbag ECU is received in the event of a collision, etc., the fuel pump relay is turned OFF, thus stopping the fuel pump.

2-14 IMMOBILIZER SYSTEM COMMUNICATION (IMMOBILIZER SYSTEM-EQUIPPED VEHICLE ONLY)

The engine control computer communicates with the immobilizer ECU for code verification. If the code does not match, fuel injection and ignition are stopped to prevent the engine from starting.



2-15 CAN COMMUNICATION

The engine control computer conducts CAN communication with the meter ECU and ABS ECU. Multiple pieces of information and data are sent and received through a pair of communication wires (twisted pair wiring).

Refer to the section "CAN communication system" for the details of CAN communication.

2-16 DIAGNOSIS (SELF-DIAGNOSIS) FUNCTION

2-16-1 OUTLINE

(1) DESCRIPTION

In the diagnosis system, a computer memorizes any system which encounters abnormality in its output/input signal systems, and inform the driver of the abnormality by flashing or illuminating the malfunction indicator lamp (MIL, warning lamp) while the engine is running.

Since the memory of the diagnosis content is performed directly by the battery, the diagnosis content is memorized even if the IG switch is turned ACC or LOCK. For detailed information about the assignment of the diagnosis trouble code (DTC), the checking and erasing procedures for the DTC, refer to the EF section of the service manuals. The following shows the DTC the table showing failsafe functions, although these information is posted in the EF section of the service manuals.

(2) Instructions on use of this technical information book

This technical information book covers both the area where type certification is conducted based on the EC exhaust emission approval procedures, and other areas. However, the assignment of the diagnosis trouble codes and their reading are different between these two areas. Hence, observe the following instructions.

1. Use of DS-21 diagnosis tester or OBD II generic scan tool:
   (1) Areas where type certification are performed based on EC exhaust emission approval procedures: Use the 4-digit code (example, P0105) which is assigned according to the ISO standards.
   (2) You can use the 4-digit codes by using the DS-21 diagnosis tester or OBD II generic scan tool. Or you can also use two-digit codes (example, 31) without using such tester or tool. You can employ whichever convenient method.
2. The OBD II generic scan tool refers to a scan tool which complies with the ISO 14230 (KWP2000) format.
3. When the OBD II generic scan tool is used, all trouble codes (4-digit codes) can not be read out. It should be remembered that only trouble codes which have a zero after P, like P0XXX, can be read out.
4. The 2-digit codes are slightly inferior to the 4-digit codes in identifying the trouble sections.

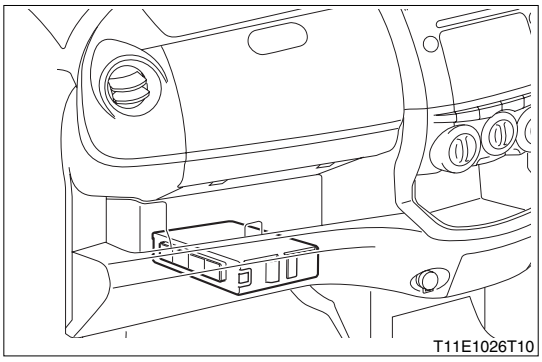
2-16-2 FAIL-SAFE FUNCTION

Fail safe specifications

Item	Fail-safe execution conditions	FAIL-SAFE SPECIFICATIONS
Manifold absolute pressure sensor signal system	When abnormality takes place in the signal from the manifold absolute pressure sensor:	The manifold absolute pressure is estimated by the throttle opening angle and the engine revolution speed. When abnormality occurs in the signal from the throttle position sensor, the signal from the manifold absolute pressure sensor is set to the constant value. If both the throttle opening angle and engine speed exceed their set values, the fuel is cut.
Ignition system	When malfunction takes place in the ignition signal:	Fuel injection is cut in the cylinder whose ignition signal is faulty.
Coolant temperature sensor system	When malfunction takes place in the signal from the coolant temperature sensor:	The signal from the coolant temperature sensor is set to a constant value.
Throttle position sensor system	When abnormality takes place in the signal from the throttle position sensor:	The signal from the throttle position sensor is set to a constant value.
A/C evaporator temperature sensor signal system	When malfunction takes place in the signal from the A/C evaporator temperature sensor:	The air conditioner will be cut.
Atmospheric pressure sensor circuit malfunction	When the signals from the atmospheric pressure sensor are not outputted continuously over a certain length of time after starting.	The signal from the atmospheric pressure sensor is set to a constant value.
Knock sensor signal system	When abnormality takes place in the signal from the knock sensor:	The ignition timing is retarded.
Intake air temperature sensor signal system	When malfunction takes place in the signal from the intake air temperature sensor:	The signal from the intake air temperature sensor is set to a constant value.
ISC stepper motor signal system	When malfunction takes place in the detection signal for the ISC stepper motor:	ISC control is stopped. Fuel is cut.
Oil control valve system	When malfunction takes place in the control voltage for the oil control valve:	Oil control valve energizing control is prohibited.
Camshaft position sensor system	When malfunction takes place in the signal from the camshaft position sensor:	The signal from the camshaft position sensor is set to a constant value.
Rear O_2 sensor system.	When abnormality takes place in the signal from the rear O_2 sensor:	The feedback control is changed to open control.
Immobilizer communication system.	When abnormality takes place in the communicates with the immobilizer ECU, code reference failed due to malfunction in the computer internals.	Fuel injection and ignition are stopped.
Stepper motor type EGR valve system	When abnormalities take place in the EGR gas flow: When open or short circuit occurs in the wiring to the EGR stepper motor:	After the EGR valve is fully closed, control of energizing the EGR stepper motor is stopped.

3 COMPONENTS

3-1 ENGINE CONTROL COMPUTER



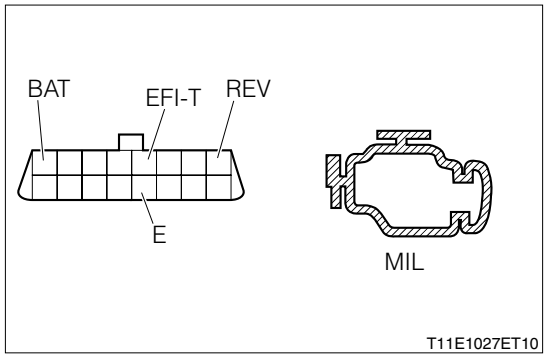
The engine control computer is mounted under the glove box on the front passenger seat side, providing fuel injection control, electronic spark advance control, variable valve timing control, idol speed control, evaporator purge control, etc. The engine control computer communicates with other ECU's, outputs the operation status of the engine through EFI ECU, and inputs the signal from ECU's, providing various controls such as idle-up, fuel cut, and ignition stop.

3-2 DLC

3-2-1 DESCRIPTION

The DLC is installed in front of the driver's seat (at the lower end of the instrument panel, on the driver's door side), providing the following checks.

(1) Indication of diagnosis
(2) Indication of O_2 sensor state



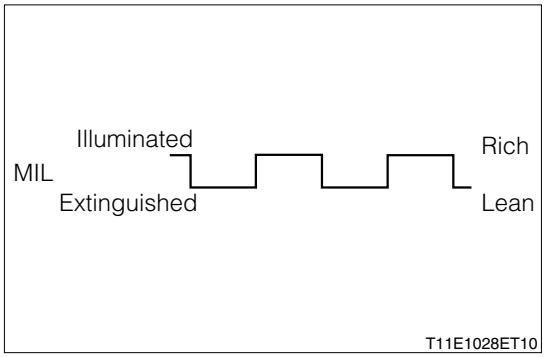
3-2-2 INDICATION OF DIAGNOSIS

When the terminal EFI T and E are shorted while the IG switch is ON, the engine check lamp inside the combination meter flashes to indicate the error code, starting with a smaller code. The error code is identified by the number of flashing, displayed repeatedly.

3-2-3 INDICATION OF O_2 SENSOR STATE

Short-circuit the terminal EFI T and E with the IG switch turned ON, maintain the engine speed above 2000rpm, and keep the brake pedal depressed. In this way, the output status of the O_2 sensor and feedback control can be checked by ON/OFF operations of the engine check lamp.
(No indication of the rear O_2 sensor state)

(1) Rich side: Lamp ON
(2) Lean side: Lamp OFF

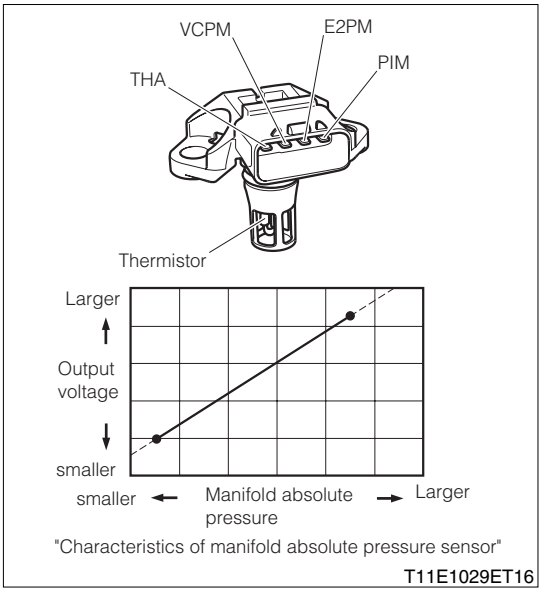


3-3 MANIFOLD ABSOLUTE PRESSURE / INTAKE AIR TEMPERATURE INTEGRATED SENSOR

The sensor is an integral type where the manifold absolute pressure sensor and the intake air temperature sensor are integrated.
The sensor is mounted on the intake manifold to detect the manifold absolute pressure in the intake manifold and intake air temperature. The manifold absolute pressure outputs are sent to the PIM terminal, and intake air temperature outputs are sent to the THA terminal through the thermistor, whose resistance changes with temperature.

Characteristics of intake air temperature sensor

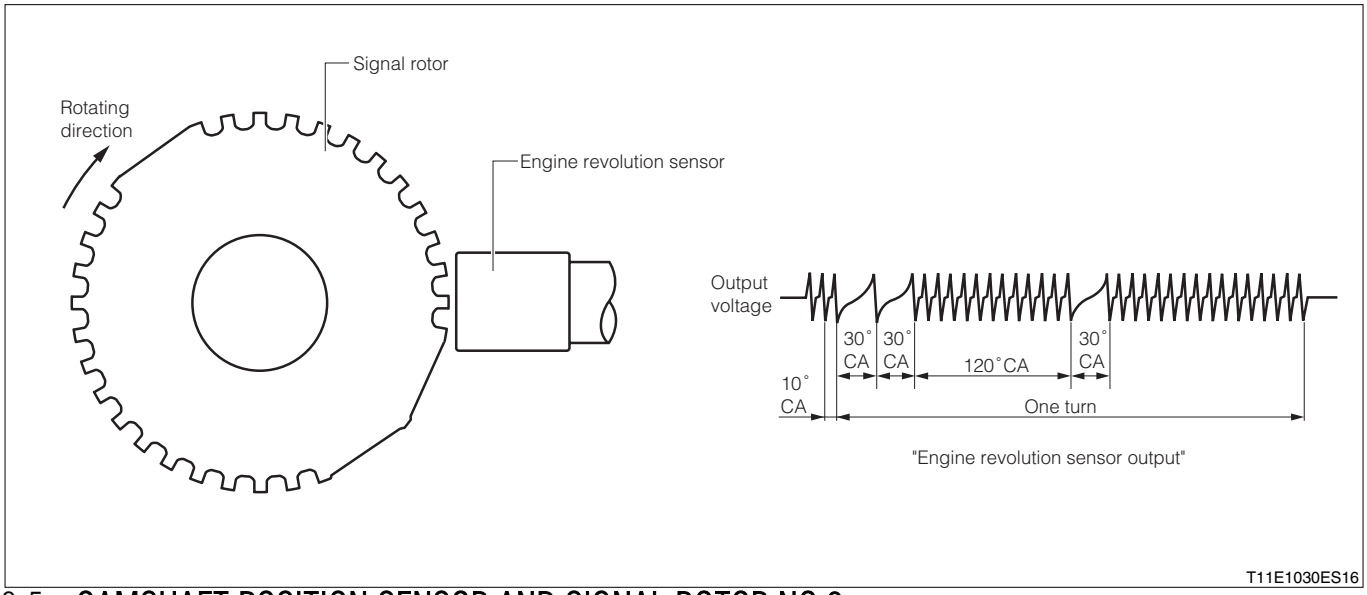
Temperature [℃]	−30	−20	20	80	120
Resistance [kΩ]	-28.6	16.2	2.45	0.322	-0.117



NOTE
- Figures inside parentheses show reference values.

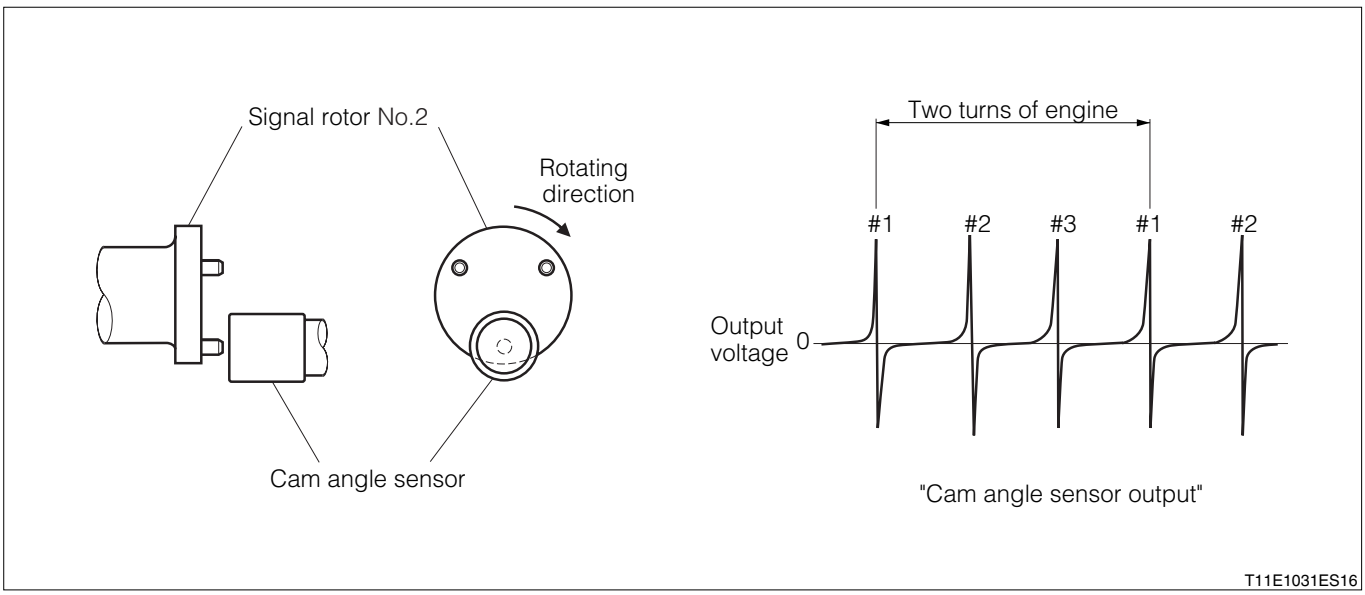
3-4 ENGINE SPEED SENSOR, SIGNAL ROTOR

The signal rotor is installed at the front of the crankshaft in order to detect the crank angle. The signal rotor has a projection for which the engine speed sensor is installed.
As the crankshaft turns, the air gap changes between the engine revolution sensor and the projection provided on the signal rotor, causing changes in the magnetic flux to generate a pulse.
The engine speed is calculated based on the interval of the pulses generated by this projection.



3-5 CAMSHAFT POSITION SENSOR AND SIGNAL ROTOR NO.2

A projection is provided at the rear of the No.1 camshaft to detect the phase of the No.1 camshaft and the crankshaft. The camshaft position sensor is mounted at the rear of the cylinder head.
When the No.1 camshaft makes a turn, the air gaps change between the camshaft position sensor and each of the three projections on the signal rotor No.2. As a result, the magnetic flux changes, and three pulses per turn are generated at the camshaft position sensor.
The phase of the No.1 camshaft and the crankshaft is detected by the signals from the camshaft position sensor and the engine speed sensor. The variable valve timing control is performed based on this phase.

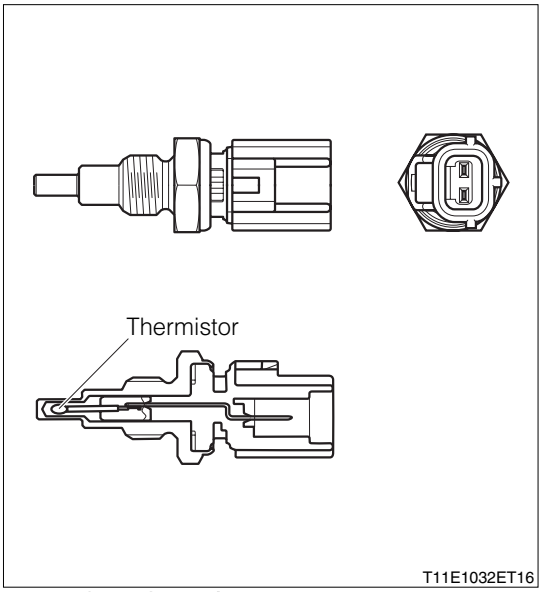


3-6 COOLANT TEMPERATURE SENSOR

The coolant temperature sensor, mounted on the cylinder head, detects the coolant temperatures.
The sensor has a built-in thermistor, whose resistance changes with temperature. The input signals from the thermistor are sent to the engine control computer.
The coolant temperature gauge in the meter uses coolant temperature signals sent from the engine control computer through CAN communication.

Characteristics of coolant temperature sensor

Temperature [℃]	−20	20	80	110
Resistance [kΩ]	15.04	2.45	0.318	0.142

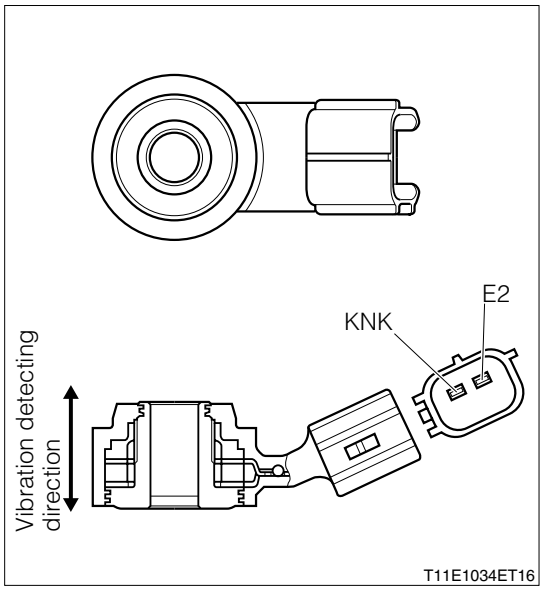


3-7 ATMOSPHERIC PRESSURE SENSOR (EU-SPECIFICATION VEHICLE ONLY)

The atmospheric sensor is incorporated in the engine control computer. This sensor senses the atmospheric pressure, which is used for compensation of the fuel injection amount, etc.

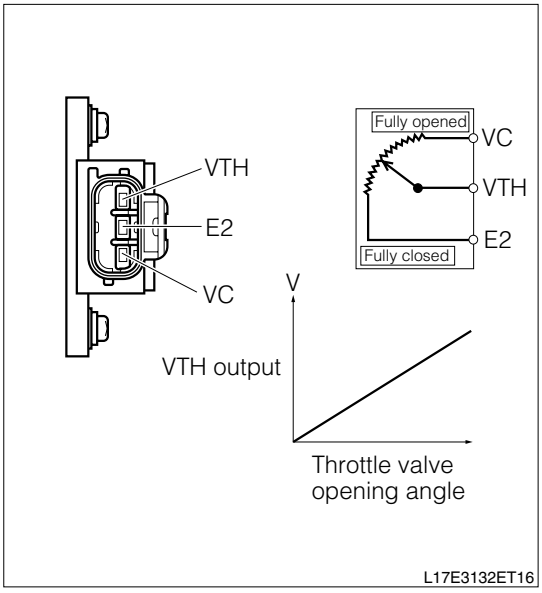
3-8 KNOCK SENSOR

The knock sensor is mounted on the cylinder block and detects knocking indirectly from the vibration of the cylinder block that occurs by knocking.
A piezoelectric element, which is built into the sensor, converts vibrations of the cylinder block into electric signals.
The non-resonance type knock sensor is used to improve accuracy in knock detection.



3-9 THROTTLE POSITION SENSOR

The sensor is installed to the throttle body and has a built-in potentiometer, which detects a throttle opening angle linearly.

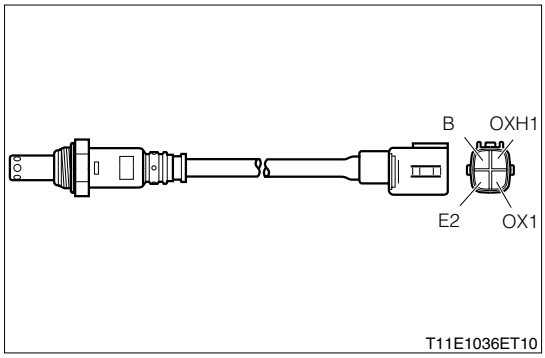


3-10 O_2 SENSOR

The sensor is installed to the exhaust manifold and detects the oxygen concentration in the exhaust emission by the amount of the electromotive force generated within the sensor. The lower the oxygen concentration, the greater the electromotive force gets, indicating that the air-to-fuel ratio is rich (rich condition).

Based on this voltage, the engine control computer judges whether the current air-to-fuel ratio is greater or smaller than the stoichiometric ratio.

The sensor begins operating at about 300℃ or more. In order to activate the sensor sooner, a heater circuit is provided. This helps improve accuracy of the air-to-fuel ratio feedback control, thus reducing the exhaust emission.

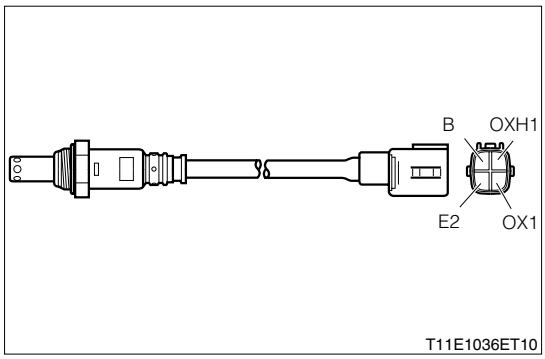


3-11 REAR O_2 SENSOR (EU-SPECIFICATION VEHICLE ONLY)

The sensor is installed to the exhaust front pipe. It detects the oxygen concentration in the exhaust emission after passing over the catalyst, by the amount of the electromotive force generated within the sensor. The lower the oxygen concentration, the greater the electromotive force gets.

Based on this voltage, the engine control computer judges whether the current air-to-fuel ratio is the target value or not, thus monitoring the oxygen sensor provided upstream.

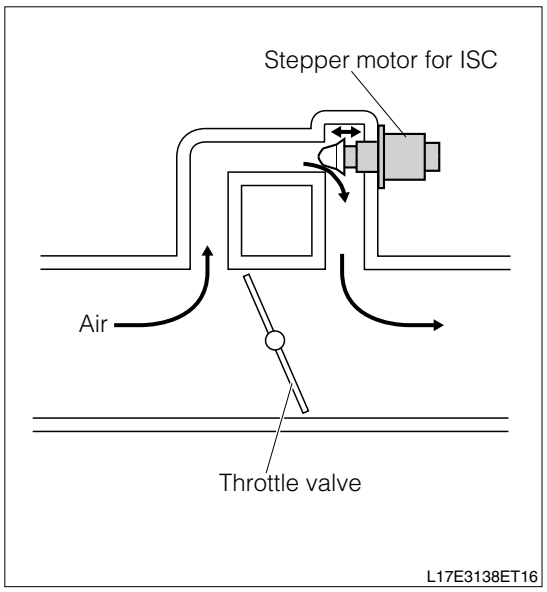
The sensor begins operating at about 300℃ or more. In order to make the sensor operate more early, a heater circuit is provided.



3-12 ISC STEPPER MOTOR

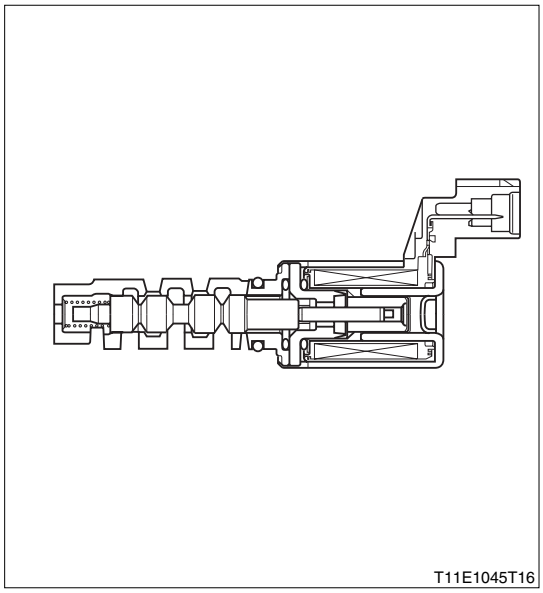
The engine control computer activates the stepper motor and controls the intake air during idling by changing the area of the pass way that bypasses the main passage, where the throttle valve is located.

The stepper motor is driven with 200 steps from the full-close to full-open position of the ISC valve, opening the valve in the reverse direction and closing in the forward direction.



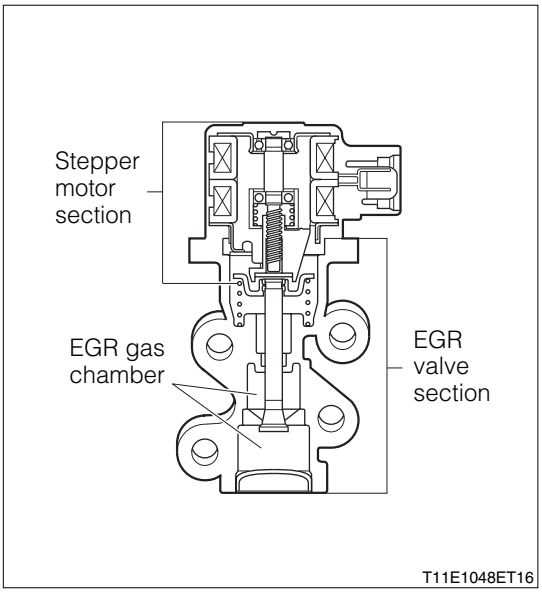
3-13 OIL CONTROL VALVE

The oil control valve turns ON and OFF according to the duty signal from the engine control computer so as to regulate the hydraulic pressure applied to the variable valve timing controller. This way, the opening/closing timing of the intake air valve can be controlled to the target timing.



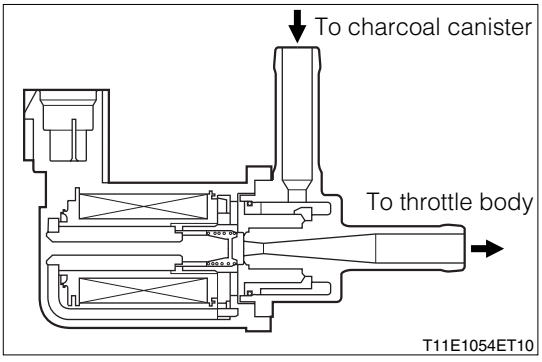
3-14 EGR STEPPER MOTOR

The EGR valve uses the stepper motor to regulate the opening angle of the EGR valve by means of the duty signal from the engine control computer, thereby controlling the amount of exhaust emission mixed with the intake air.

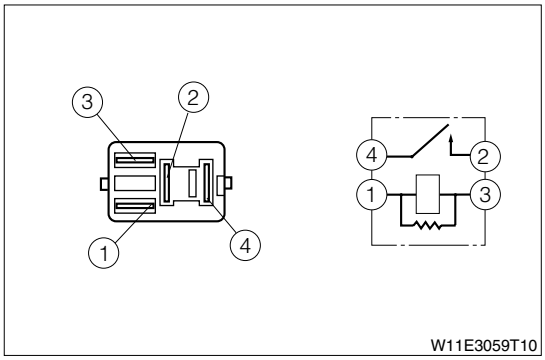


3-15 VSV FOR EVAPORATOR PURGE CONTROL

The amount of fuel evaporative emission that flows to the engine combustion chamber is controlled by the duty signal from the engine control computer.



3-16 MAIN RELAY, FUEL PUMP RELAY, RADIATOR FAN RELAY



This is installed in the relay box of the engine compartment.
The main relay supplies power to the engine control computer when the IG switch is ON.
When the IG switch is ON, the fuel pump relay is activated by the signal from the engine control computer to supply power to the fuel pump.
When conditions to activate the radiator fan motor control are satisfied, the radiator fan relay is turned ON by the signal from the engine control compute to supply power to the radiator fan motor.

B9 EMISSION CONTROL SYSTEM

■ 1KR

1 OUTLINE

1-1 DESCRIPTION

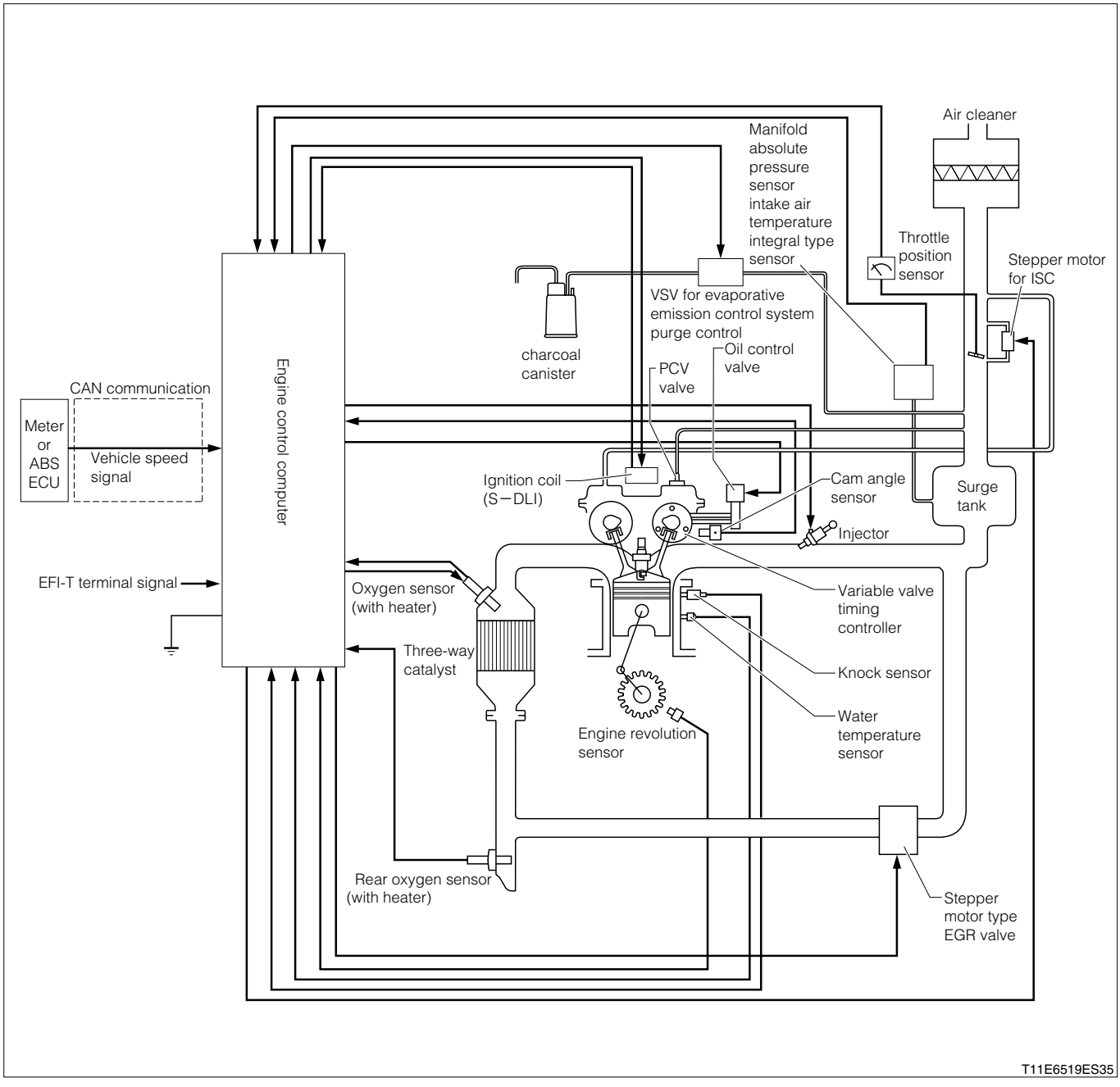
1. The 1KR− FE type engine conforms to 1999/102-/EC (emission control, Step IV) specifications for EU, and to 1999/102-/EC (emission control, step Ⅲ) specifications for Australia and general destinations, by combining following equipment.
   (1) Electronically controlled fuel injection system (EFI)
   (2) Electronic spark advance system (ESA)
   (3) Variable valve-timing control system
   (4) Evaporative emission control system with electronically controlled purging system
   (5) Electronically controlled exhaust gas recirculation system

1-2 LIST OF EMISSION CONTROL DEVICES

Name of device	System of device	COMPONENTS	Purpose/function
Catalyst device	Three-way catalyst system	(1)Monolithic catalyst 0.849ℓ	·Reduction of CO, HC and NO_x
Air-fuel ratio control device	Electronic controlled fuel injection system	(1)Injector (2) Oxygen sensor (with heater) (3)Rear oxygen sensor (with heater)*1 (4)Computer for control (5)Operation control device Throttle position sensor, intake pipe pressure/intake air temperature integrated sensor, water temperature sensor, engine revolution sensor, atmospheric pressure sensor*1, stepper motor for ISC	·Reduction of CO, HC and NO_x (The air-fuel ratio of the mixture taken in the combustion chamber will be controlled approximately to the stoichiometric air-fuel ratio, thus enabling the three-way catalyst to fully exercise the purification performance.)
Ignition timing control device	Electronic controlled system	(1)Ignition coil (Ion current detection device built-in) (2)Computer for control (3)Operation control device Intake pipe pressure/intake air temperature integrated sensor, water temperature sensor, throttle position sensor, engine revolution sensor, cam angle sensor, knock sensor, injector	·Reduction of HC ·Reduction of NO_x (An appropriate ignition timing control is performed according to the operating conditions.)
Deceleration control device		(1)Injector (2)Computer for control (3)Operation control device Throttle position sensor	·Reduction of CO and HC during deceleration ·Improvement of fuel consumption ·Prevention of catalyst heating (Fuel cut is carried out during deceleration by the control device.)
Evaporative emission control device	Canister type	(1)Charcoal canister 0.36 ℓ (2)VSV for evaporative emission control system purge control (3)Computer for control	·Emission control of fuel evaporative emission
Blow-by gas recirculation device	Closed type	(1)Ventilation hose (2)PCV valve	·Reduction of CO and HC (The blow-by gas will be burned again to prevent emission of CO and HC.)
Variable valve timing device		(1)Oil control valve Variable valve timing controller (3)Computer for control (4)Operation control device Engine revolution sensor, cam angle sensor, intake pipe pressure/intake air temperature integrated sensor, water temperature sensor, injector	·Reduction of NO_x (The NO_x is reduced by controlling the opening and closing of the intake valve to the appropriate timing according to the operating conditions.)
Exhaust gas recirculation device	Electronic controlled system	(1)Stepper motor type EGR valve (2)Computer for control (3)Operation control device Engine revolution sensor, water temperature sensor, intake pipe pressure/intake air temperature integrated sensor, throttle position sensor	·Reduction of NO_x (The NO_x in the exhaust gas is reduced by the external EGR effect.) ·Improvement of fuel consumption

On-board diagnosis device		Engine control computer, throttle position sensor, intake pipe pressure/intake air temperature integrated sensor, water temperature sensor, engine revolution sensor, cam angle sensor, oxygen sensor, oxygen sensor heater circuit, rear oxygen sensor, rear oxygen sensor heater circuit, oil control valve, atmospheric pressure sensor, ignition coil (ion current detection device built-in), fuel supply system, exhaust gas recirculation system, warning lamp	·Detection of failure of the emission control device

1-3 SCHEMATIC DIAGRAM OF EXHAUST EMISSION PURIFICATION DEVICE



2 CONSTRUCTION AND OPERATION

2-1 CATALYST DEVICE

2-1-1 DESCRIPTION

The catalyst, made of ceramic, has gas passages called monolith which has grid cross-section with its surface covered with noble metal. This catalyst is mounted in the exhaust manifold so that harmful components of the exhaust gas can be removed as the exhaust gas passes through the passages.
The O_2 sensor is mounted downstream of the catalyst for EU specification vehicles to monitor degradation of the O_2 sensor mounted upstream of the catalyst, to prevent exhaust gas from deterioration.

2-2 AIR-TO-FUEL RATIO CONTROL DEVICE

2-2-1 DESCRIPTION

The air-to-fuel ratio is controlled by the electronically controlled fuel injection system so that the air to fuel ratio which is fit to the engine's operating conditions can be obtained and that high purification performance can be obtained in the catalyst device.

2-3 IGNITION TIMING CONTROL DEVICE

2-3-1 DESCRIPTION

The ignition timing is controlled by the electronic spark advance system so that the ignition timing may become fit to the engine operating conditions and that harmful emissions in the exhaust gas can be reduced.

2-4 CONTROL DEVICE DURING DECELERATION

2-4-1 DESCRIPTION

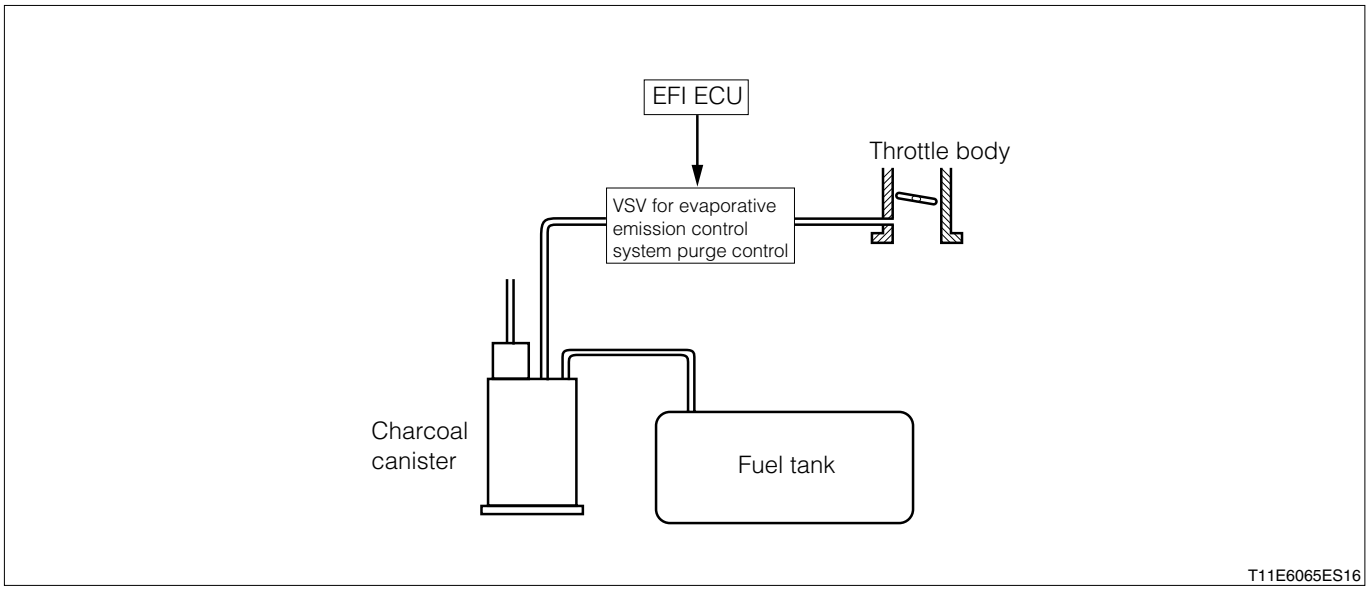
Deceleration fuel cut occurs when the throttle valve opening degree and engine speed fall into the fuel cut range in order to reduce unburnt components discharged when the throttle valve is closed during deceleration.

2-5 FUEL EVAPORATIVE EMISSION CONTROL DEVICE

2-5-1 CANISTER METHOD

(1) Description

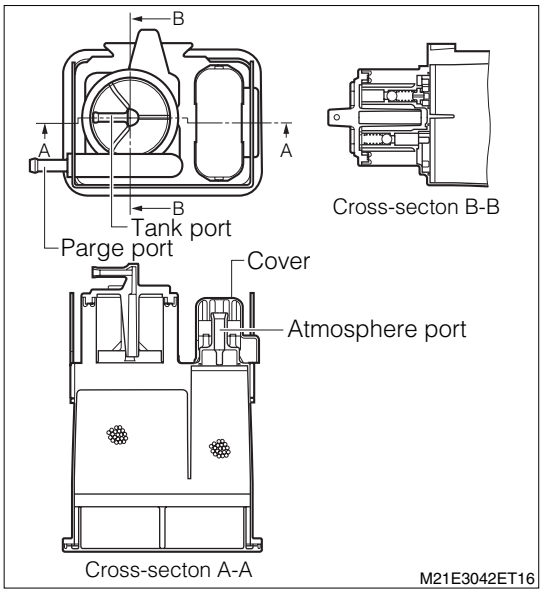
Fuel evaporative emissions generated inside the fuel tank are absorbed in the charcoal canister.
The adsorbed fuel evaporative emissions are sucked into the intake manifold and burned during engine operation.



(2) Components

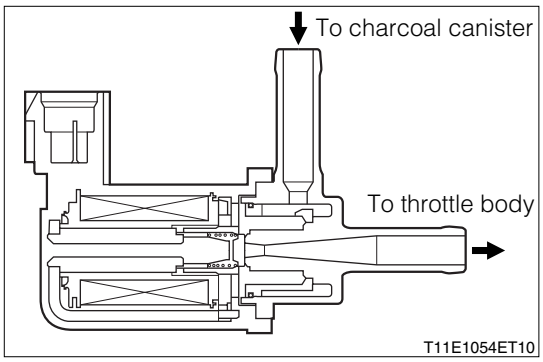
① Charcoal canister

The charcoal canister (capacity : 0.36 ℓ) is mounted on the vehicle left side dash in the engine compartment.



② Evaporator purge VSV

The purge amount of the evaporative emission gas to the intake manifold is controlled by the signal (duty ratio) sent from the engine control computer, which is calculated based on operation conditions of the engine, fuel evaporative emission concentration, etc.

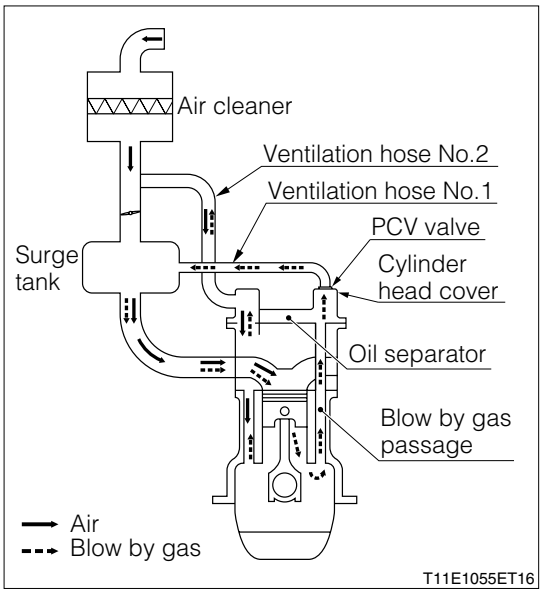


2-6 BLOW-BY GAS RECIRCULATION DEVICE

2-6-1 DESCRIPTION

The crank case ventilation system is employed, in which the blow-by gas inside the crank case flows through the blow-by gas passage of the cylinder block into the cylinder head cover side.

The oil separator is provided in the cylinder head cover and the cylinder block so that the blow-by gas is separated and enters into the combustion chamber for afterburning .



2-7 DYNAMIC VARIABLE VALVE TIMING DEVICE

2-7-1 DESCRIPTION

The open/close timing of the intake air valve is controlled to provide the intake air amount and internal EGR amount, etc. that are fit to the operating conditions, thereby reducing the exhaust emissions.

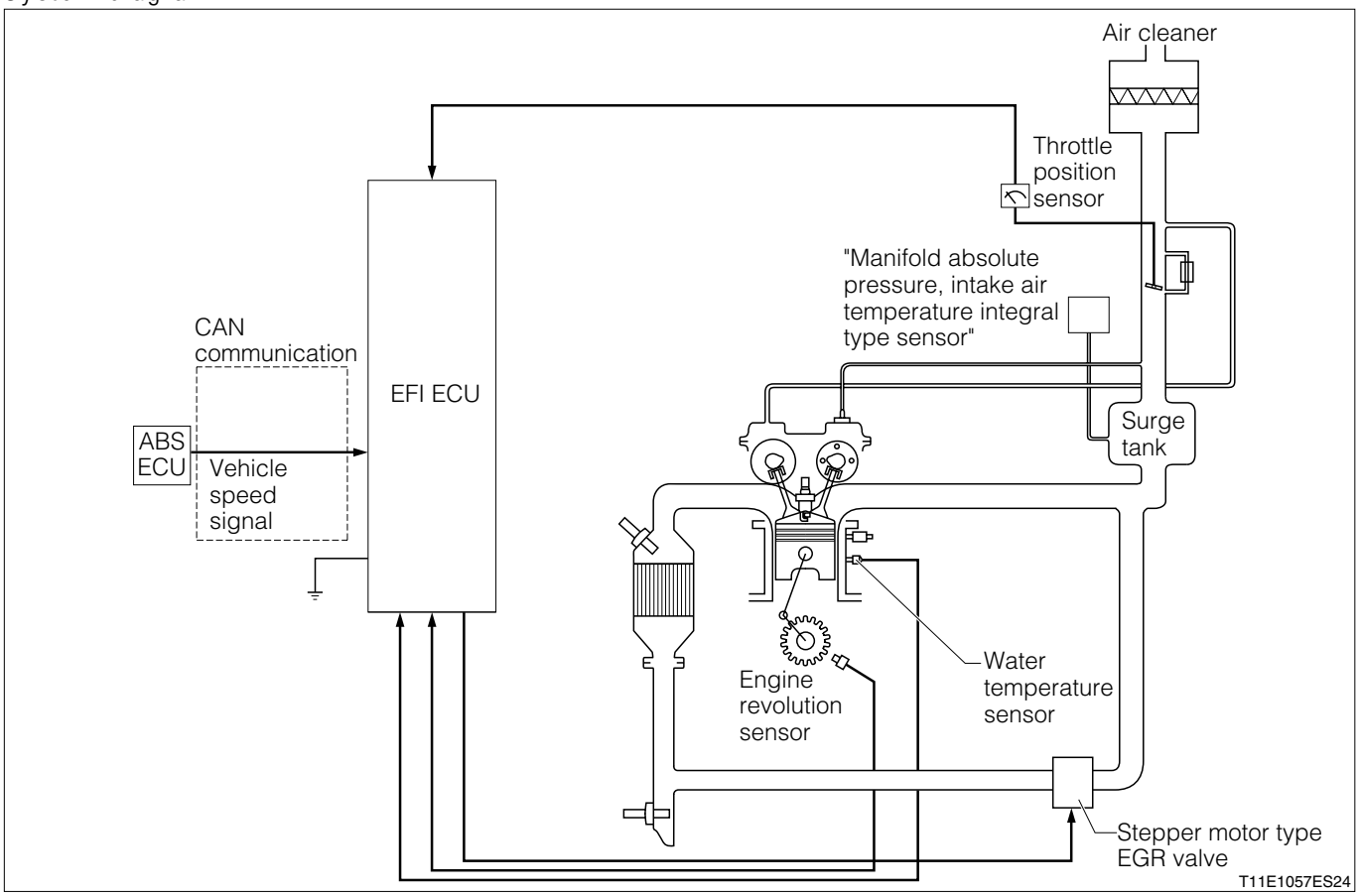
2-8 EXHAUST GAS RECICULATION DEVICE

2-8-1 DESCRIPTION

The electronically controlled exhaust gas recirculation system is employed so that an optimum amount of the exhaust emissions that are adjusted according to the operating conditions can be circulated into the combustion chamber, thereby lowering the combustion temperature and reducing NO_X.

The circulated exhaust emissions are controlled by the stepper motor type EGR valve, and pass through the three-way catalyst. Then the emissions flow in the sequence of the cylinder head, EGR valve, and intake manifold insulator and enter the combustion chamber.

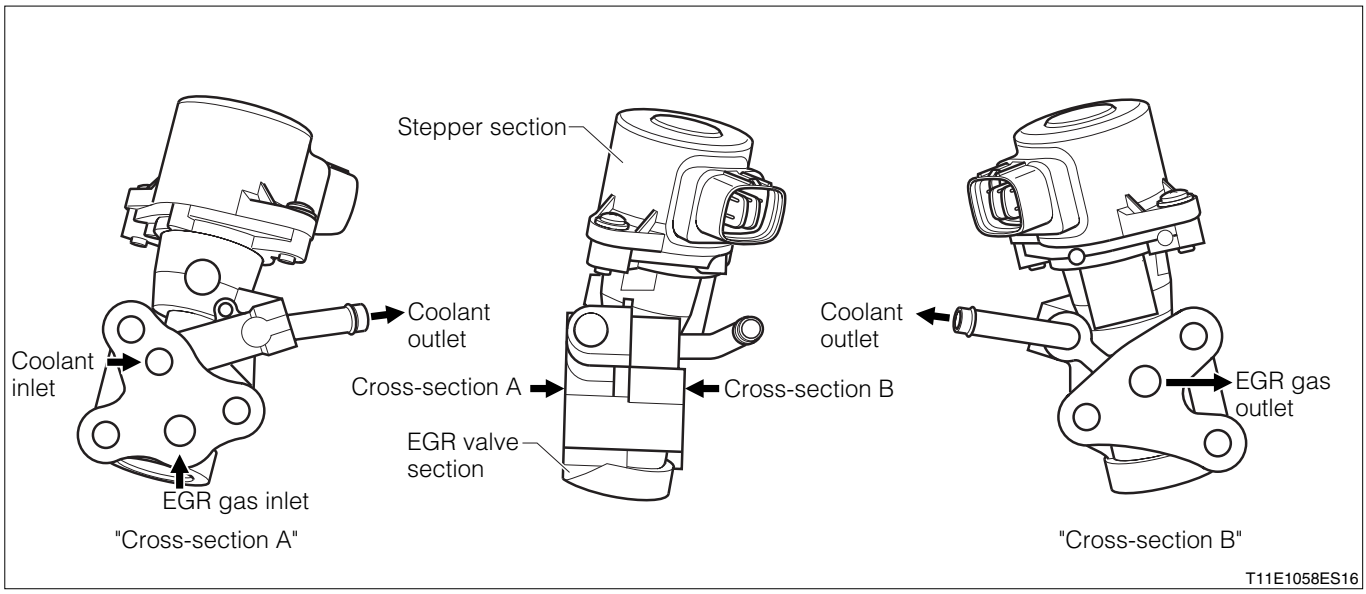
System diagram



2-8-2 COMPONENTS

(1) Stepper motor type EGR valve

The stepper motor type EGR valve consists of the stepper motor and the EGR valve.
The EGR stepper motor controlled by the engine control computer drives the EGR valve and regulates the EGR valve opening degree. In this way, the exhaust emission amount mixed into the intake air can be controlled.
The coolant circulates through the stepper motor type EGR valve in order to cool the valve's sliding portion and the stepper motor.



B10 IGNITION SYSTEM

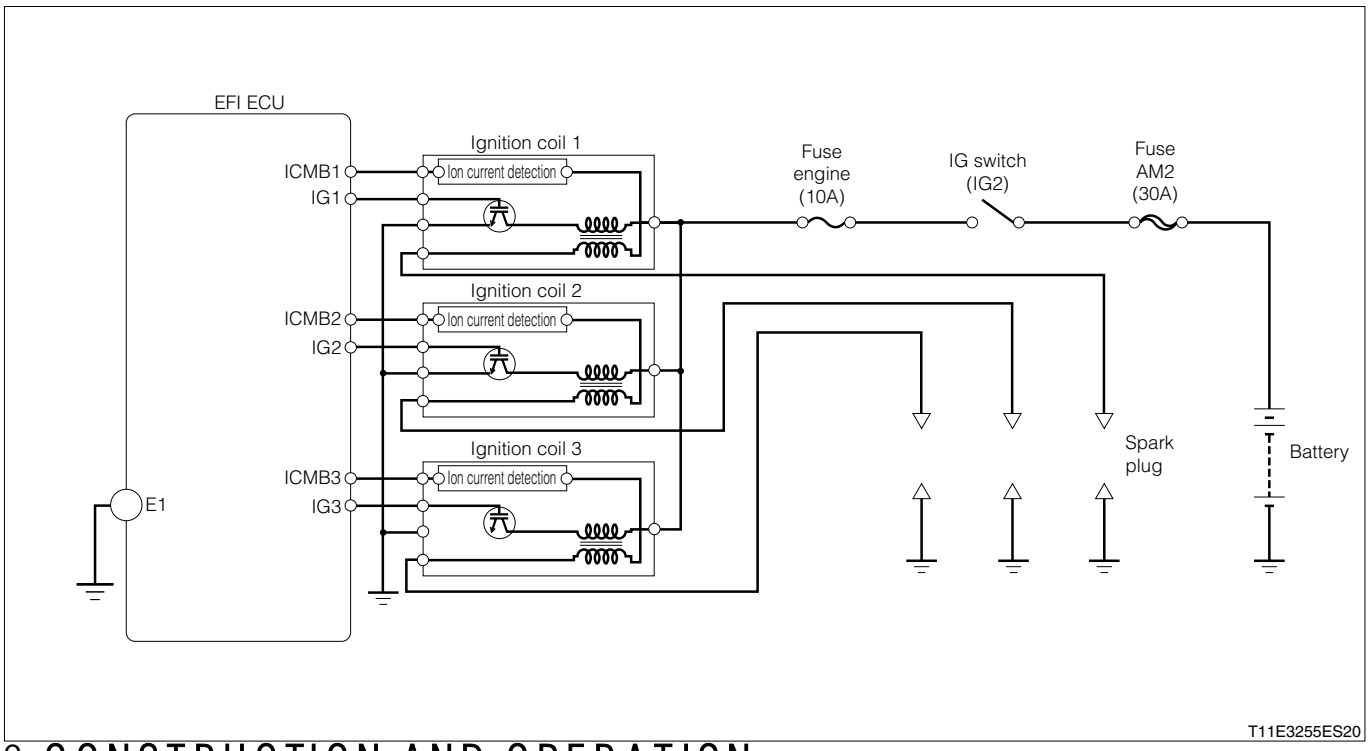
■ 1KR

1 OUTLINE

1-1 DESCRIPTION

The DLI (DistributorLess Ignition) system is adopted to improve ignition performance. In this DLI system, there is no distributor and the ignition coil is provided right above the spark plug. Therefore, there exists no ignition energy loss by distribution and the electric energy generated by the coil can be directly supplied. As a result, the best ignition condition can be assured at all times.

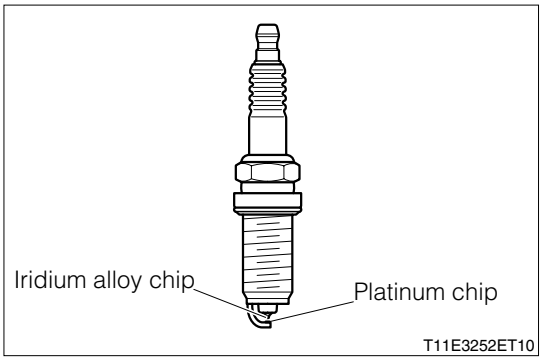
1-1-1 EU SPEC.



2 CONSTRUCTION AND OPERATION

2-1 SPARK PLUG

An iridium plug with high ignition energy is adopted to improve output performance and clean emission gas. The long reach type is employed to comply with the water jacket shape of the cylinder head, thus improving anti-knocking ability.



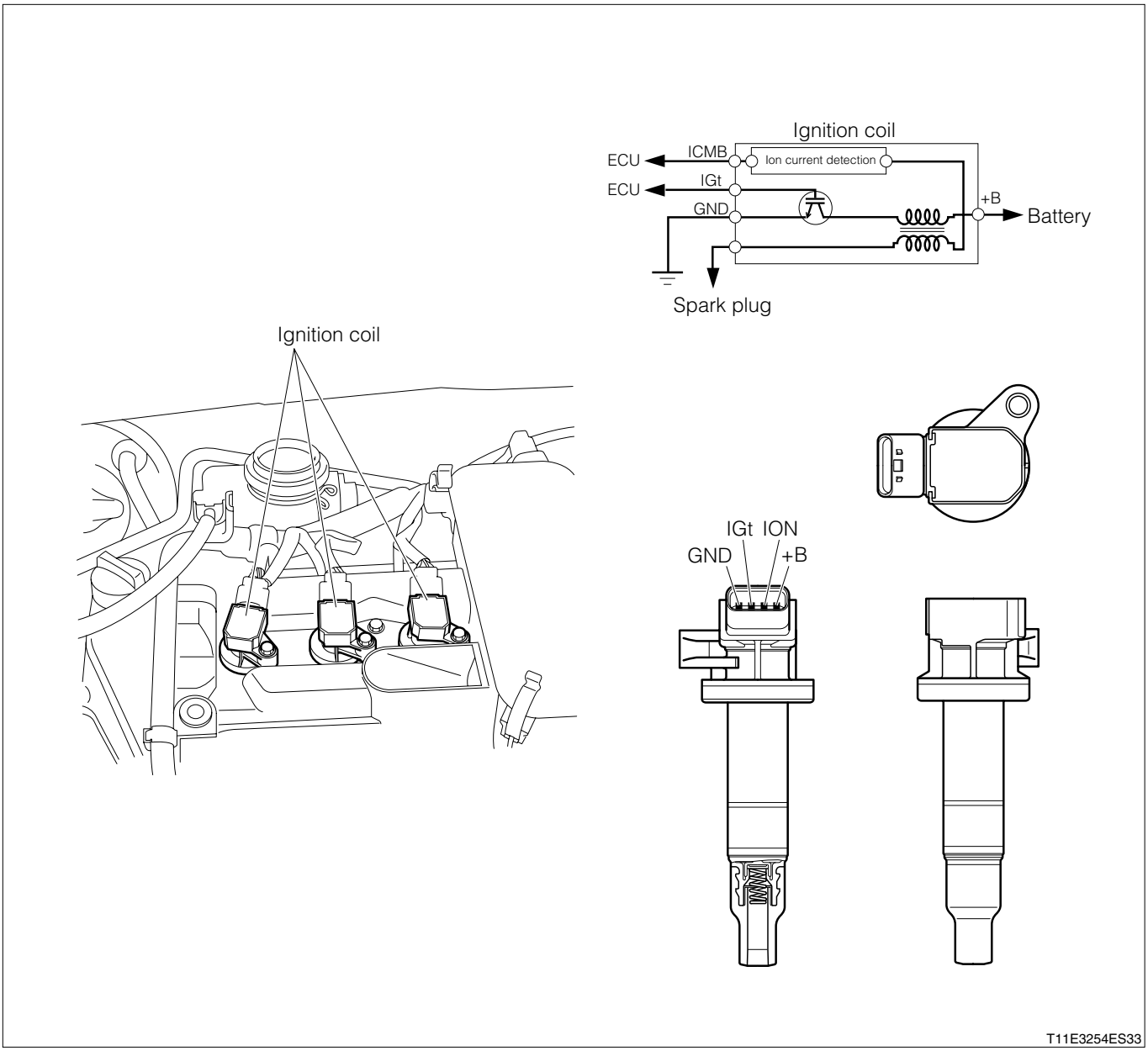
Spark plug specifications

Type	SK20HR11	ILFR6C11
Electrode gap(mm)	1.0−1.1	1.0−1.1
Width across flats	16	16

2-2 IGNITION COIL

1. A small type ignition coil with built-in ignitor is adopted.
2. The mounting position is on the cylinder head cover that is right above the spark plug of each cylinder.

2-2-1 **EU SPEC.**

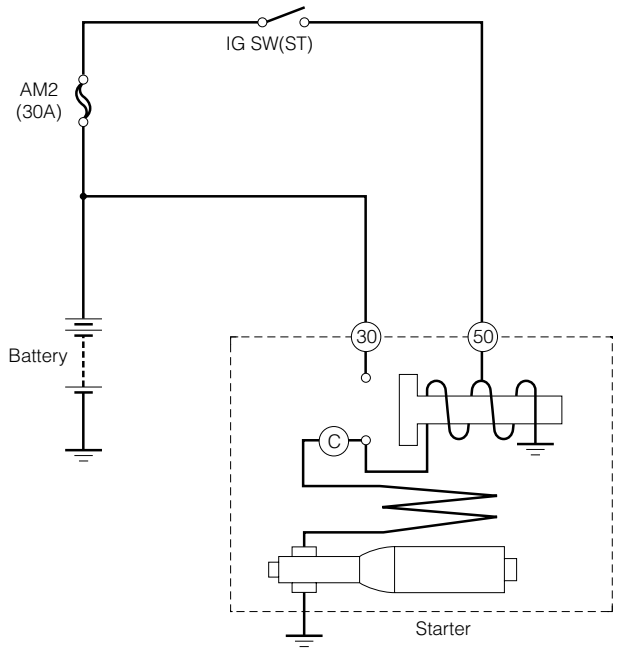

Ignition coil
ECU
ICMB
Ion current detection
ECU
IGt
GND
+B
Battery
Spark plug
Ignition coil
IGt ION
GND +B
T11E3254ES33

B11 STARTING SYSTEM/CHARGING SYSTEM

■ STARTING SYSTEM (1KR)

1 OUTLINE

1-1 CIRCUIT DIAGRAM



T11E8507ES20

2 CONSTRUCTION AND OPERATION

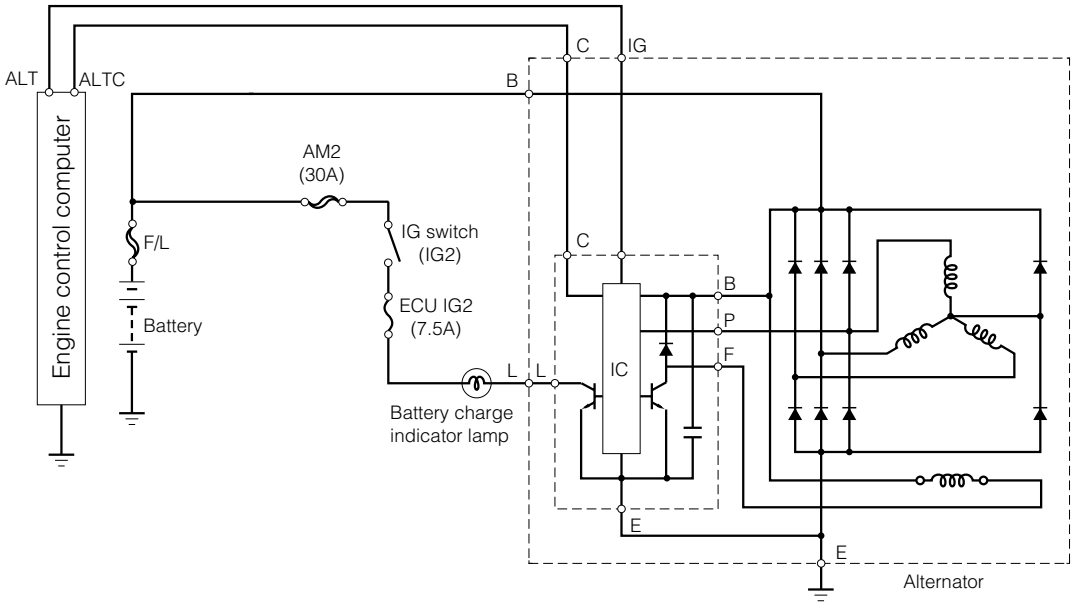
2-1 STARTER

	Standard	Cold region
Rated output (kW)	0.7	1.0
Non-loaded characteristics	50 A or less [at time of 11.5 V] 6,000 rpm or more	90 A or less [at time of 11.5 V] 3,000 rpm or more
Number of pinion teeth	9	9
Rotating direction	Clockwise as viewed from pinion side	Clockwise as viewed from pinion side
Weight (kg)	3.25	3.15

■ CHARGING SYSTEM (1KR)

1 OUTLINE

1-1 CIRCUIT DIAGRAM

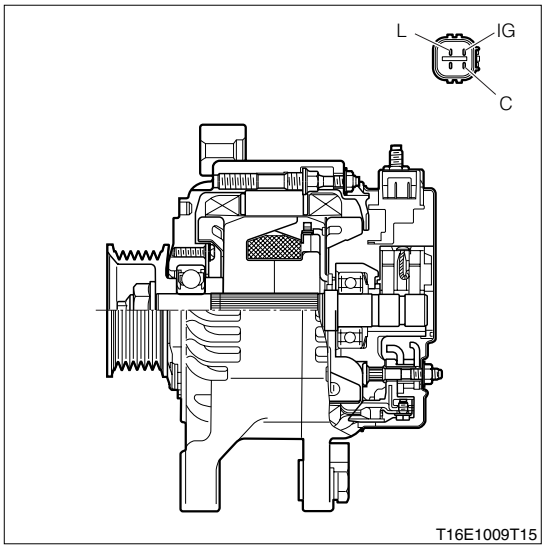


T11E3287ES20

2 CONSTRUCTION AND OPERATION

2-1 ALTERNATOR

1. A small and light alternator with the built-in IC regulator and multi-step charging feature is adopted.
2. Use of the engine control computer makes it possible to conform to the control to switch the regulator adjusting voltage in 2 stages.



T16E1009T15

Alternator specifications

Rated voltage, maximum output (V−A)	12−65
Output characteristics [13.5 V,5,000 rpm] (A)	77.0 or more
Permissible maximum rotation speed (rpm)	18,000
Regulator regulation voltage [5,000rpm, 10A, 25−] (V)	Hi:14.2−14.8V Lo:12.5−13.1V
Rotating direction	Clockwise as viewed from pulley side
Pulley diameter (mm)	55 (Pulley outer diameter 61.4 mm)
Weight (kg)	4.08

B12 ENGINE MOUNTING

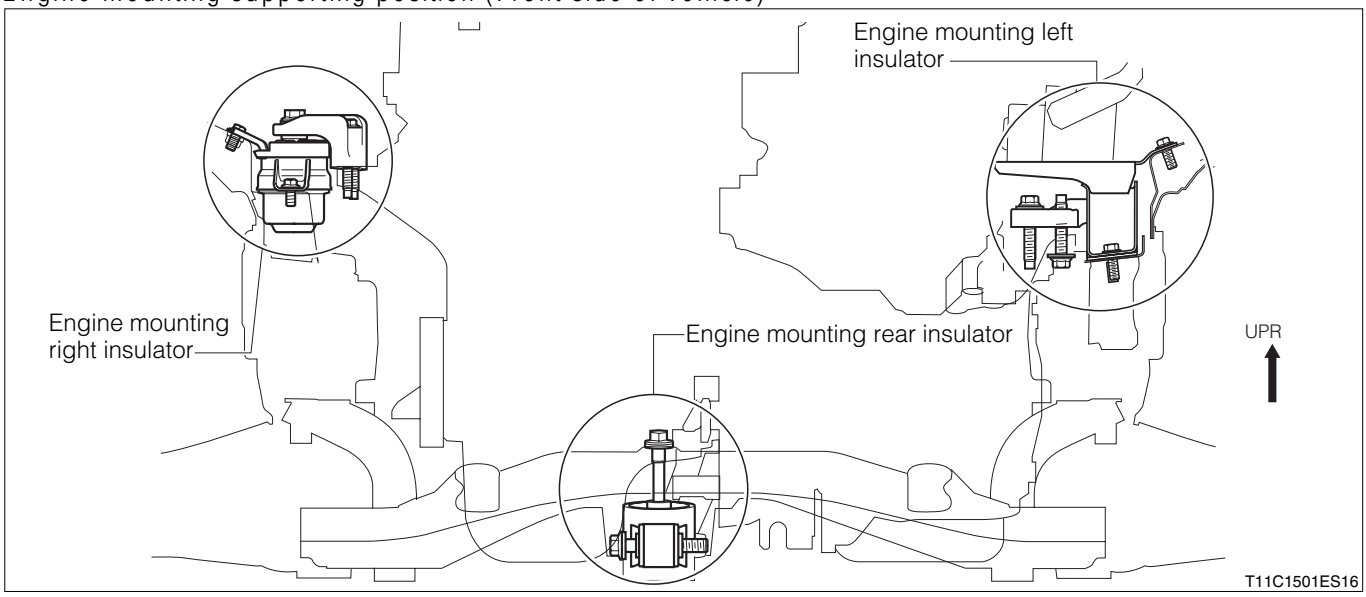
1 OUTLINE

1-1 DESCRIPTION

The engine mounting has employed a three-point supporting type on all models. Vibrations and noises have been reduced by taking the following measures.

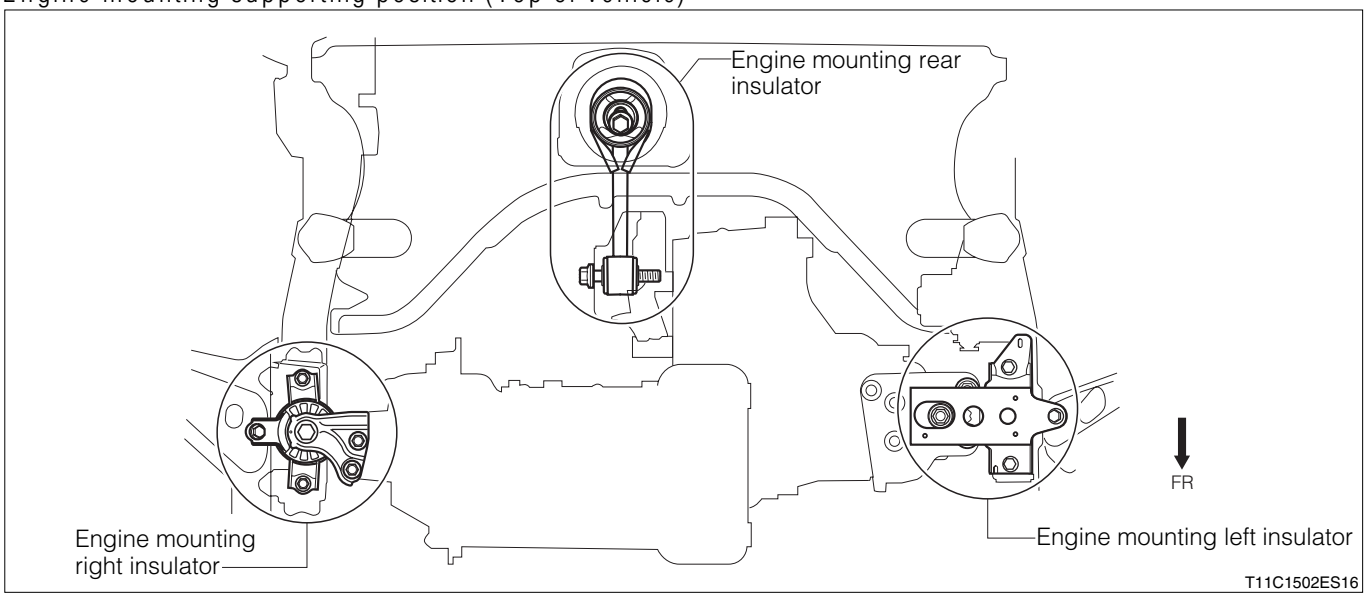
1. The engine mounting right insulator has employed a hydraulic damping mount on all models.
2. The engine mounting rear insulator has employed a torque rod type.

Engine mounting supporting position (Front side of vehicle)



The figure above shows the position for Type 1KR engine-mounted vehicles.

Engine mounting supporting position (Top of vehicle)

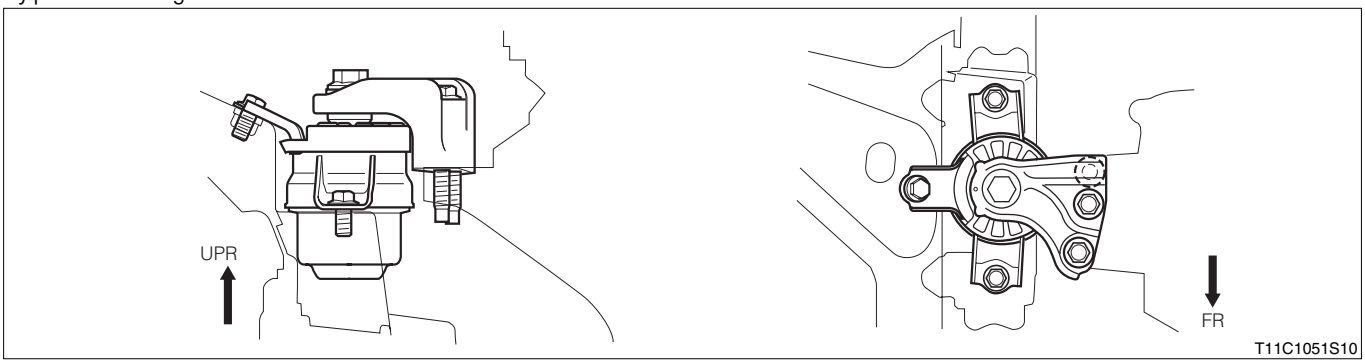


The figure above shows the position for Type 1KR engine-mounted vehicles.

2 CONSTRUCTION AND OPERATION

2-1 RIGHT ENGINE MOUNTING INSULATOR

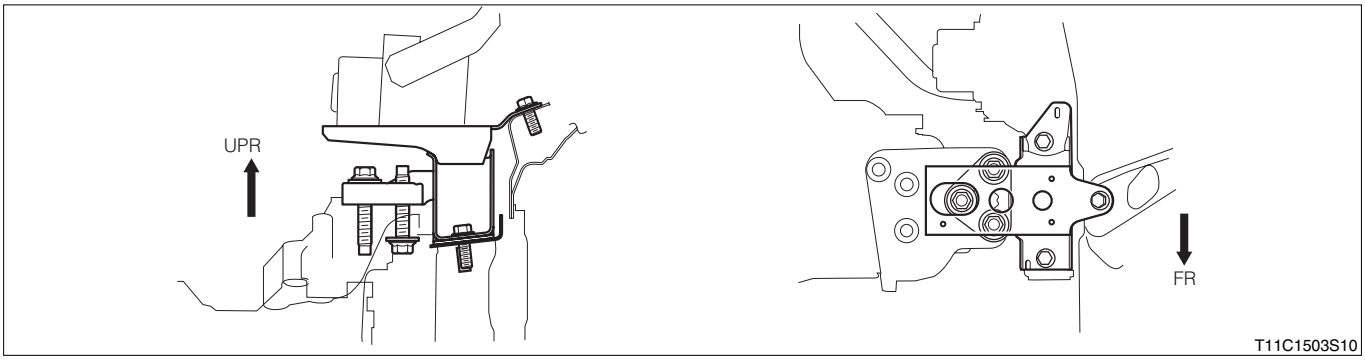
Type 1KR engine-mounted vehicles



Left figure: Front side of vehicle; Right figure: Top of vehicle

2-2 LEFT ENGINE MOUNTING INSULATOR

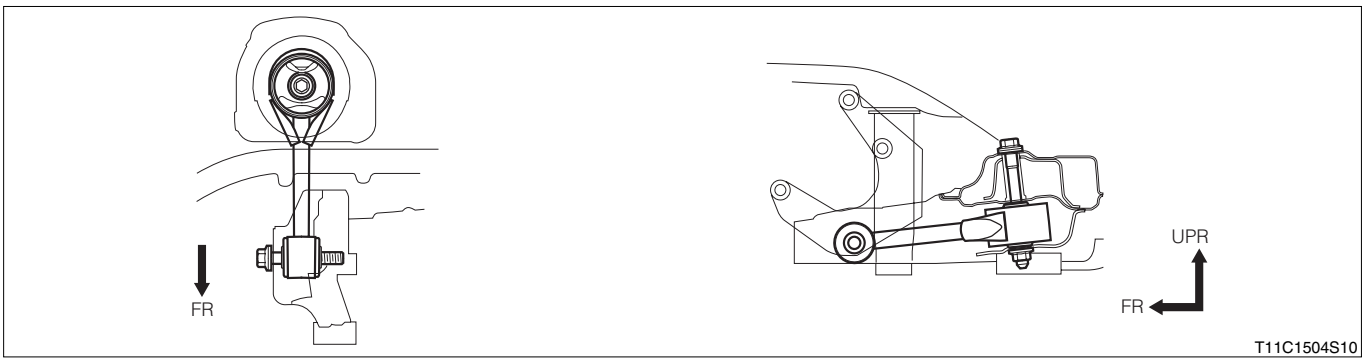
M/T vehicles



Left figure: Front side of vehicle; Right figure: Top of vehicle

2-3 REAR ENGINE MOUNTING INSULATOR

M/T vehicles



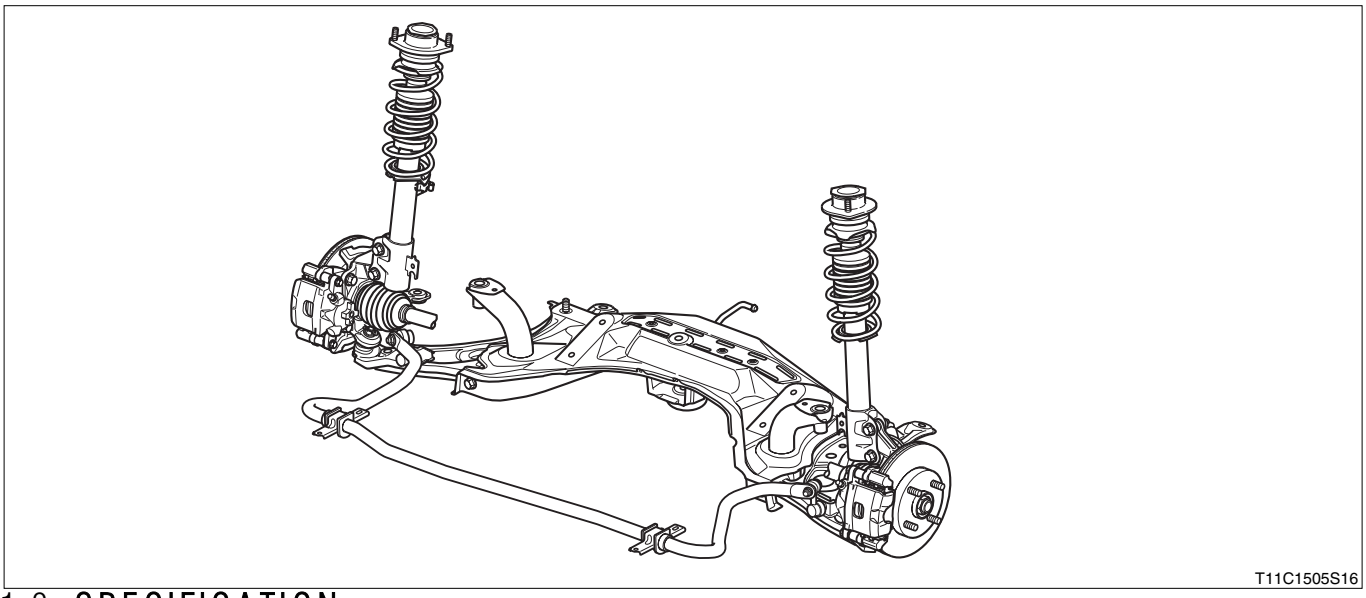
Left figure: Top of vehicle; Right figure: Side of vehicle

C1 FRONT SUSPENSION

1 OUTLINE

1-1 DESCRIPTION

1. The MacPherson strut type suspension with an L-shaped lower arm has been employed on all models.
2. Optimized suspension geometry successfully combines excellent drivability and maximum riding comfort.
3. The MacPherson strut type suspension with an L-shaped lower arm has been employed on all models.
4. Some specifications provide the front stabilizer bar, which offers sufficient roll rigidity.



1-2 SPECIFICATION

1-2-1 FRONT WHEEL ALIGNMENT SPECIFICATION

Vehicle model	M300RF	M300LF
Toe-in [mm]	0	
Camber angle	0˚	
Caster angle	3˚28´	
Kingpin angle	10˚36´	

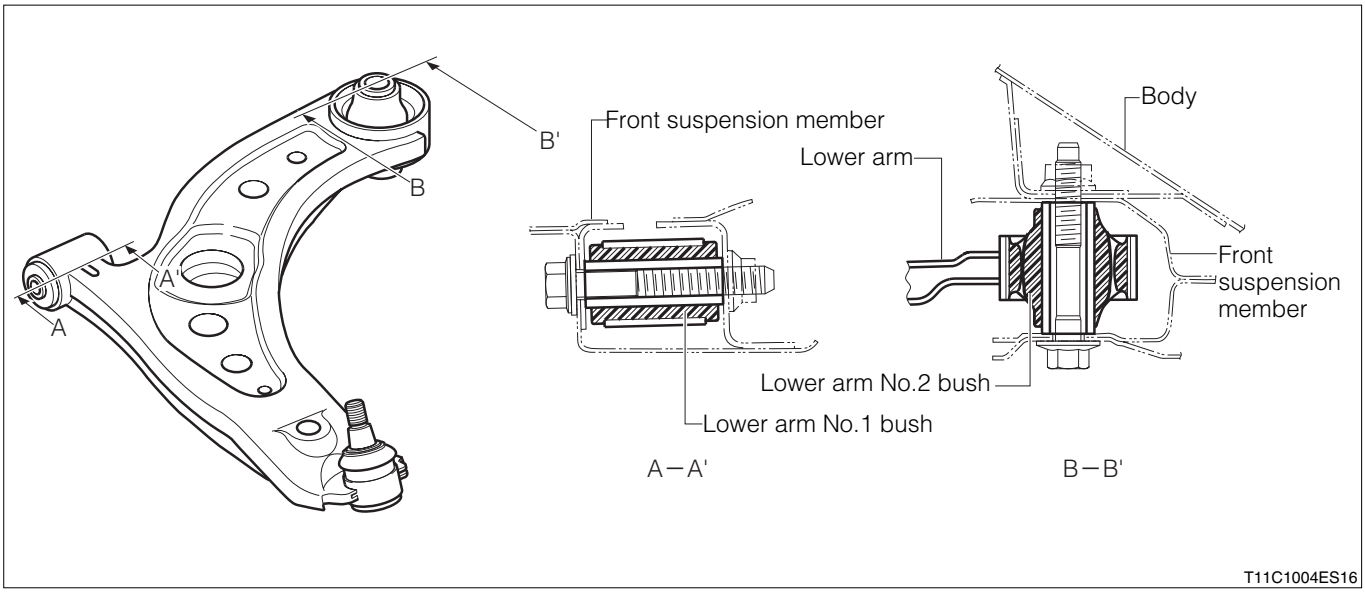
2 CONSTRUCTION AND OPERATION

2-1 LOWER ARM

1. An L-shape lower arm has been adopted. Optimized arm shape successfully combines high and lightweight.
2. Optimized mounting location and characteristics of the lower arm bush offer optimum compliance characteristics, thereby combining riding comfort and steering feeling.
3. The bush No. 2 with a larger diameter has been employed. As a result, the compliance *1 at the front and rear sides has been increased, thus contributing to the improvement of harshness *2.

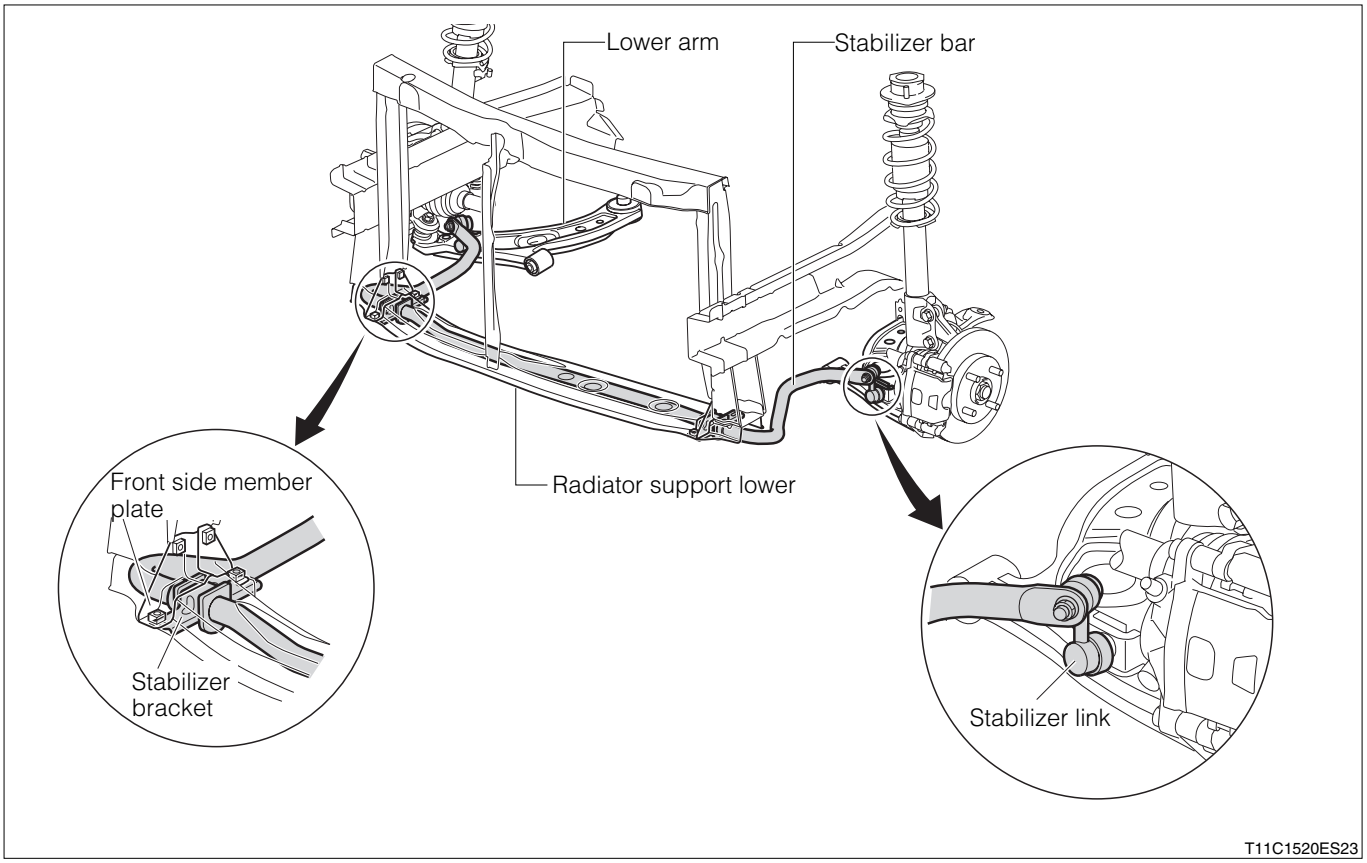
*1 Front and rear compliance: Moving amount of tire in a fore-and-aft direction

*2 Harshness: relates to a shock accompanied by sound transmitted from tires when driving on joints of the paved road, projections and steps of rough road surface, etc.

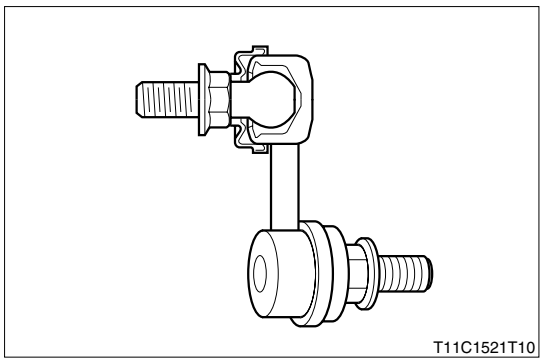


2-2 FRONT STABILIZER BAR

1. The stabilizer bar is installed to the radiator support lower and lower arm as indicated below.
   (1) The radiator support lower side is installed in such a way that it is sandwiched between the front side member plate and stabilizer bracket.
   (2) The lower arm side is installed through the stabilizer link.

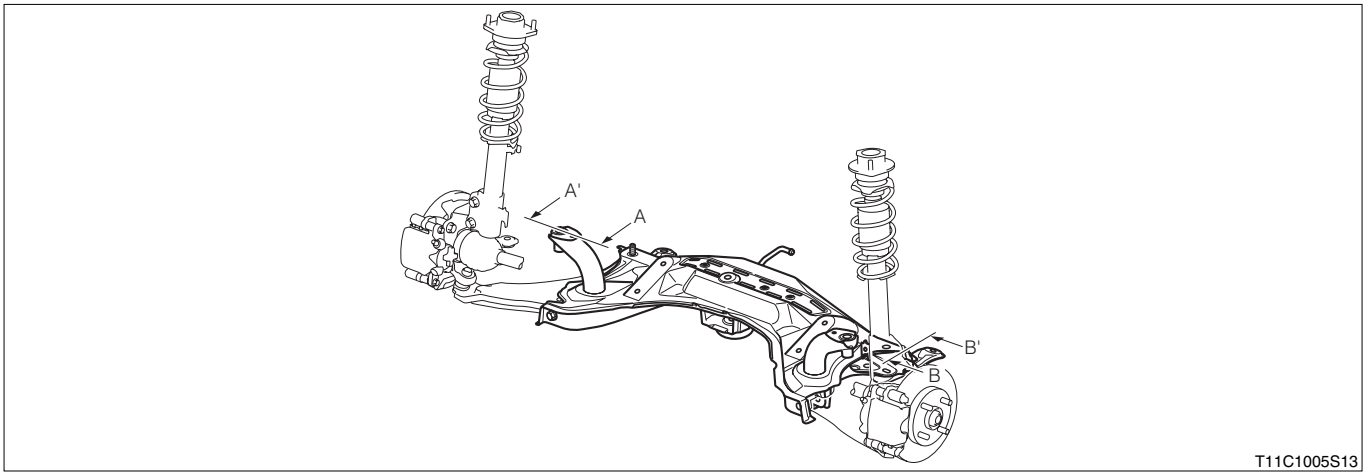


2. The stabilizer link employs the ball joint type, thus assuring the excellent response and rolling rigidity.

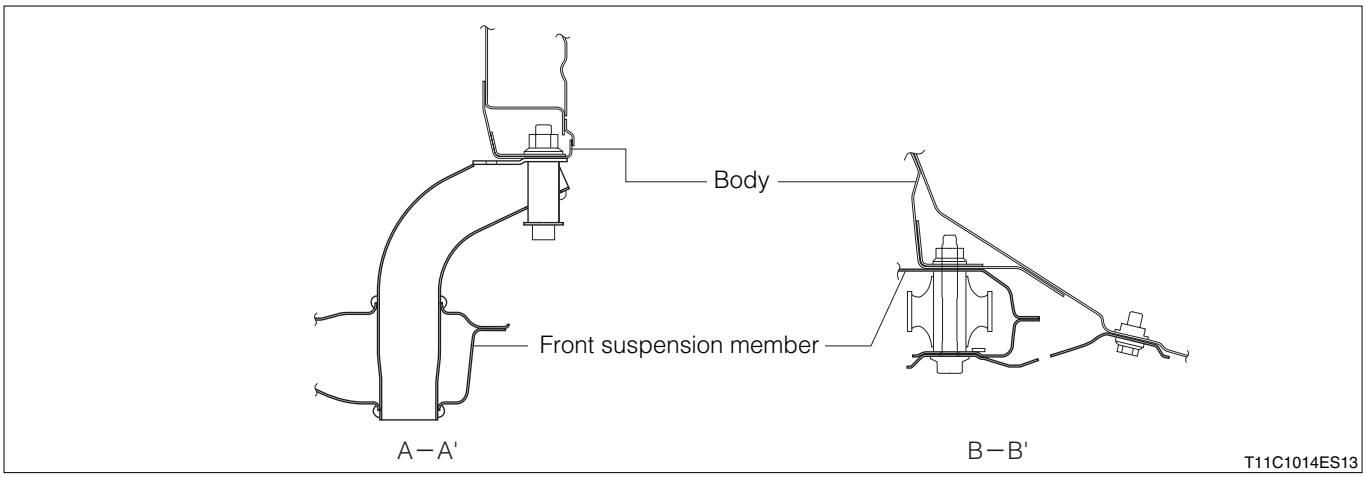


2-3 FRONT SUSPENSION MEMBER

1. An H-type front suspension member (frame) has been employed for the front frame, offering both lightweight and drivability.
2. To ensure higher rigidity as well as joint rigidity with the body, the press steel sheet has adopted pipe passing-through construction.
3. For reduced noise and enhanced rigidity of the suspension and steering, the lower arm and steering gear have been mounted on the front suspension member.



Cross-sectional view

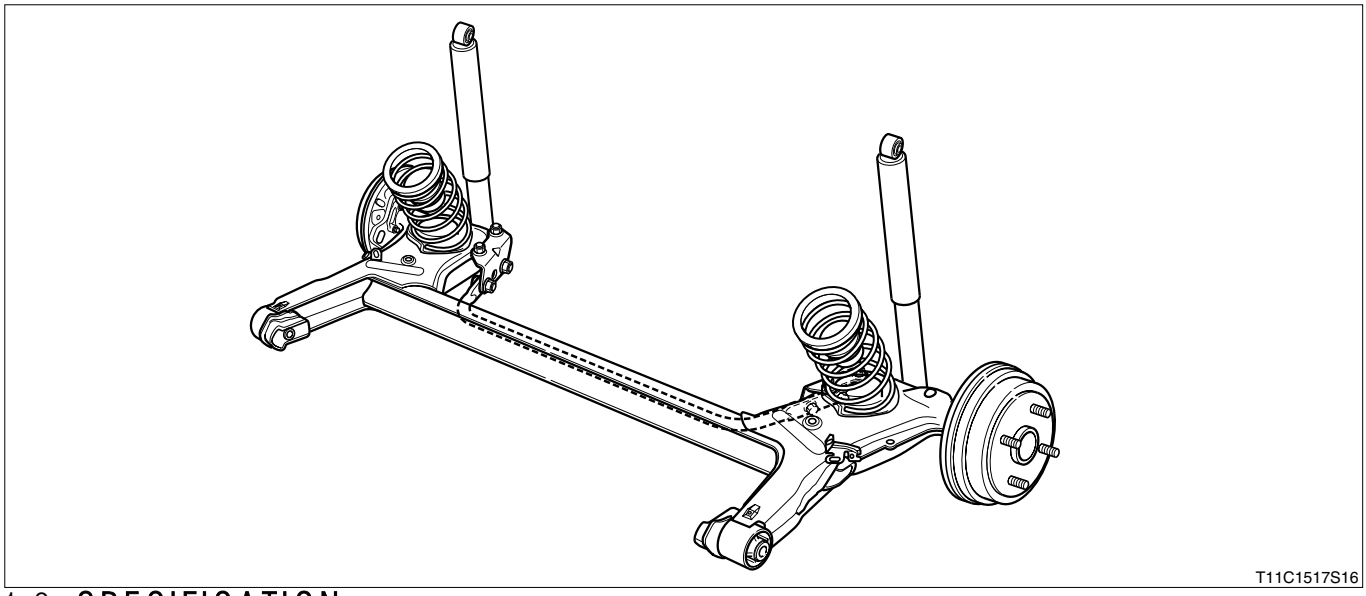


C2 REAR SUSPENSION

1 OUTLINE

1-1 DESCRIPTION

1. A trailing arm type suspension with torsion beam has been employed.
2. For assured excellent controllability and riding comfort, the trailing arm section employs a toe correct bush.
3. Some specifications provide the rear stabilizer bar, which offers sufficient roll rigidity.



1-2 SPECIFICATION

1-2-1 REAR WHEEL ALIGNMENT SPECIFICATIONS

Vehicle model	M300RF	M300LF
Toe-in [mm]	3	
Camber angle	−0°45′	

2 CONSTRUCTION AND OPERATION

2-1 TORSION BEAM TYPE SUSPENSION

2-1-1 DESCRIPTION

This type of suspension is capable of containing changes in alignment which occur as a result of movements and input from the suspensions. Furthermore, for optimum strength and rigidity, a U-shaped beam and an open end arm have been adopted. For excellent driving stability and riding comfort, the bushing characteristics can vary, depending on the input direction of the suspension.

2-1-2 TOE-CORRECT BUSHING

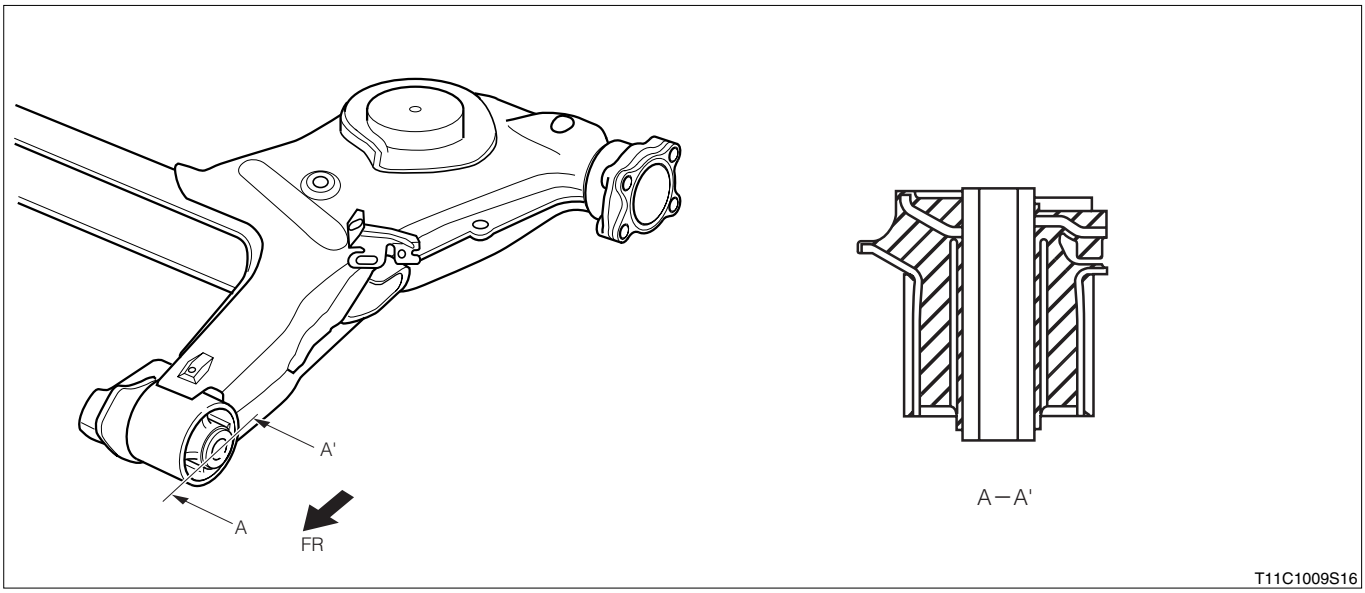
(1) Construction

With regard to the bushing construction in which the body and trailing arm have been joined, the setting has been made in such a way that the compliance *1 characteristics differ between the fore-and-aft direction and the right-and-left direction of the body.

Both excellent controllability and riding comfort have been achieved by generating a compliance steer *2, using deflection that occurs due to the longitudinal force and lateral force that are generated while the vehicle is cornering.

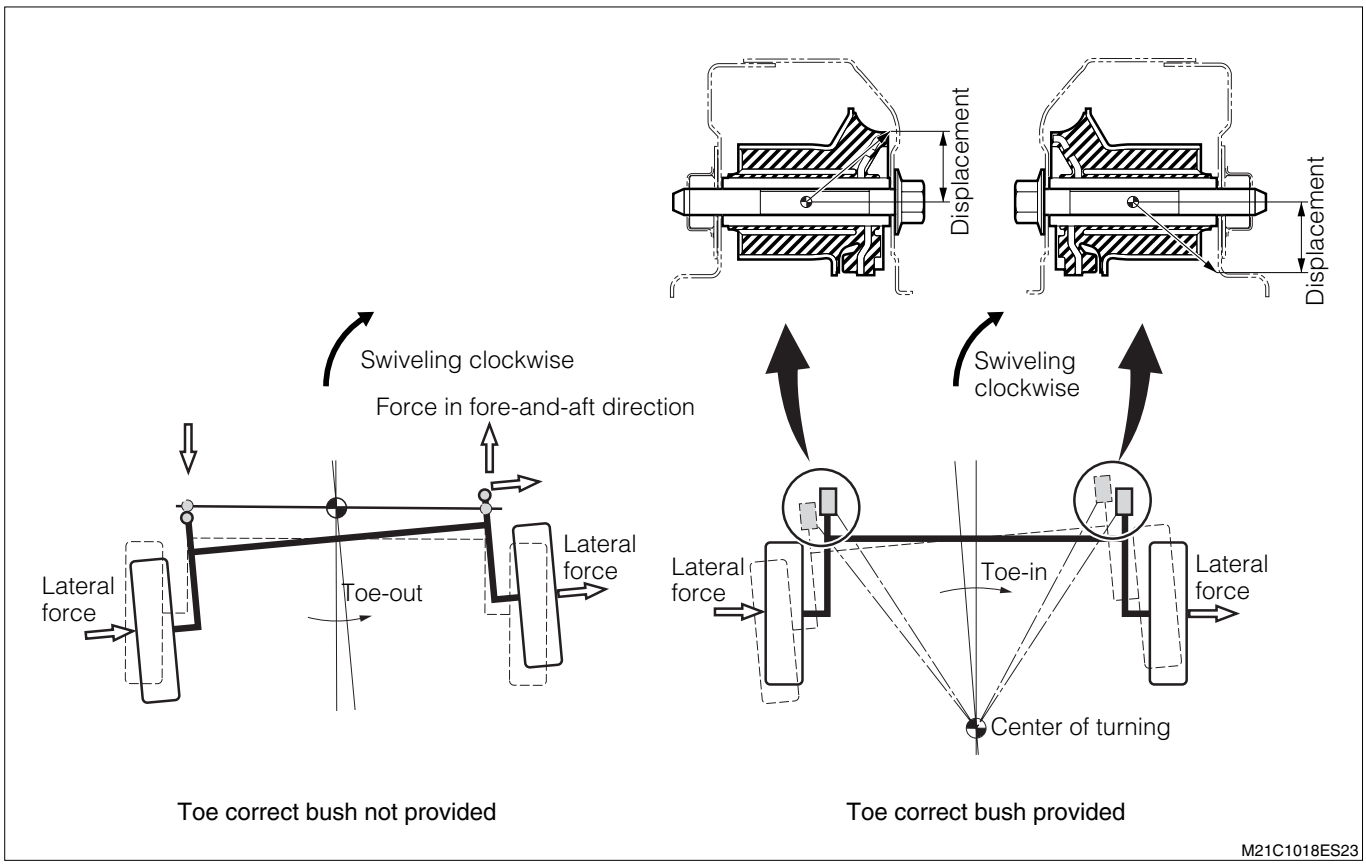
*1Compliance: This denotes flexibility of suspension

*2 Compliance steer: When longitudinal and lateral forces are applied to the ground contact section of the tire, this generates deflections at the arm and bush that constitute the suspension. These deflections alter the alignment, thus producing a steer angle and. As a result, the effect as if the steering wheel was turned is obtained.



(2) Operation

Due to the longitudinal force and lateral force of the vehicle body generated while the vehicle is turning, the bushing attached at the trailing arm will be deformed. At the right turning side, the right trailing arm will tend to move to the front side, whereas the left trailing arm will tend to move to the rear. As a whole, the trailing arm will turn in the same direction as the steering operation. Thus, a force is generated to correct the entire vehicle to the under steer side, using the longitudinal force and lateral force which occur, while the vehicle is turning, due to the shape of the bushing attached at the trailing arm. Consequently, the steering angle of the rear wheels is optimized.



C3 WHEEL & TIRE

1 OUTLINE

1. The following tires and disc wheels given below have been employed.
   (1) Tire having the size of 155/80R13 79S, and steel wheel having the size of 13×4.00B
   (2) Tire having the size of 175/65R14 82S, and aluminum wheel having the size of 14×5.00J
   (3) Tire having the size of 175/65R14 82T, and aluminum wheel having the size of 14×5.00J
2. As regards the tire and disc wheel to be mounted, their type differs depending on the specifications.

1-1 SPECIFICATION

1-1-1 TIRE & DISK WHEEL

RHD vehicles

			Vehicle model	
			M300RF	
Type No	Tire size	Disc wheel	GMNE	GMNEW
No.1	155/80R13 79S	13×4.50B[Steel]	○	○
No.2	175/65R14 82T	14×5.00J[Aluminum]	○	○
No.3	175/65R14 82S	14×5.00J[Aluminum]	−	○

○: Provided −:Not provided

LHD vehicles

			Vehicle model	
			M300LF	
Type No	Disc wheel	Tire size	GMNE	GMNEW
No.1	155/80R13 79S	13×4.50B[Steel]	○	○
No.2	175/65R14 82T	14×5.00J[Aluminum]	○	○

○: Provided −:Not provided

1-1-2 SPARE TIRE

RHD vehicles

		Vehicle model	
		M300RF	
Type No	Tire size	GMNE	GMNEW
No.1	T115/70D14	○	○

○: Provided −:Not provided

LHD vehicles

		Vehicle model	
		M300LF	
Type No	Tire size	GMNE	GMNEW
No.1	T115/70D14	○	○

○: Provided −:Not provided

2 CONSTRUCTION AND OPERATION

2-1 TIRE

Table showing tire air inflation pressure

Vehicle model	Tire			
	Size	Air inflation pressure [kPa{kgf/cm^2}]		Depth of groove [mm]
		Front wheel	Rear wheel	
M300RF M300LF	155/80R13 79S	220{2.2}		1.6 or more
	175/65R14 82S			
	175/65R14 82T			

Table showing spare tire air inflation pressure

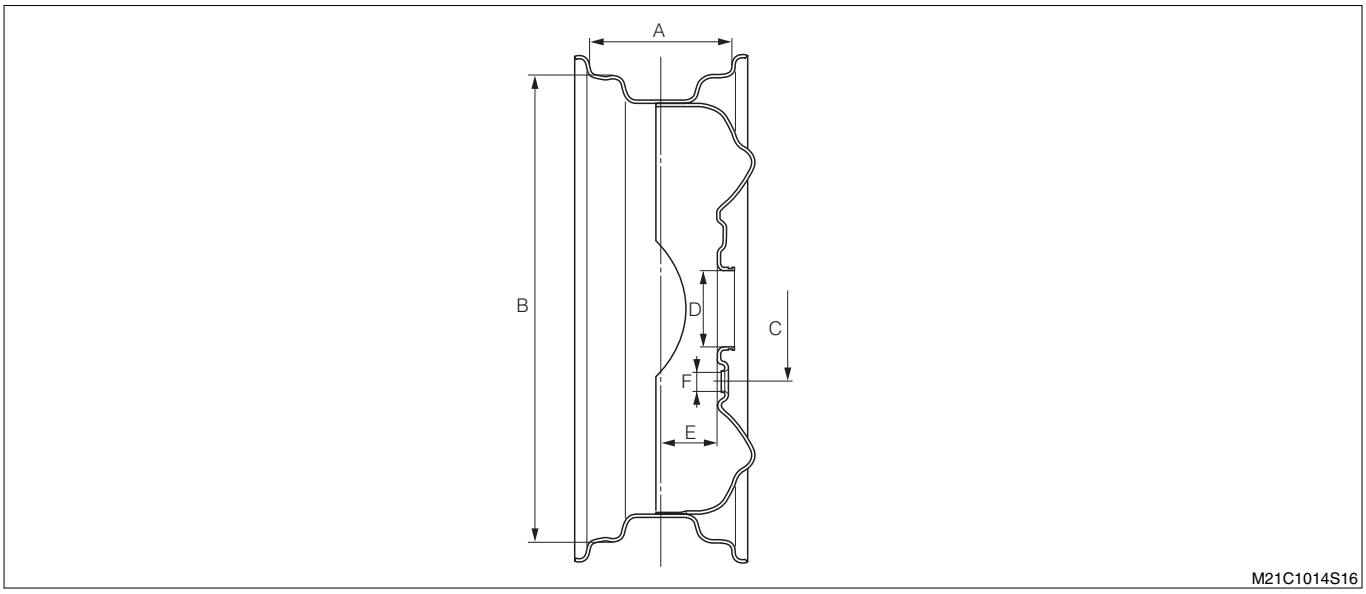
Vehicle model	Tire			
	Size	Air inflation pressure [kPa{kgf/cm^2}]		Depth of groove [mm]
		Front wheel	Rear wheel	
M300RF M300LF	T115/70D14	420{4.2}		1.6 or more

2-2 DISC WHEEL

Table showing disc wheels

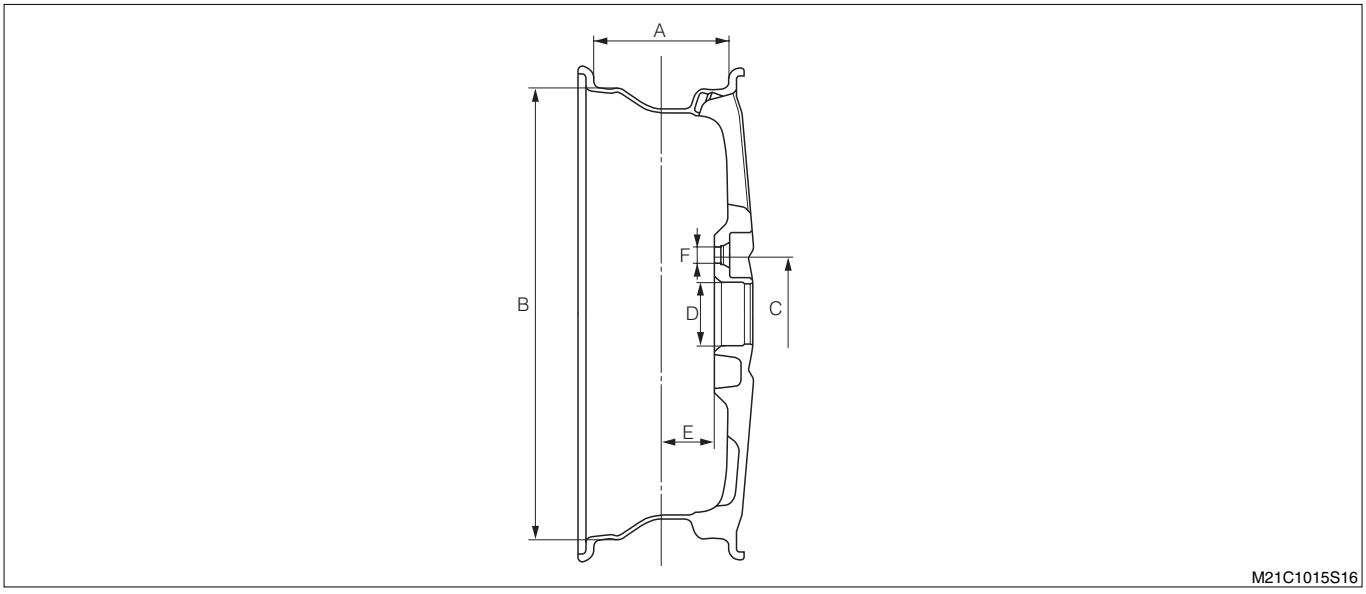
Wheel	Dimensions [mm]					
	A	B	C	D	E	F
	Rim width	Rim diameter	PCD	Hub hole diameter	Offset	Bolt hole diameter
13×4.50B[Steel]	114	329.4	100	54	35	14
14×5.00J[Aluminum]	127	354.8	100	54	40	13

Steel wheel



M21C1014S16

Aluminum wheel



M21C1015S16

D2 DRIVE SHAFT/PROPELLER SHAFT/AXLE

■ FRONT AXLE

1 OUTLINE

1-1 DESCRIPTION

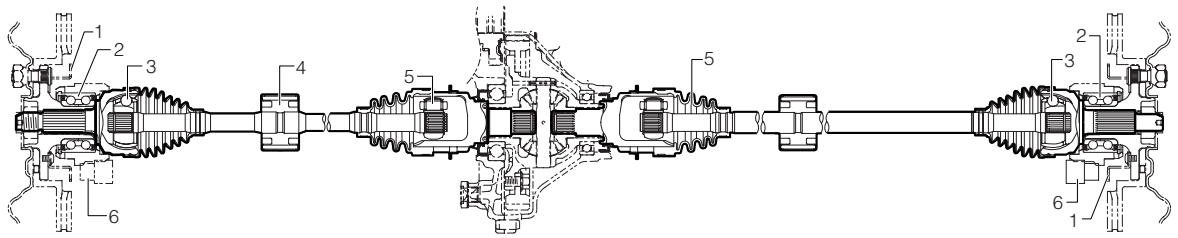
1. As regards the front drive shaft, an undercut free type constant-velocity joint has been employed at the wheel side; and a tripod type constant-velocity joint at the differential side.Especially the joint at the wheel side has adopted a high-angle corresponding type joint .
   The undercut free type constant-velocity joint at the wheel side mainly corresponds to the change in angle of the steering tires. Conversely, the tripod type joint at the differential side mainly corresponds to the change in length of the axle as a result of the movement of the suspension.
2. The joint at the wheel side of the front drive shaft has employed a resin boot.
3. The wheel bearing has adopted an angular ball bearing that features excellent resistance to loads in the thrust direction and a less rolling resistance. This bearing is to be mounted on the hub.

1-2 SPECIFICATION

Specifications of front drive shaft

Drive method		2WD
Engine type		1KR−FE
Joint type	Wheel side	Undercut free type
	Differential side	Tripod type
Distance between joints (mm)	RH	665.3
	LH	442.0
Diameter of intermediate shaft (mm)	RH	23.0 Dia. (with Dynamic Damper)
	LH	19.0 Dia. (with Dynamic Damper)

1-3 SECTIONAL VIEW



T11K1501S20

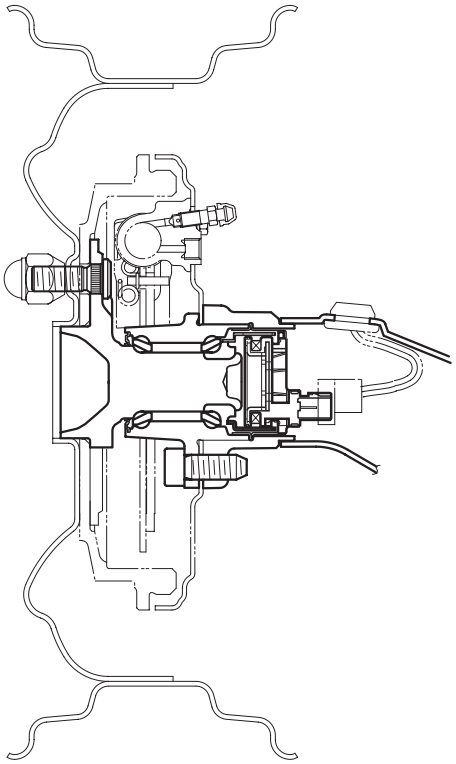
1 Sensor rotor(vehicles equipped with ABS)	4 Dynamic damper
2 Angular ball bearing	5 Tripod type constant-velocity joint
3 Undercut free type constant-velocity joint	6 Wheel speed sensor(vehicles equipped with ABS)

■ REAR AXLE

1 OUTLINE

1-1 DESCRIPTION

1. On 2WD vehicles equipped with ABS, an angular ball bearing has been employed in the same way as the front side. The hub, bearing, wheel speed sensor and sensor rotor have been integrated, thus making up a unit construction.



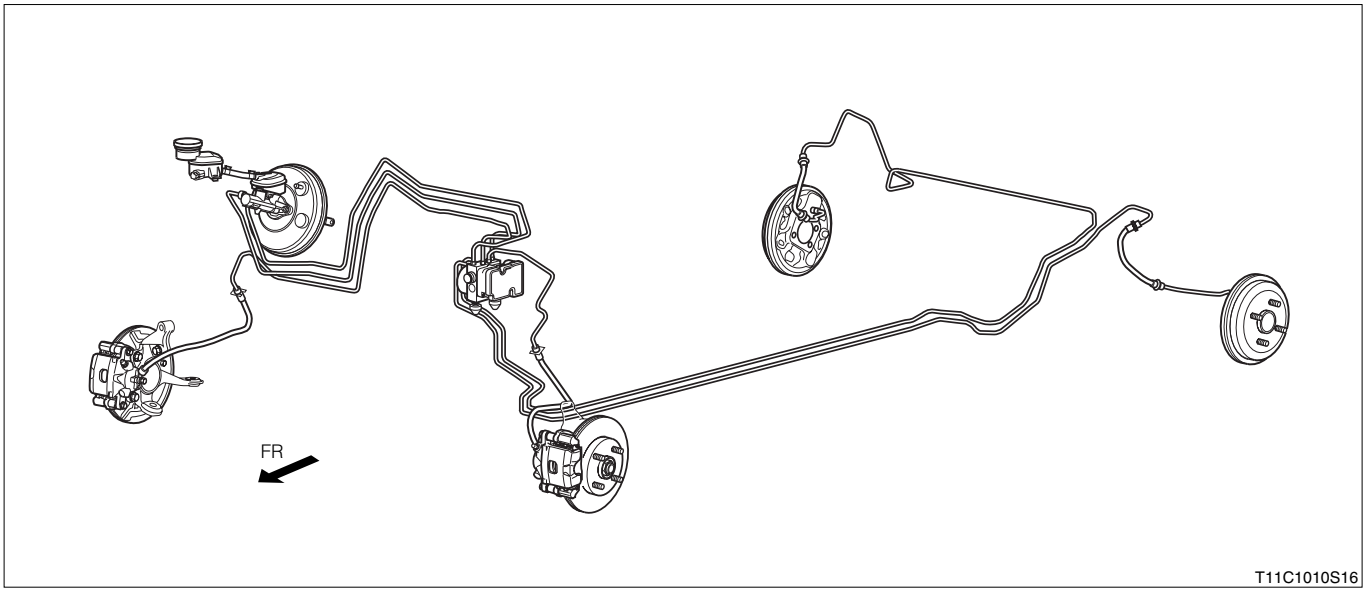
T11K1502ES25

E1 BRAKE

1 OUTLINE

1-1 DESCRIPTION

1. With regard to the brake mechanism, a disc brake has been employed at the front side, whereas a drum brake at the rear side.
2. On all models, the brake piping has employed a diagonal two-system piping (cross piping).
3. A separated-type brake reservoir tank is mounted.
4. The EBD control has been employed.



The illustration represents the RHD vehicle.

2 CONSTRUCTION AND OPERATION

2-1 BRAKE PIPING

2-1-1 DESCRIPTION

All vehicles have employed a diagonal dual brake piping (cross piping) so as to assure safety in the event that one brake system fails.

2-1-2 SPECIFICATIONS

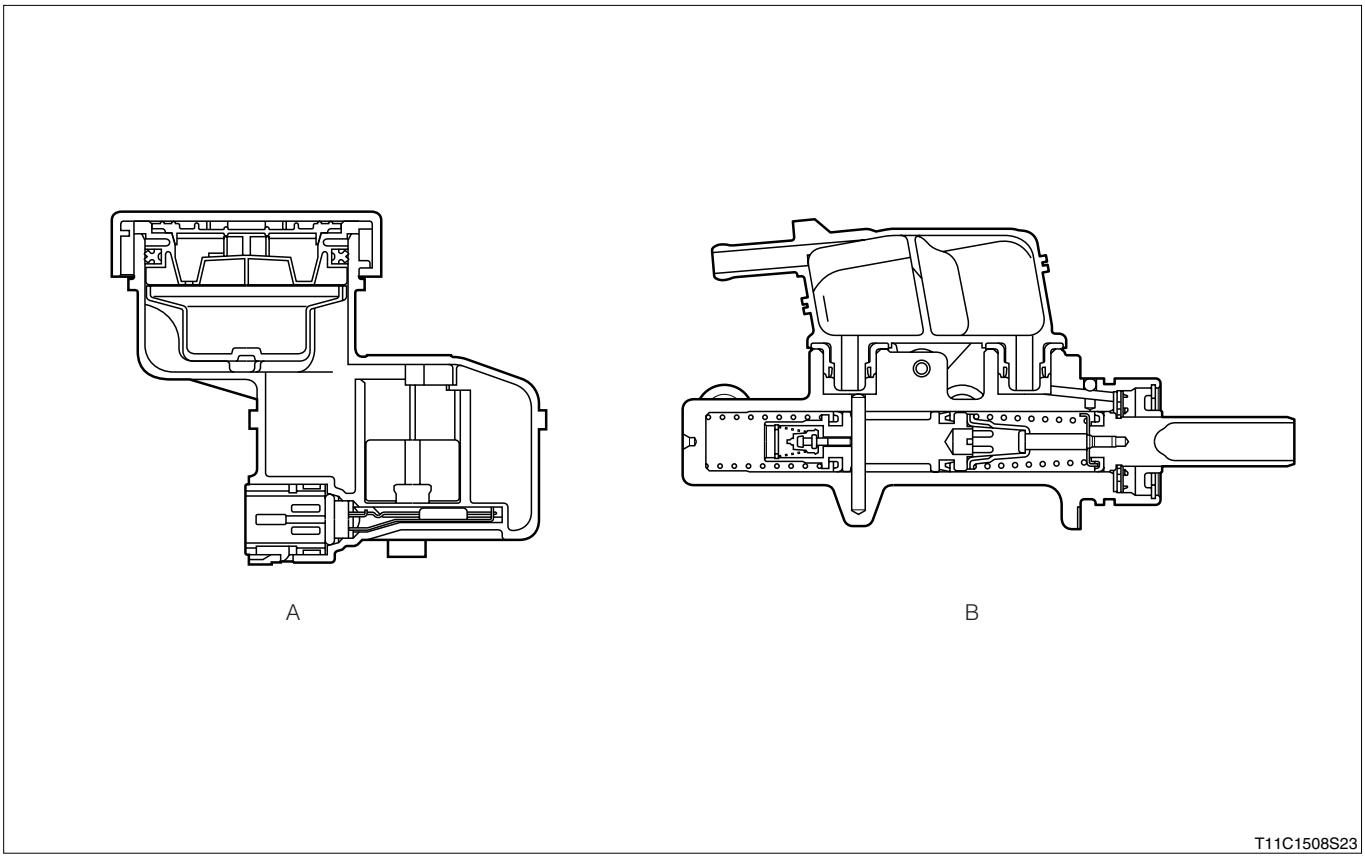
	M300RF	M300LF
Operating system	Diagonal, dual circuit (cross piping)	

2-2 BRAKE MASTER CYLINDER

2-2-1 DESCRIPTION

1. On all models, the master cylinder has employed a tandem type. The master cylinder comes in the following three types, according to the port type and cylinder bore diameter.
   (1) Vehicles equipped with ABS: One-side center port type, cylinder bore diameter 19.0 mm
   (2) Vehicles equipped with ABS: One-side center port type, cylinder bore diameter 20.6 mm

2. All vehicles are equipped with the separated-type reservoir tank.



A in the figure: Reservoir tank
B in the figure: Master cylinder (Vehicles equipped with ABS)

2-2-2 SPECIFICATIONS

RHD vehicles

	M300RF
	Vehicle equipped with ABS
Type	Tandem center port (One side)
Diameter [mm]	19.0

LHD vehicles

	M300LF	
	GMNE GMNEW	GMNEW
	Vehicle equipped with ABS	Vehicle equipped with ABS
Type	Tandem center port (One side)	Tandem center port (One side)
Diameter [mm]	19.0	20.6

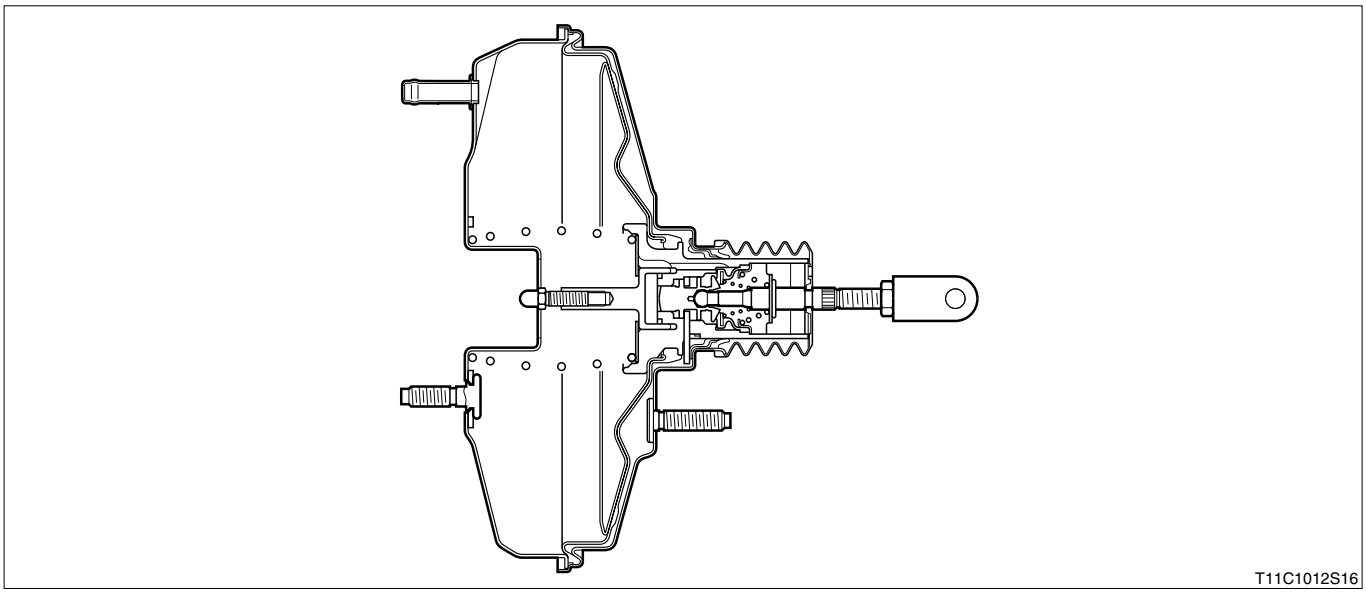
2-3 BRAKE BOOSTER

2-3-1 DESCRIPTION

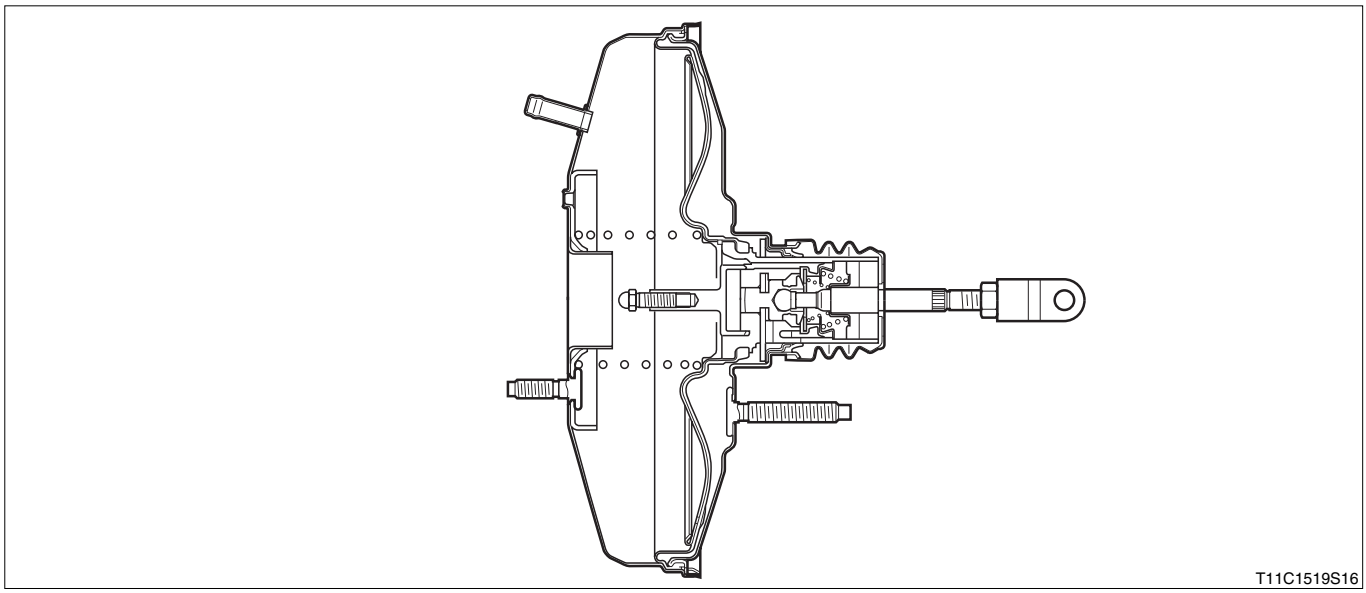
1. The brake booster employs the vacuum boosting type on all models. The brake booster comes in two kinds according to the size.
   (1) 8-inch single type
   (2) 9-inch single type

2. For an enhanced brake performance at the time of emergency hard braking, a brake assist mechanism has been provided on vehicles equipped with ABS (except those equipped with a 9-inch brake booster).

8-inch brake booster



9-inch brake booster



2-3-2 SPECIFICATIONS

RHD vehicles

	M300RF
	Vehicle equipped with ABS
Type	Vacuum boosting type (with the brake assist mechanism)
Size [Inch]	8

LHD vehicles

	M300LF	
	GMNE GMNEW	GMNEW
	Vehicle equipped with ABS	Vehicle equipped with ABS
Type	Vacuum boosting type (with the brake assist mechanism)	Vacuum boosting type (with the brake assist mechanism)
Size [Inch]	8	9

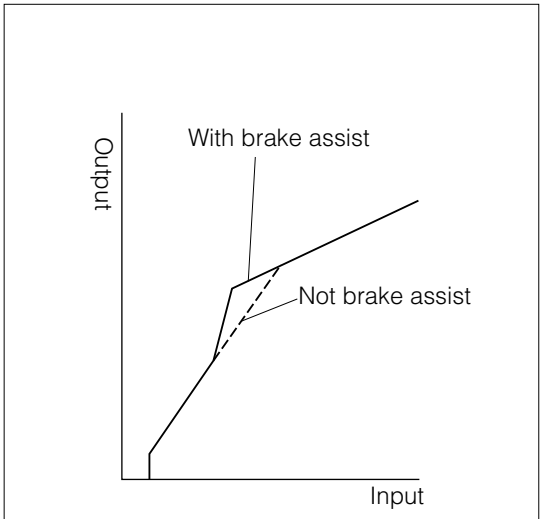
2-3-3 BRAKE ASSIST MECHANISM

(1) Description

During emergency braking situations, a panicked driver will step on a brake pedal quickly; however the brake pedal may not be depressed hard enough. Or even if the brake pedal is depressed hard, it may be difficult for the driver to keep stepping hard on the brake.

In this case, the vehicle may not be allowed to exert its brake performance fully.

The brake booster equipped with a brake assist mechanism is a system that increases the assist to the braking force by the brake booster after the brake pedal depressing force exceeds a certain value, thereby enhancing brake performance, including ABS, at the time of emergency.



Brake booster characteristics

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CAUTION

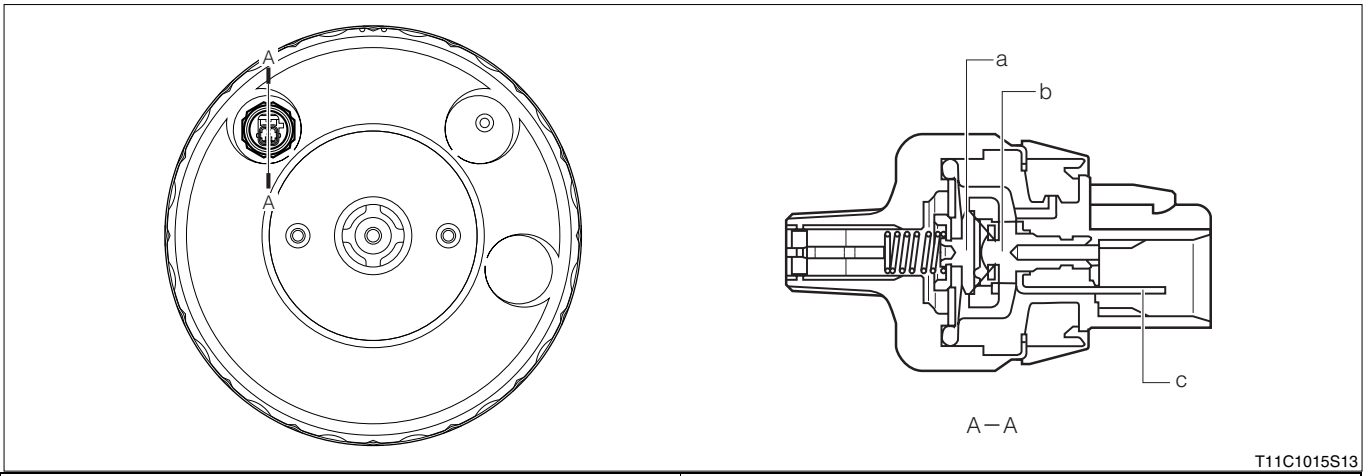
- The brake assist mechanism is not a mechanism which is capable of performing braking beyond the brake performance that the vehicle is designed to have or beyond the tire performance. Full attention should be paid during driving.
- The brake assist mechanism functions only when the brake pedal is depressed strongly during an emergency braking period. The driver will not feel any difference during the normal braking.

2-3-4 BRAKE VACUUM SWITCH

(1) Description

The brake vacuum switch reduces changes in negative pressure in the brake booster when the air-conditioner is ON to provide more stabilized performance of the brake servo.

(2) Operation



T11C1015S13

a	Contact point A
b	Contact point B
c	Terminal

1. When the pressure inside the brake booster is below the working pressure of the brake vacuum switch, the points of contact A and B are separated.
2. When the pressure in the brake booster increases (exceeding the working pressure of the brake vacuum switch), the point of contact A moves toward the point of contact B until it touches the point B, thereby providing body earth to the terminal.
3. The signal input is sent to the EFI ECU and the air-conditioner cutting is controlled on the EFI ECU side.

2-4 BRAKE PEDAL

2-4-1 DESCRIPTION

All vehicles are equipped with a backward movement preventing mechanism of the brake pedal in order to enhance passive safety.

2-4-2 BACKWARD MOVEMENT PREVENTING MECHANISM

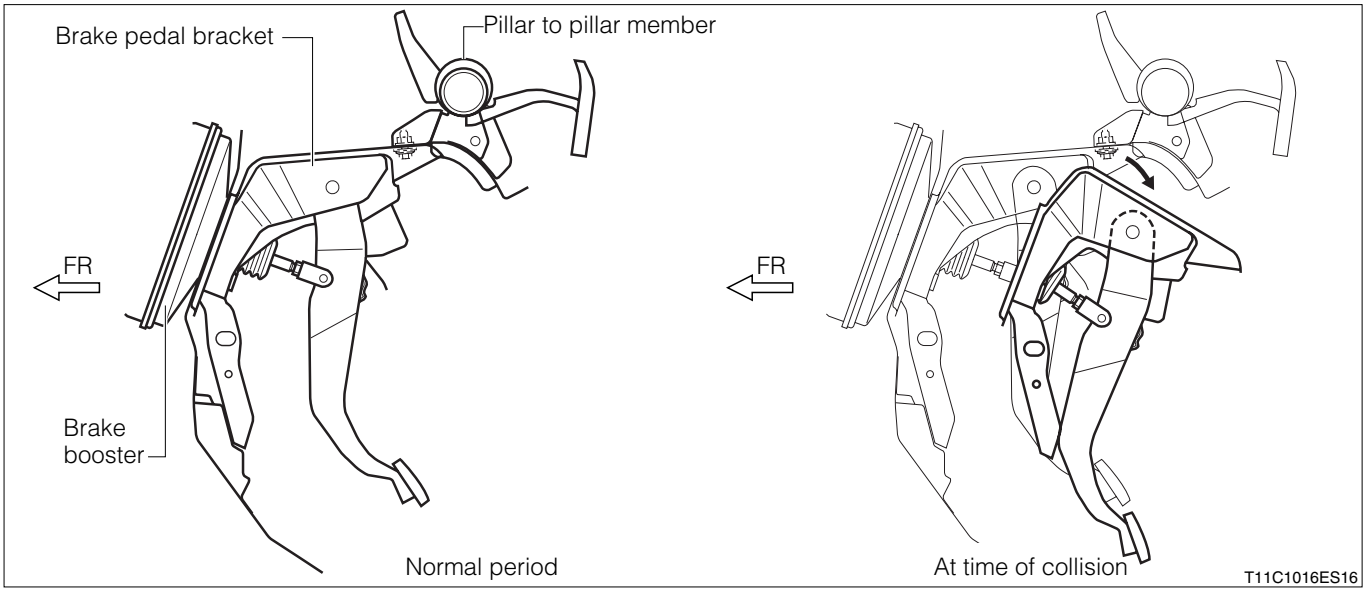
(1) Description

When an impact is applied from the front section of the vehicle body at the time of an accident, etc., and thus the brake master cylinder is pushed toward the vehicle interior, the brake pedal moves toward the rear side of the vehicle via the push rod of the brake booster. In this way, there is the possibility that the driver may be injured.

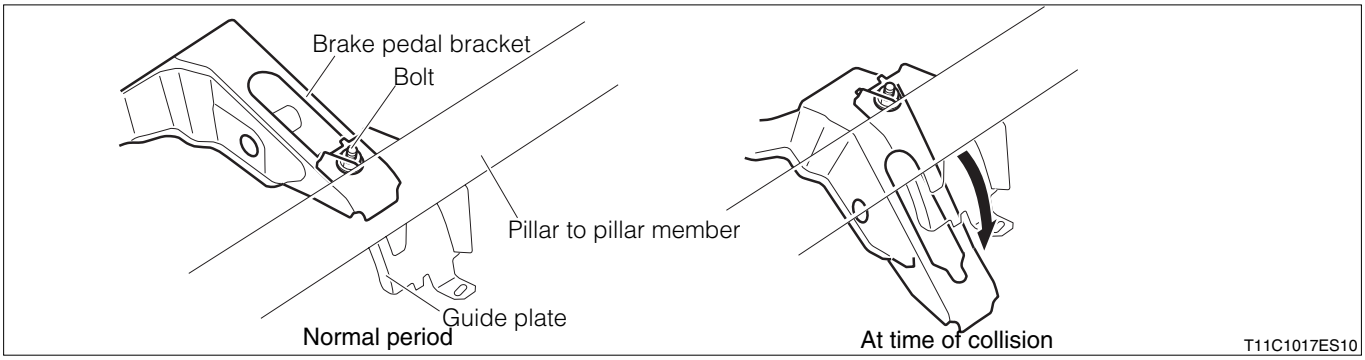
In order to prevent the brake pedal from moving backward, the backward movement preventing mechanism of the brake pedal has been employed on the brake pedal bracket and pillar-to-pillar member.

(2) Operation

1. When an impact is applied from the front section of the vehicle body at the time of an accident, etc., and thus the brake master cylinder is pushed toward the vehicle interior due to the backward movement of the engine itself, the brake booster pushes the brake pedal bracket.
2. The impact from the brake pedal bracket will disengage the pillar-to-pillar member, causing the brake pedal bracket to bend.



3. The brake pedal bracket moves by sliding toward the rear lower side of the vehicle over the guide plate on the pillar-to-pillar member.
4. This operation moves the brake pedal depressing surface toward the vehicle front lower side, thereby preventing the brake pedal from moving backward.



2-5 FRONT BRAKE

2-5-1 DESCRIPTION

1. The ventilated disc brake is employed on all models. The disc brake comes in two kinds according to the size.
   (1) 13-inch ventilated disc brake (front disc 234mm dai)
   (2) 14-inch ventilated disc brake (front disc 246mm dai)
2. The brake pad audible wear indicator is mounted on the brake pad inside the vehicle which provides an audible alarm if the pad remaining amount is reduced.

2-5-2 SPECIFICATIONS

	M300RF	M300LF
	GMNE GMNEW	GMNE GMNEW
Type	13 inch ventilated disk	
Cylinder diameter [mm]	51.1	
Rotor outer diameter [mm]	234	
Rotor thickness [mm]	16	
Pad area [cm^2/piece]	30	

2-6 REAR BRAKE

2-6-1 DESCRIPTION

1. All vehicles are equipped with the leading-trailing type drum brake.

2-6-2 SPECIFICATIONS

	M300RF	M300LF
Type	Drum (Leading trailing)	
Cylinder diameter [mm]	17.4	
Drum inner diameter [mm]	180	
Lining area [cm^2/piece]	43	

2-7 BRAKING FORCE CONTROL SYSTEM

2-7-1 DESCRIPTION

1. The EBD control has been employed on ABS-equipped vehicles. The braking force distribution between the front and rear wheels is electronically controlled ideally according to changes in the loading state and the load transfer due to deceleration, etc.

2-7-2 SPECIFICATIONS

	Vehicle equipped with ABS
Type	ABS with EBD control

E2 PARKING BRAKE

1 OUTLINE

1-1 OUTLINE

1. On all models, the parking brake has employed a leading trailing rear two-wheel braking type, that is shared in common with the rear brake.
2. On all models, the center lever type has been employed.

1-2 SPECIFICATIONS

	M300RF	M300LF
Type	Mechanical type wheel braking	
Type	Manual type	

E3 BRAKE CONTROL

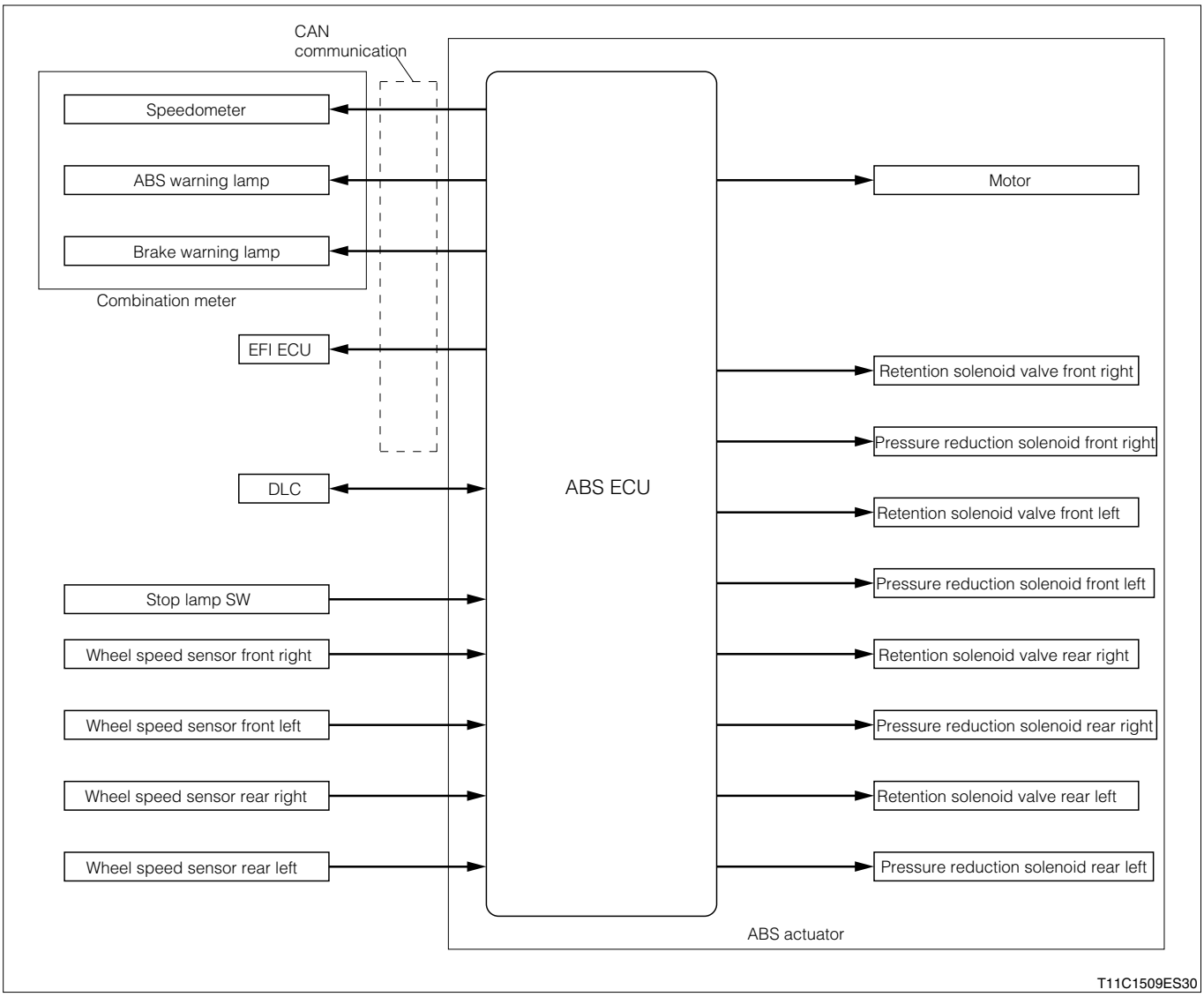
■ ABS

1 OUTLINE

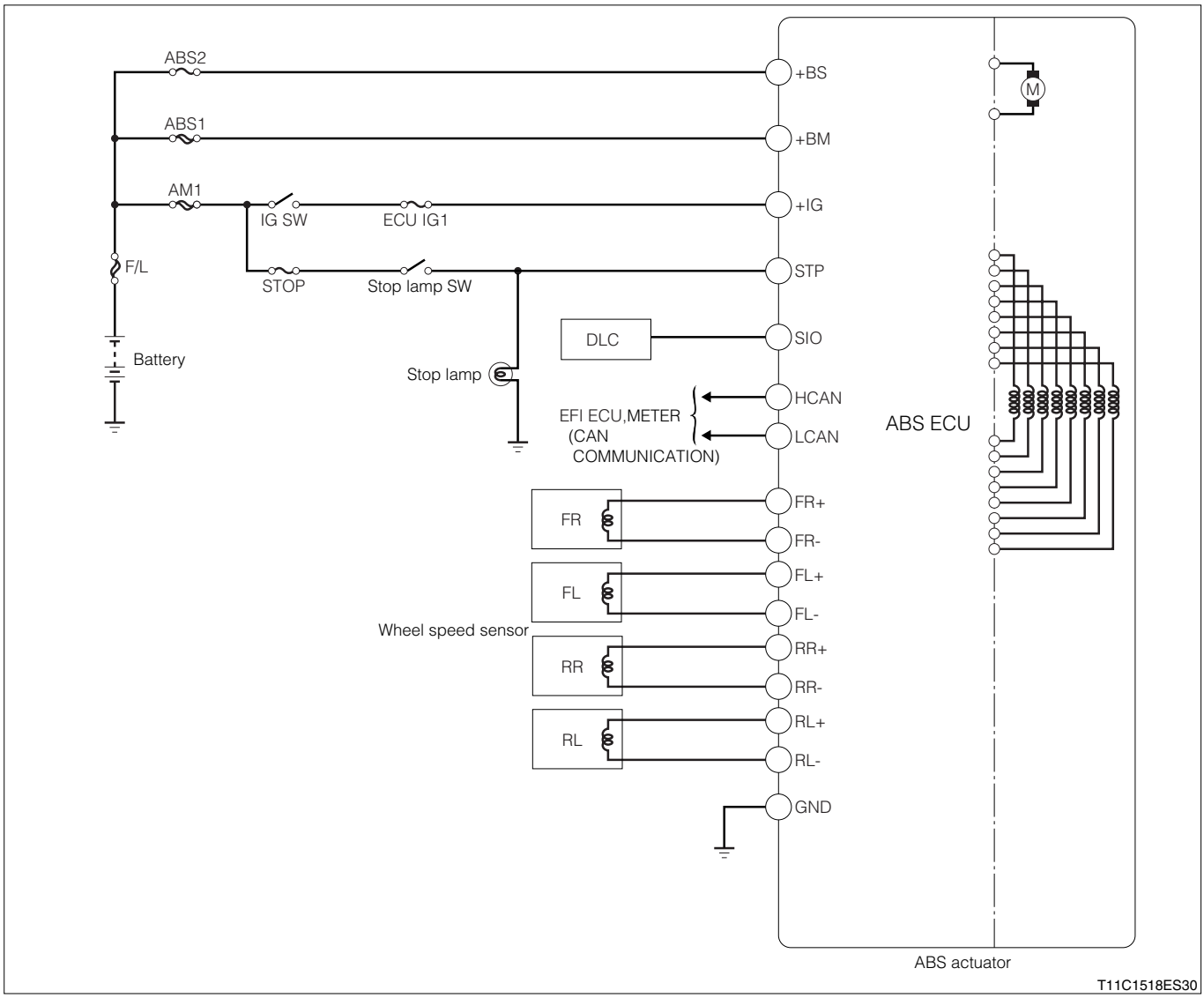
1-1 DESCRIPTION

1. The ABS with EBD control has been adopted.
   (1) The ABS is a brake system designed to prevent the wheels from slipping, which is caused by wheel lock-up during hard braking or driving on a slippery road covered with snow, etc. It is also used to achieve maximum braking performance in every driving situation in order to maintain stable vehicle posture and steering control.
   (2) The ABS with EBD control is the system that controls the distribution of brake forces between the front and rear wheels in addition to ABS. The brake forces between the front and rear wheels are properly adjusted in accordance with the load movements due to changes in load conditions, deceleration, etc. Also the ABS with EBD controls the distribution of braking forces between the left and right wheels, helping to maintain the vehicle stability during braking while the vehicle is turning.
2. When a fault occurs, the warning lamp lights up by the fail safe function, letting the driver know that there is a malfunction, while. Also, the diagnosis (self-diagnosis) function lets the operator know where that malfunction is occurring.
3. The ABS ECU uses CAN communication to communicate with the meter ECU, and EFI ECU.
   Refer to the section "CAN communication system" for details.

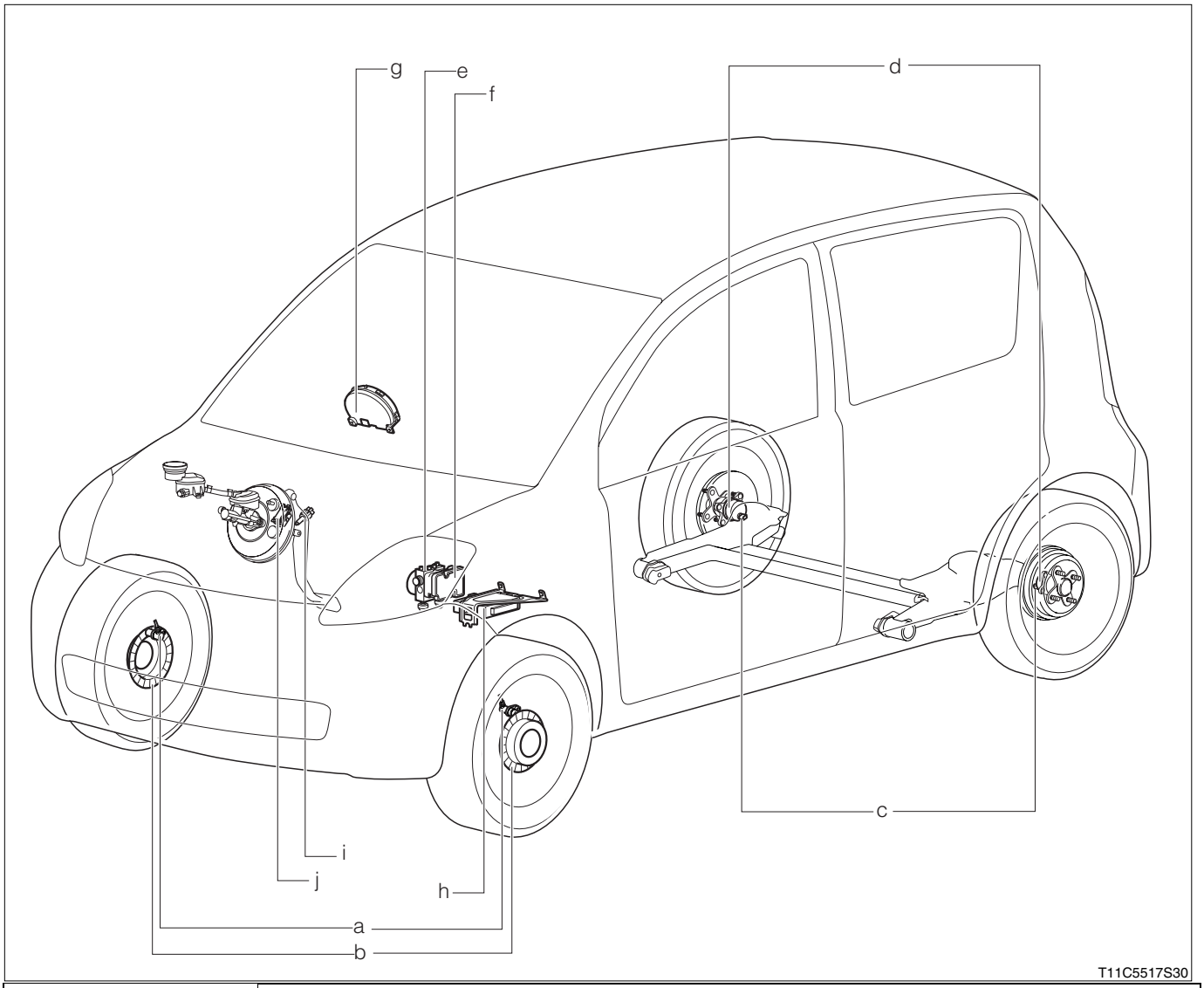
1-2 SYSTEM DRAWING



1-3 SYSTEM WIRING DIAGRAM



1-4 LOCATION OF COMPONENTS



a	Front wheel speed sensor
b	Front wheel speed sensor rotor
c	Rear wheel speed sensor
d	Rear wheel speed sensor rotor
e	ABS actuator
f	ABS ECU
g	Combination meter (ABS warning lamp, brake warning lamp, LCD)
h	EFI ECU
i	Stop lamp switch
j	DLC

2 CONTROL

2-1 BASIC PRINCIPLE

When the brake is depressed, the wheel speed will drop below the vehicle speed, causing slippage between wheels and the road surface. The magnitude of this slippage is called slip rate, which is calculated using the formula below.

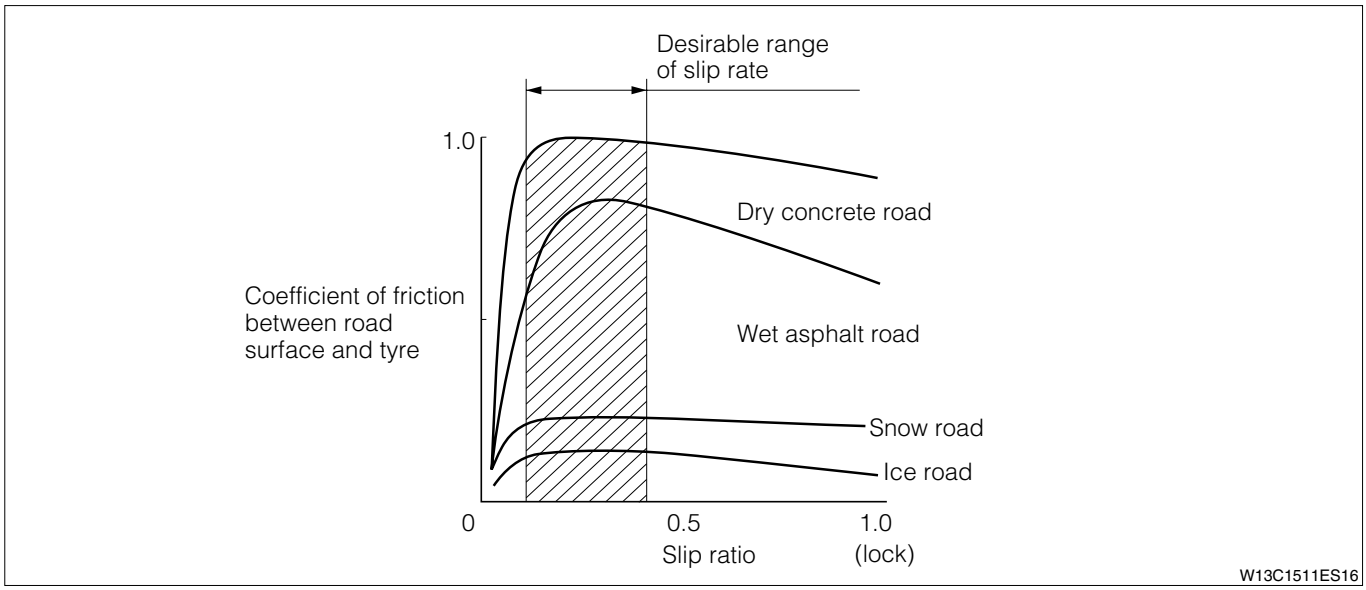
Slip ratio = (vehicle speed − wheel speed) / vehicle speed

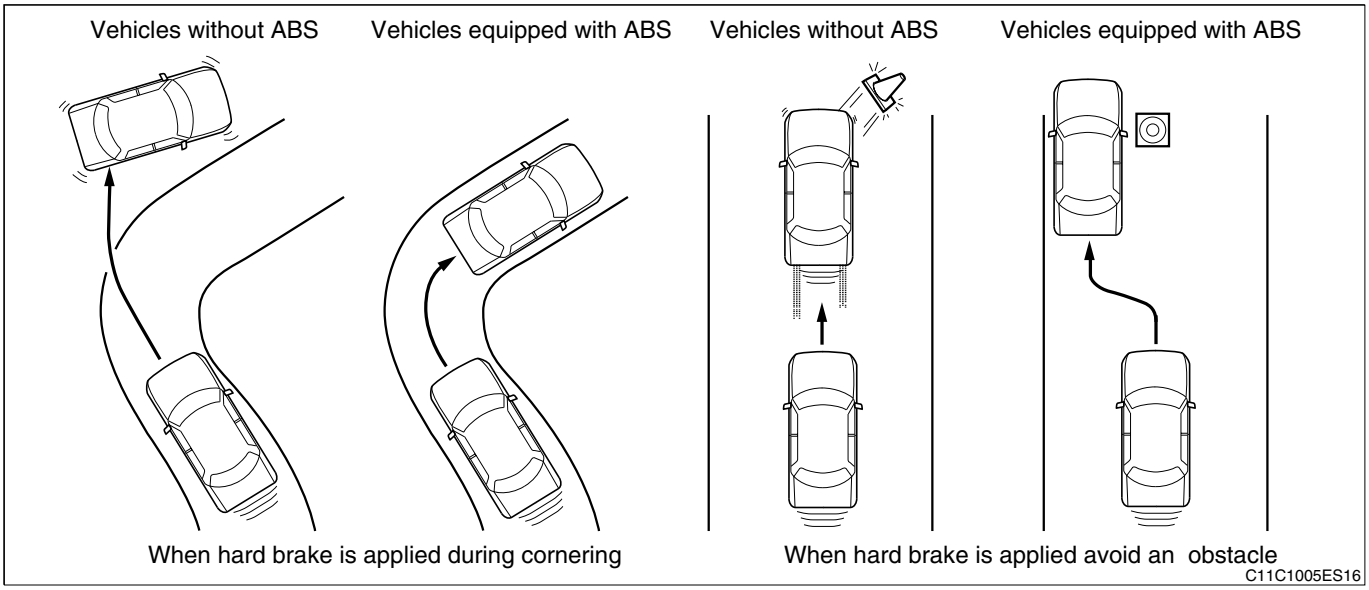
Normally, the friction coefficient between a tire and a road surface reaches the peak at the slip ratio of 0.1−0.3, with the braking effort also reaching the maximum. The value falls below the maximum when the wheels are locked.

The cornering force generated by tires when the vehicle is turning reaches the peak when the slip ratio is "0". The cornering force decreases as the slip ratio increases, reaching the minimum force during locking (slip ratio 1.0).

When steering with the front wheels being locked, the direction of the front wheels change, but they only slip on the road surface without causing any change in vehicle's direction. When the rear wheels are locked, if an external force, such as a change in the coefficient of friction of the road surface, is applied, the rear wheels start to skid, causing the vehicle slip laterally.

The ABS controls the ABS actuator based on the signal from each wheel speed sensor so that the wheel slip ratio can be constantly maintained in the high slip region of the friction coefficient by increasing, holding, or reducing the brake fluid pressure applied to each wheel, in order to maintain stable vehicle posture and directional control during deceleration.

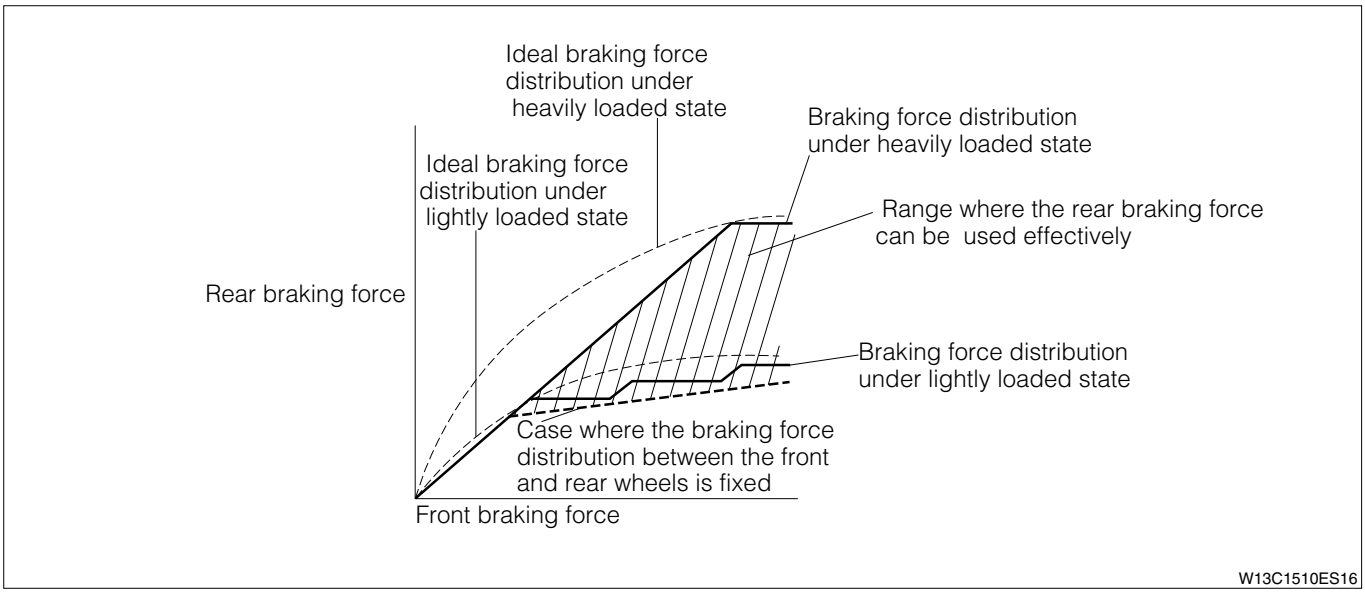




2-1-1 CONTROL OF BRAKING FORCE DISTRIBUTION BETWEEN FRONT AND REAR

The brake force distribution control between the front and rear wheels has achieved optimum distribution of braking force between the front and rear wheels in response to the driving conditions with a view to obtaining the excellent braking performance.

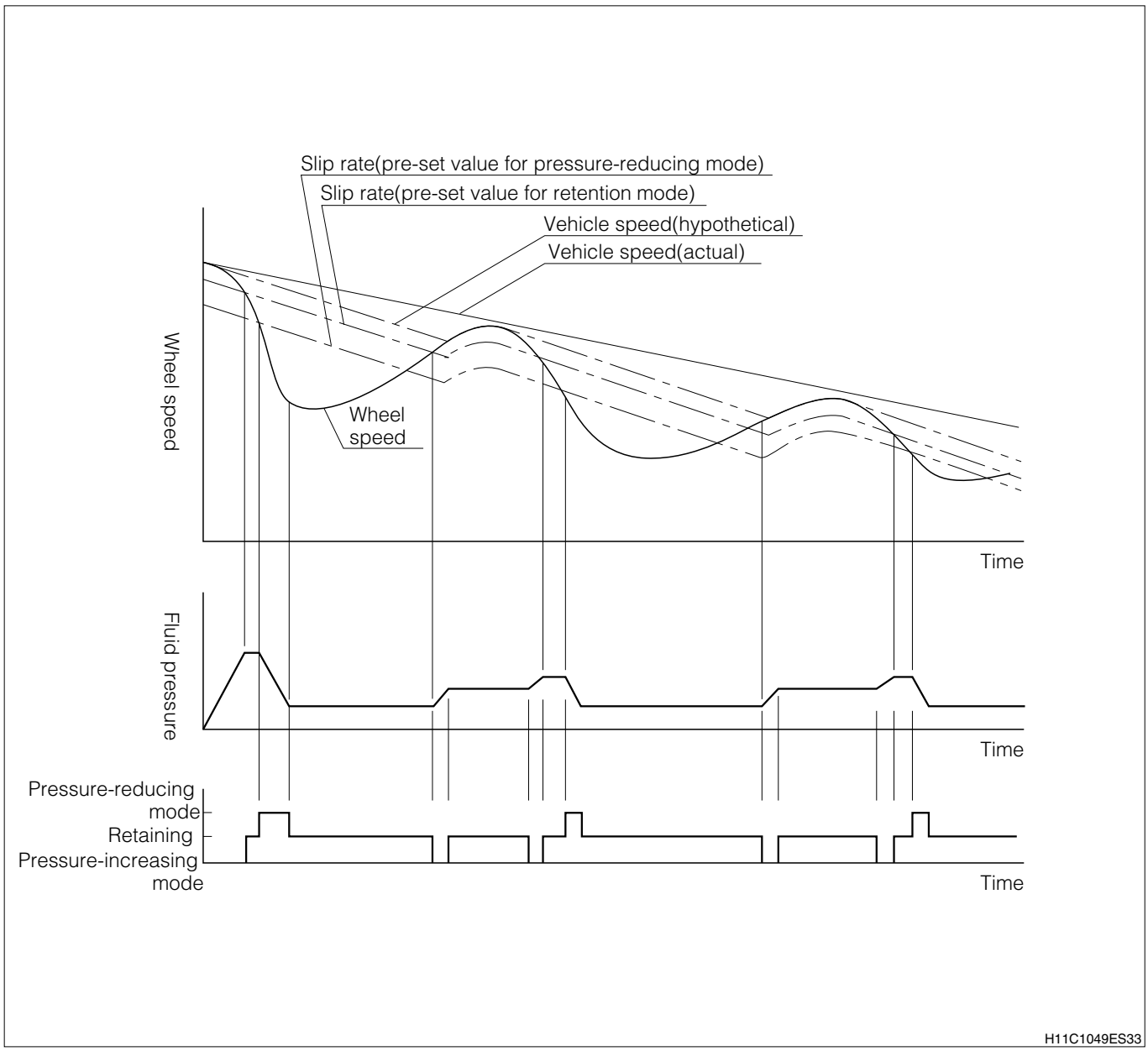
This allows the braking force of the rear wheels to function effectively responsive to changes in load condition or deceleration, thereby reducing braking effort especially during loading conditions to ensure excellent braking performance.



2-2 FLUID PRESSURE CONTROL

2-2-1 BASIC CONTROL

The ABS ECU calculates the speed and deceleration rate (magnitude of the drop in wheel speed) for each wheel based on the signal from the wheel speed sensor, and estimates the vehicle speed and the wheel slip rate. Based on the calculations, the ABS ECU controls the solenoid valve inside the ABS actuator by increasing/holding/reducing the brake fluid hydraulic pressure for each wheel, thus controlling the brake fluid pressure applied to the wheel cylinder so that the optimal vehicle speed and wheel slip rate can be maintained.



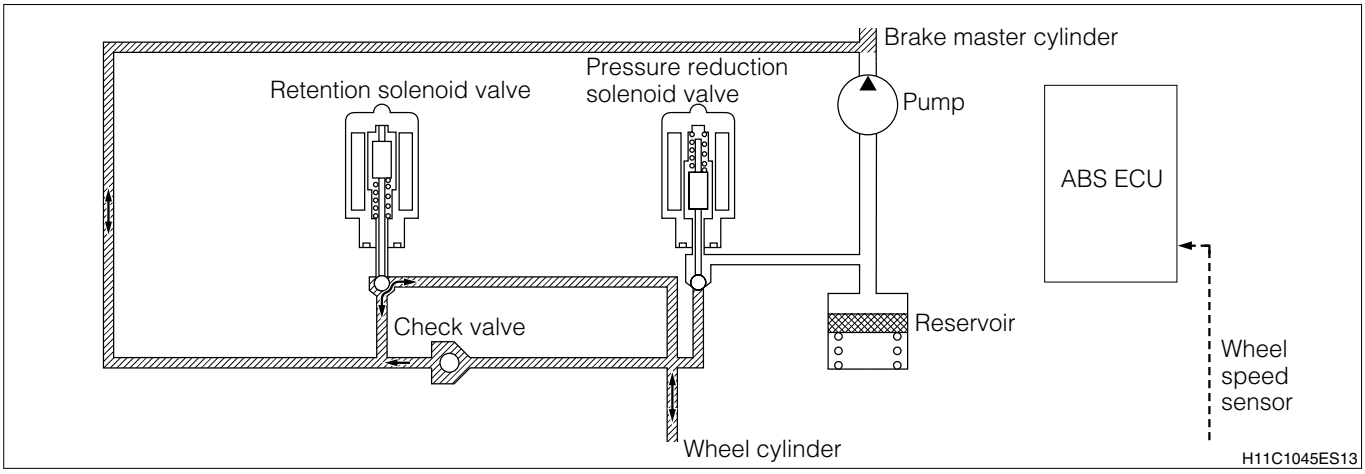
2-2-2 ABS OPERATION

The ABS hydraulic system consists of four systems; right front wheel, left front wheel, right rear wheel, left rear wheel.

The following explanation is about the operation of only one system of the front wheel. The other systems work in the same way.

(1) During normal braking(During ABS non-operation)

1. Because the signal from the ABS ECU is not inputted, the solenoid valve will not be energized, causing the retention solenoid valve to open, while the pressure-reducing solenoid valve to close.
2. When the brake pedal is depressed in this state, the brake fluid pressure from the master cylinder will increase, pumping the brake fluid through the retention solenoid valve into the wheel cylinder.
3. At this time, the pump is not activated. When the brake pedal is released, the brake fluid in the wheel cylinder flows through the retention solenoid valve and check valve, and returns to the master cylinder.



(2) During hard braking(during ABS operation)

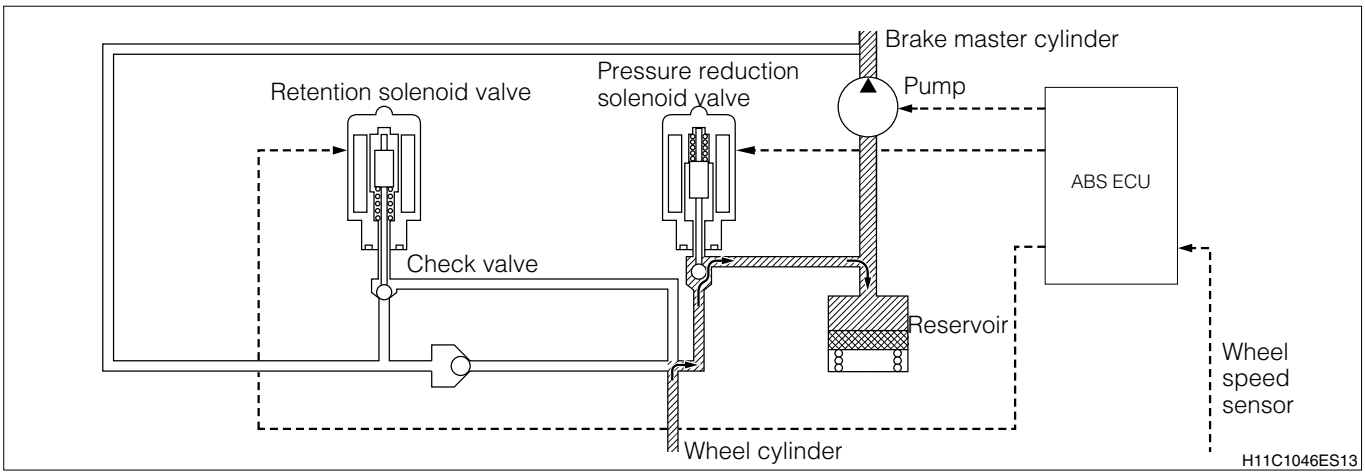
ABS control operation

During ABS operation	Pressure - reduction	Retention	Pressure - increasing
Retention solenoid valve	ON (Closed)	ON (Closed)	OFF (Open)
Pressure reduction solenoid valve	ON (Open)	OFF (Closed)	OFF (Closed)
Hydraulic pressure of the wheel cylinder	Releases hydraulic pressure.	Retains hydraulic pressure.	Applies hydraulic pressure.

The words in parentheses indicate open/close status of the solenoid valve.

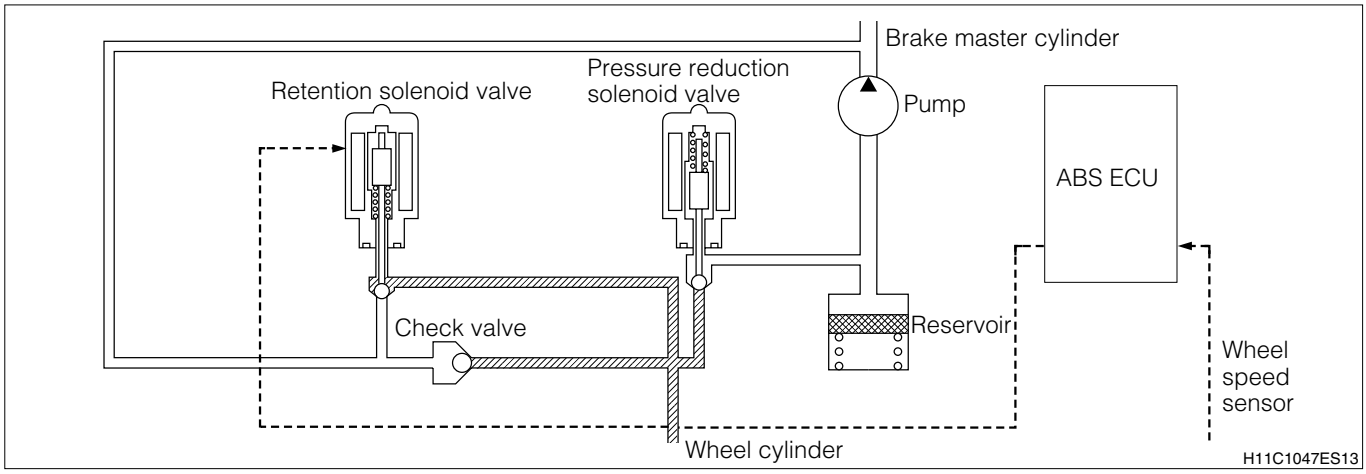
① Pressure - reduction

1. The ABS ECU sends a signal to the solenoid valve to activate each solenoid valve.
2. The brake fluid passes through the pressure reduction solenoid valve and flows into the reservoir, thereby reducing the hydraulic pressure.
3. During the ABS operation, the pump is activated to flush the brake fluid that collects in the reservoir back to the master cylinder.
4. The rate of fluid pressure reduction is controlled by repetition of the pressure reduction mode and the retention mode, which is described below.



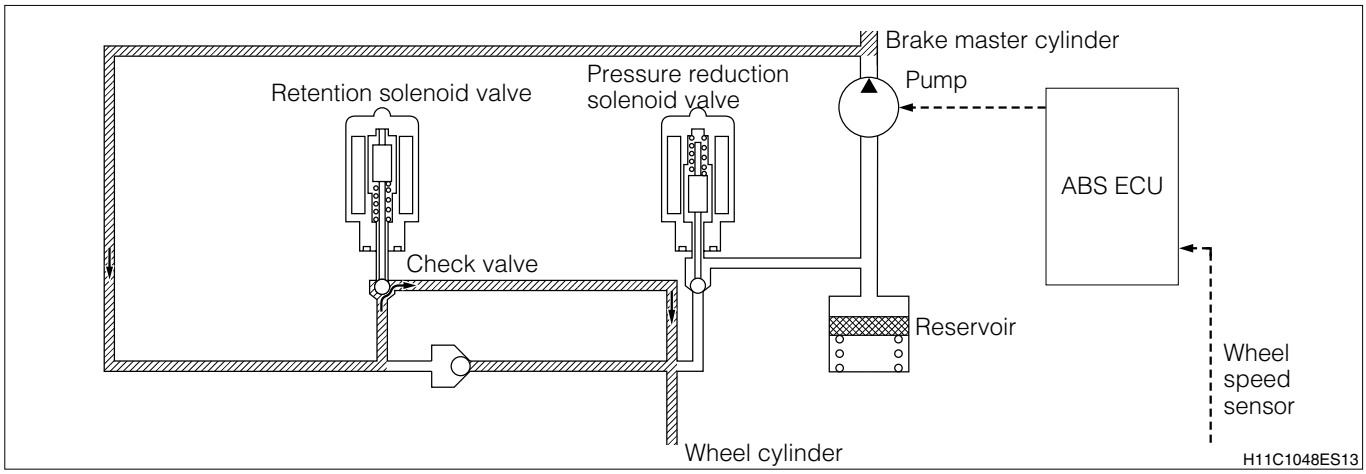
② Retention

1. The ABS ECU sends a signal only to the retention solenoid valve, which shuts off the brake fluid passage.
2. The brake fluid pressure of the wheel cylinder is maintained.



③ Pressure - increasing

1. The ABS ECU does not send a signal to the solenoid valve. The brake fluid is sent to the wheel cylinder, causing the fluid pressure to increase.
2. When the reservoir has some remaining brake fluid, the pump is activated to send the brake fluid in the reservoir back to the master cylinder.
3. The rate of fluid pressure increase is controlled by repetition of the pressure increase mode and the retention mode, which is described above.



2-3 CAN COMMUNICATION

1. The ABS ECU performs CAN communication with the meter ECU, A/T ECU, and EFI ECU, transmitting and receiving multiple pieces of information via a pair of communication wires (twisted pair wire).
   Refer to the section "CAN communication system" for details.

2-4 INITIAL CHECK FUNCTION

2-4-1 LAMP CIRCUIT

When the IG SW is turned ON, the ABS ECU will light up the ABS warning lamp and brake warning lamp for approx. 3 seconds, and check the lamp circuit.

2-4-2 DRIVING OF ACTUATOR

When the vehicle is started with the IG SW turned ON and the stop lamp switch turned OFF, the ABS ECU will check the motor operation inside the ABS actuator.

NOTE

- Although the operating sound of the motor and other components is generated from the engine compartment during the initial check of the actuator, that is not a sign of malfunction.

2-5 DIAGNOSIS

2-5-1 DESCRIPTION

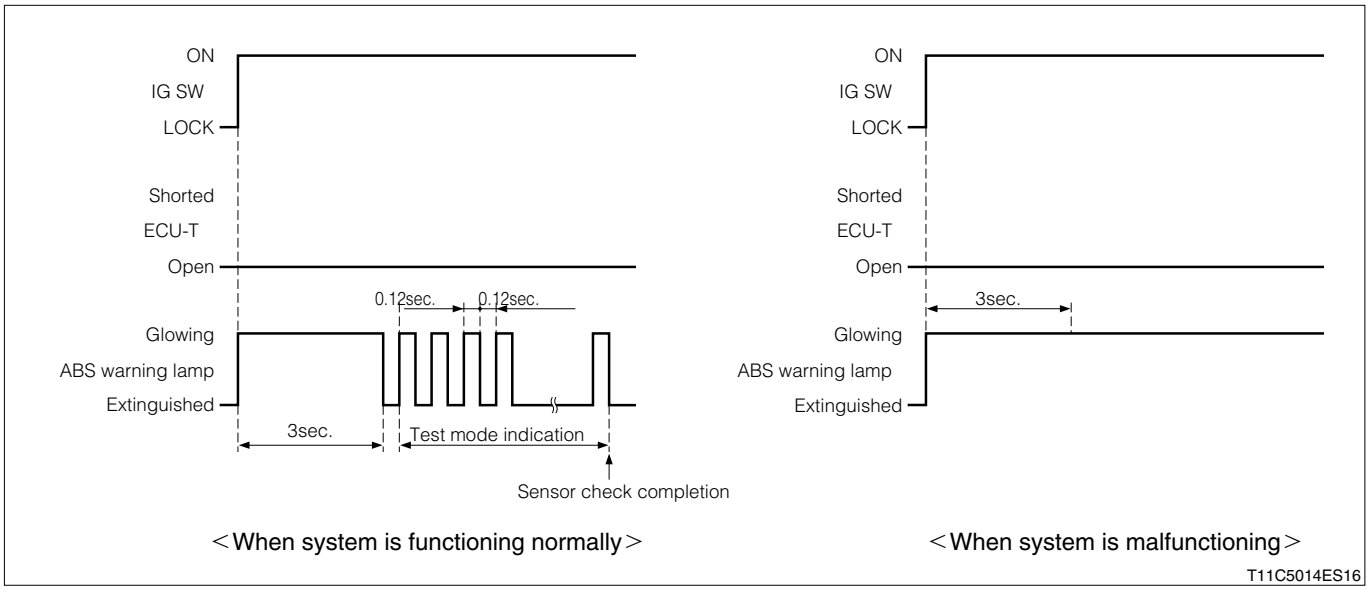
Diagnosis literally means {{}} failure diagnosis ″, which provides the function that allows the ECU to notify an operator of the fault that has occurred in the input and output system. The ECU stores faulty conditions when a fault occurs. The information is stored in the nonvolatile (EEPROM), therefore the diagnosis result will be stored even when the power supply is shut down.

Refer to the service manual for the details of diagnosis.

2-6 TEST MODE FUNCTION

2-6-1 DESCRIPTION

1. The ABS has a test mode function that checks the output value from each sensor to determine if the sensor is functioning properly, in addition to the diagnosis function that checks failure, open circuit, short-circuit, etc. of the system components.
2. The test mode is executed in any of the following cases.
   (1) Immediately after the abnormality code is erased by brake pedal operation.
   (2) When the IG SW is turned ON for the first time after the new ABS actuator is installed.
3. The test mode checks the following items. It also detects any faulty output value of each sensor, and deformation, missing teeth, etc. of the wheel speed sensor rotor.
   (1) Output voltage of wheel speed sensor
   (2) Output interval of wheel speed sensor
4. During the test mode, the ABS warning lamp flashes. When the checks of each sensor are completed properly, the ABS warning lamp goes out.



＜When system is functioning normally＞ ＜When system is malfunctioning＞

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2-6-2 CHECK ITEMS

Check system	Code No.		Check items	Checking condition
	2-digit	4-digit		
Wheel speed sensor Output voltage	81	C1271	RH front wheel speed sensor output voltage fault	Runs straight ahead at a vehicle speed of 4km/h－7km/h.
	82	C1272	LH front wheel speed sensor output voltage fault	
	83	C1273	RH rear wheel speed sensor output voltage fault	
	84	C1274	LH rear wheel speed sensor output voltage fault	
Wheel speed sensor Output interval	85	C1275	RH front wheel speed sensor output cycle fault	Runs straight ahead for five seconds or more at a vehicle speed of 10km/h－40km/h. Or driving the vehicle straight through at the speeds above 40 km/h.
	86	C1276	LH front wheel speed sensor output cycle fault	
	87	C1277	RH rear wheel speed sensor output cycle fault	
	88	C1278	LH rear wheel speed sensor output cycle fault	

2-7 FALE—SAFE FUNCTION

1. This is a function by which control takes place so that the system may not malfunction even if any abnormality is found in the input/output signal system.
2. When the fail-safe operates, the ABS warning lamp and brake warning lamp inside the combination meter go on as follows, thus telling the driver of the abnormality. Also, the system control will be prohibited.
   (1) In cases where an abnormality which makes the ABS inoperative takes place, the ABS warning lamp goes on. Thus, the ABS control is prohibited.
   (2) In addition, in cases where an abnormality which makes the EBD inoperative takes place, the ABS warning lamp and brake warning lamp go on at the same time. Thus, the EBD control is prohibited.

LIST OF FAIL-SAFE CONTROL FUNCTIONS

System diagnosed	Diagnosis items	Warning indication (Provided: ○, Not-provided:×)		Fail safe	
		ABS	Brake	Contents of control	Conditions of control release
Solenoid relay	Open wire / Short circuit	○	○	·Prohibition of EBD control ·Prohibition of ABS control	Control will be deactivated, when the IG SW is turned from LOCK to ON after returning to the normal state.
Power supply system	Voltage increase/ drop	○	×/○*1	·Prohibition of EBD control ·Prohibition of ABS control	Releasing after the normal condition has been restored
Wheel speed sensor front right	Open wire / Short circuit	○	×*2	·2 wheels or more EBD control is prohibited. ·Prohibition of ABS control	Control will be deactivated, when the IG SW is turned from LOCK to ON after returning to the normal state.
Wheel speed sensor front left	Open wire / Short circuit	○	×*2		
Wheel speed sensor rear right	Open wire / Short circuit	○	×*2		
Wheel speed sensor rear left	Open wire / Short circuit	○	×*2		
Wheel speed sensor front right	Cycle fault	○	×*2	·2 wheels or more EBD control is prohibited. ·Prohibition of ABS control	After returning to the normal state, turn the IG SW from LOCK to ON. If the outputs of the wheel sensors at all four wheels are found normal during the driving, the control will be deactivated.
Wheel speed sensor front left	Cycle fault	○	×*2		
Wheel speed sensor rear right	Cycle fault	○	×*2		
Wheel speed sensor rear left	Cycle fault	○	×*2		
Wheel speed sensor rotor	Teeth missing	○	×*2		
Pump	No-rotation fault	○	×	·Prohibition of ABS control	Released if the initial check confirms the normal operation when the IG SW is set from LOCK to ON.
Retention or pressure-reduction solenoid front RH	Abnormal	○	○	·Prohibition of EBD control ·Prohibition of ABS control	Control will be deactivated, when the IG SW is turned from LOCK to ON after returning to the normal state.

Retention or pressure-reduction solenoid front LH	Abnormal	○	○		
Retention or pressure-reduction solenoid rear RH	Abnormal	○	○		
Retention or pressure-reduction solenoid rear LH	Abnormal	○	○		
ABS ECU	ECU internal error	○	○	· Prohibition of EBD control · Prohibition of ABS control	Control will be deactivated, when the IG SW is turned from LOCK to ON after returning to the normal state.

*1:When the voltage rises: "○", When the voltage drops:"×"
*2:When failure occurred on two or more wheels: "○"

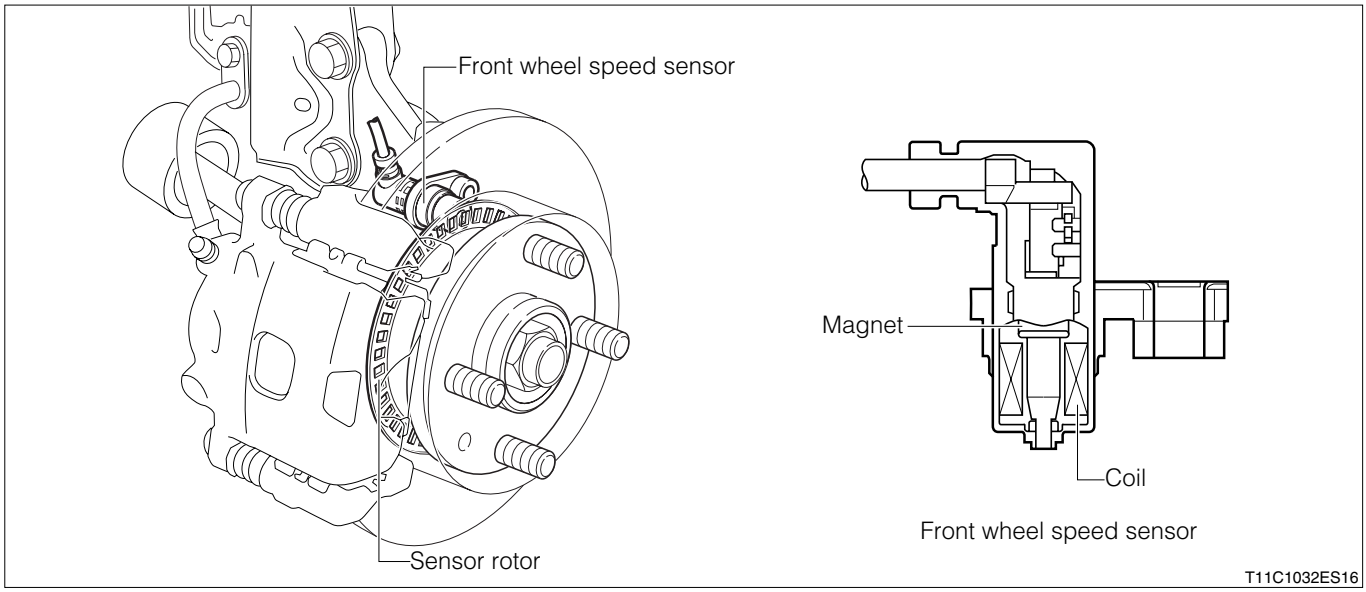
3 COMPONENTS

3-1 WHEEL SPEED SENSOR & SENSOR ROTOR

The wheel speed sensor consists of a magnet and a coil. When the sensor rotor rotates, magnetic flux that flows through the coil of the wheel speed sensor will change, generating alternating voltage in the coil. The frequency of this alternating voltage changes in proportion to the wheel rotation speed. By detecting this frequency, the vehicle speed is determined.

3-1-1 FRONT

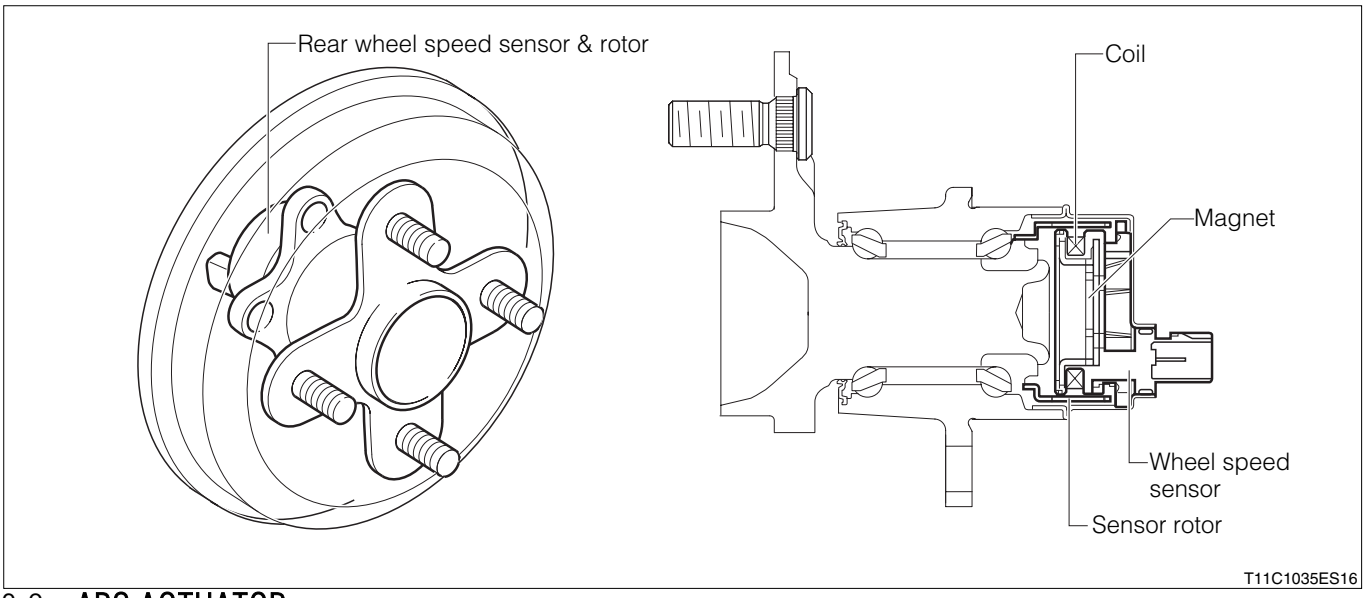
These are installed to the right and left steering knuckles, and the sensor rotor is mounted on the front axle hub.



3-1-2 REAR

(1)

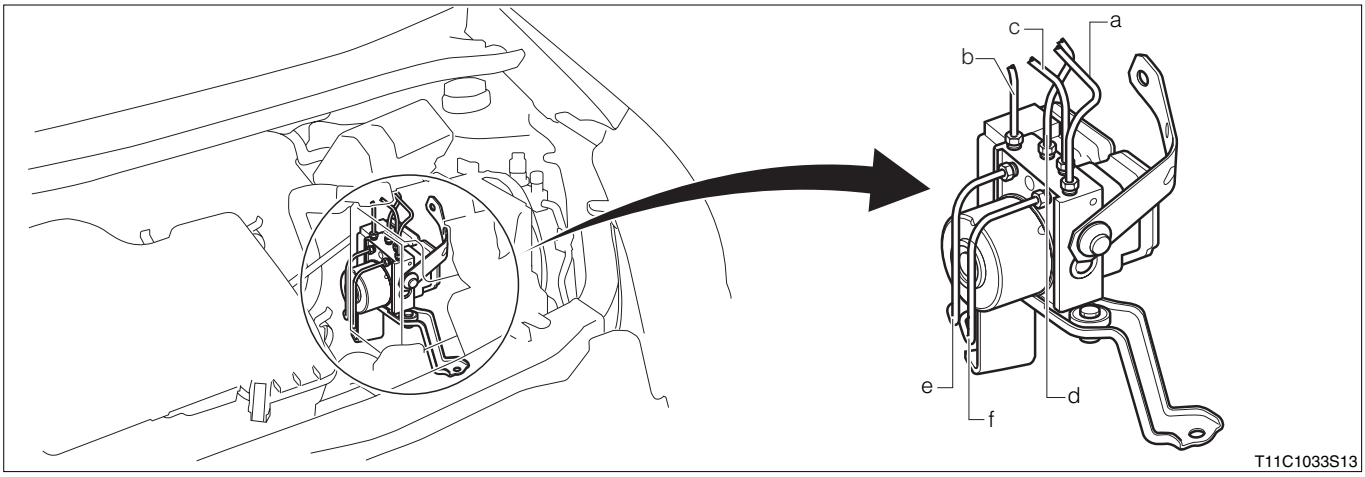
The rear axle and hub integrated type has been employed.



3-2 ABS ACTUATOR

ABS actuator, which consists of the ABS ECU, solenoid valve, pump, a motor, etc., controls fluid pressure that is applied to the wheel brakes during ABS control.

It is installed at the back of the battery in the engine compartment.

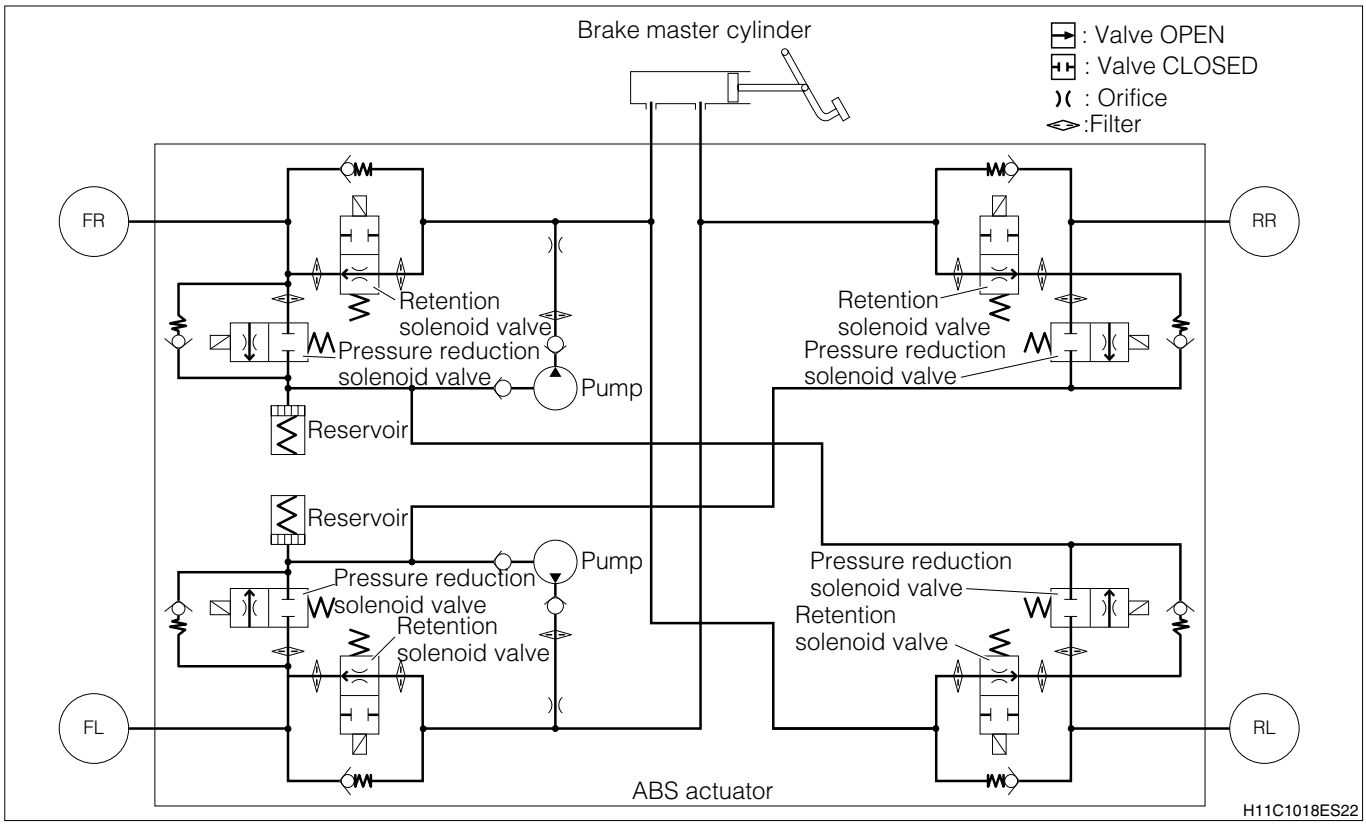


The illustration shows the RHD vehicle.

Brake pipe is connected to:

a	Master cylinder (primary side)
b	Master cylinder (secondary side)
c	Front brake RH
d	Front brake LH
e	Rear brake RH
f	Rear brake LH

3-2-1 ABS ACTUATOR FLUID PRESSURE CIRCUIT



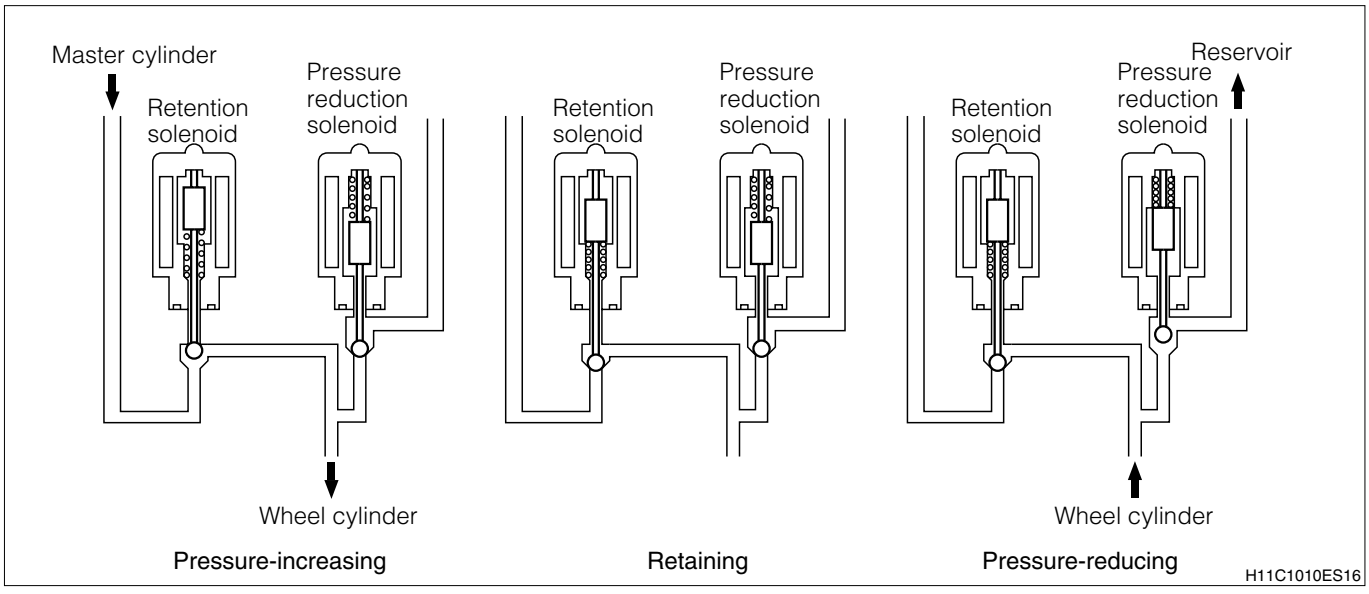
3-2-2 SOLENOID VALVE

Based on the signals from the ABS ECU, the electric current flowing into the coil is changed and the plunger is moved up and down so as to open/close the valve.

(1) The retention solenoid valve is normally open. However, it is closed upon receiving a signal from the ECU.

(2) Conversely, the pressure-reducing solenoid valve is normally closed. However, it opens upon receiving a signal from the ECU.

(3) Through the combination of this movement, the brake fluid pressure circuit can be switched into three modes of the pressure-increasing mode, retention mode, and pressure-reducing mode.



Solenoid valve operation

	Pressure - increasing	Retention	Pressure - reduction
Retention solenoid valve	OFF (Open)	ON (Closed)	ON (Closed)
Pressure reduction solenoid valve	OFF (Closed)	OFF (Closed)	ON (Open)

The words in parenthesis indicate open/close status of the solenoid.

3-2-3 RESERVOIR

1. This temporarily stores the brake fluid from the wheel cylinder, when each solenoid valve is under the pressure reduction mode.
2. When the passage between the wheel cylinder and the reservoir opens in the pressure reduction mode, the brake fluid from the wheel cylinder flows into the reservoir, by overcoming the spring force of the reservoir and pushing down the piston.

3-2-4 PUMP

It is driven by the motor, and it sends the brake fluid, which is stored in the reservoir in the pressure reduction mode, back to the master cylinder.

3-2-5 ABS ECU

This estimates the control status of the wheel by the signal from each wheel sensor, and controls the solenoid valve and the pump motor to prevent the wheel from getting locked. Also, it constantly monitors the system. When a fault is detected, it lights up the warning lamp and executes the fail safe function.

3-3 WARNING LAMP

1. An ABS warning lamp and brake warning lamp are mounted inside the combination meter. When the system is normal, the lamp lights up for about 3 seconds after the IG SW is turned on to check the lamp, and then turned off.
2. When a malfunctions occurs in the system, the ABS warning lamp and the brake warning lamp will remain illuminated.

3-3-1 BRAKE WARNING LAMP

1. When an error condition occurs and the EBD is inoperative, this lamp as well as the ABS warning lamp light up.
2. The lamp lights up when the parking brake SW or the brake fluid level SW is ON.

3-3-2 ABS WARNING LAMP

When malfunction occurs in the ABS, the lamp will remain illuminated. Also a diagnosis code is output.

3-4 STOP LAMP SWITCH

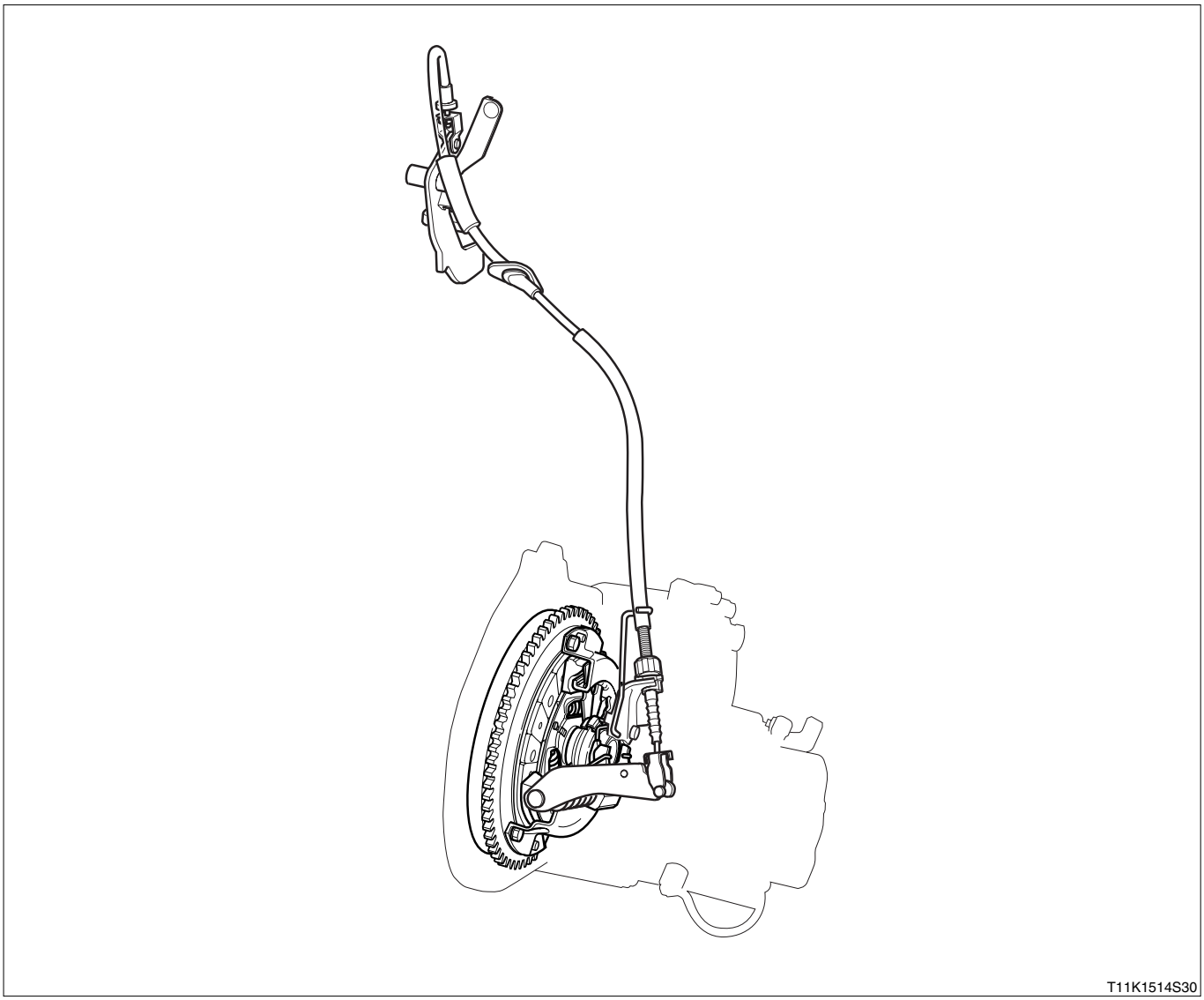
1. This is mounted at the base of the brake pedal.
2. This detects the brake pedal status. It turns ON when the brake pedal is depressed, and turns OFF when the brake pedal is released.

F1 CLUTCH

1 OUTLINE

1-1 DESCRIPTION

1. The clutch mechanism is of a dry, single-plate, diaphragm spring type. The control mechanism has employed a mechanical type that is actuated by a cable.
2. The release mechanism has employed a rotational type.



T11K1514S30

1-2 SPECIFICATION

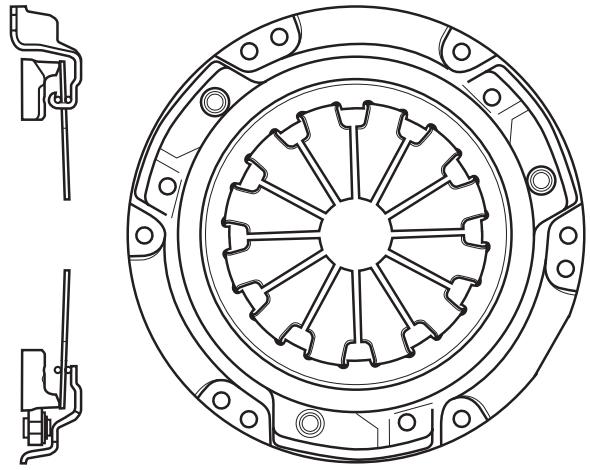
Specification table of clutch

Engine type		1KR−FE
Clutch type		Dry·Single - plate, Diaphragm spring
Clutch operation method		Mechanical type
Manufacturer		EXEDY
Clutch cover	Pressure plate size (mm)	186 Dia.×122 Dia.
	Identification (color)	Not provided
Clutch disc	Outer dia.×Inner dia. (mm)	180 Dia.×125 Dia.
	Material	Semi-mold
	Identification (color)	Not provided

2 CONSTRUCTION AND OPERATION

2-1 CLUTCH COVER

The clutch cover comes in two kinds according to the engine type.

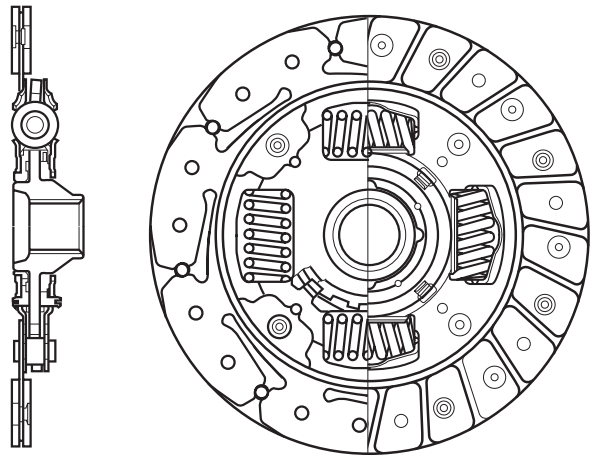


IKR−FE

T11K1503ES20

2-2 CLUTCH DISC

As is the case with the clutch cover, the clutch disc also comes in two kinds according to the engine type.



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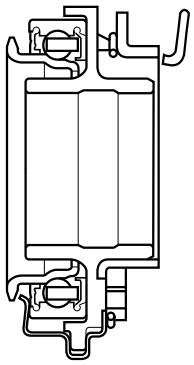
2-3 CLUTCH RELEASE BEARING

The clutch release bearing has employed a grease-sealed, automatic self-aligning radial ball bearing.



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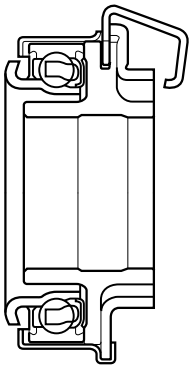

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T11K1505S20

F2 MANUAL TRANSMISSION/MANUAL TRANSAXLE

1 OUTLINE

1-1 DESCRIPTION

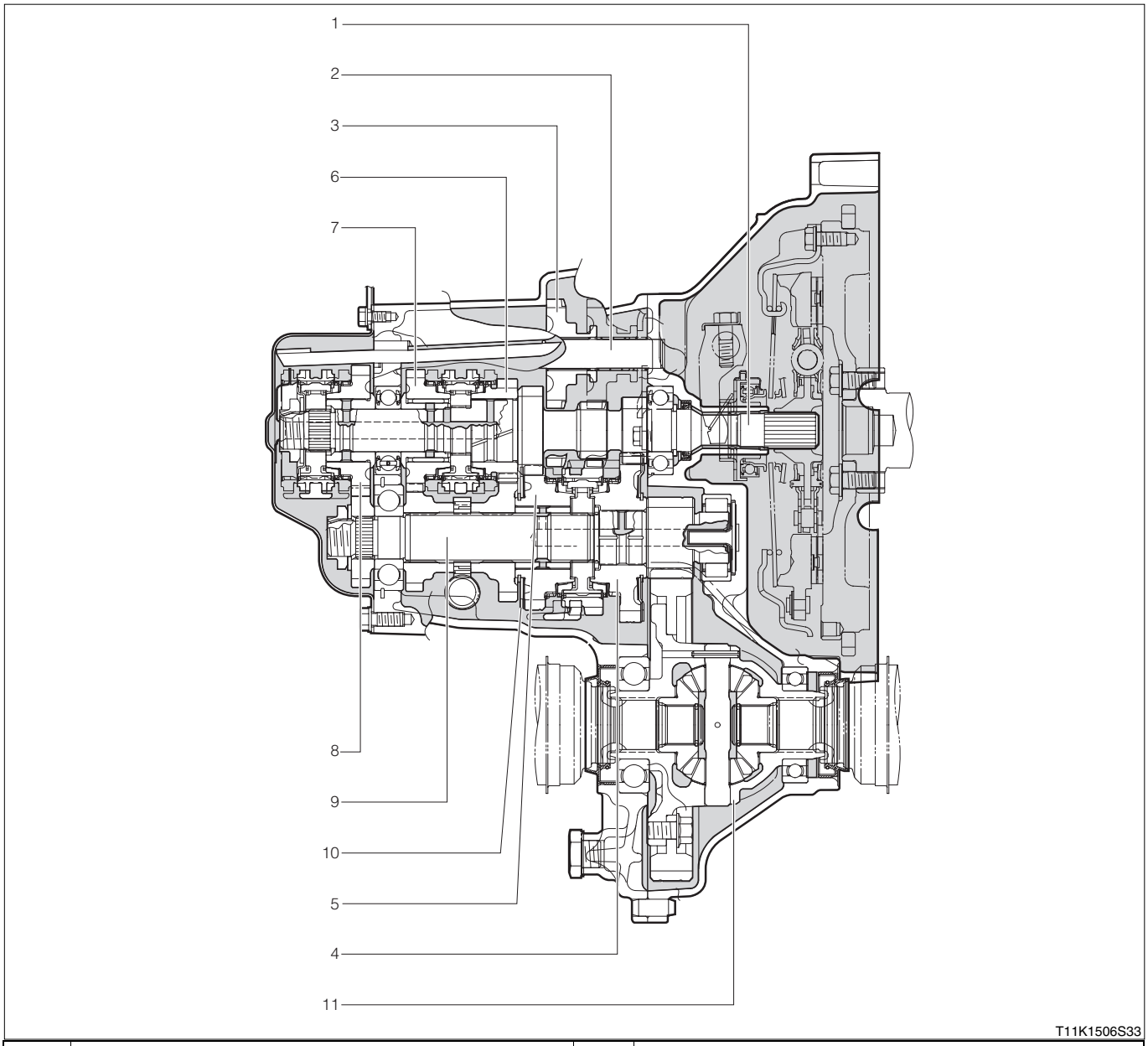
Vehicles with Type 1KR−FE engine are equipped with Type M5H−B3 manual transaxle, whereas vehicles with Type K3−VE engine are provided with Type M5H−C1 manual transaxle.

1-2 SPECIFICATION

Specifications table of manual transaxle

Driving method		2WD
Engine type		1KR−FE
Transaxle type		M5H−B3
Transaxle identification code (label)		951
Gear ratio	1st	3.182
	2nd	1.842
	3rd	1.25
	4th	0.917
	5th	0.75
	Reverse	3.143
Final reduction gear ratio		4.500
Lubrication fluid	Nomenclature	Transmission gear oil SAE75W−85 or 75W−90 (API classification GL−3 or GL−4)
	Capacity	2.25ℓ

1-3 SECTIONAL VIEW



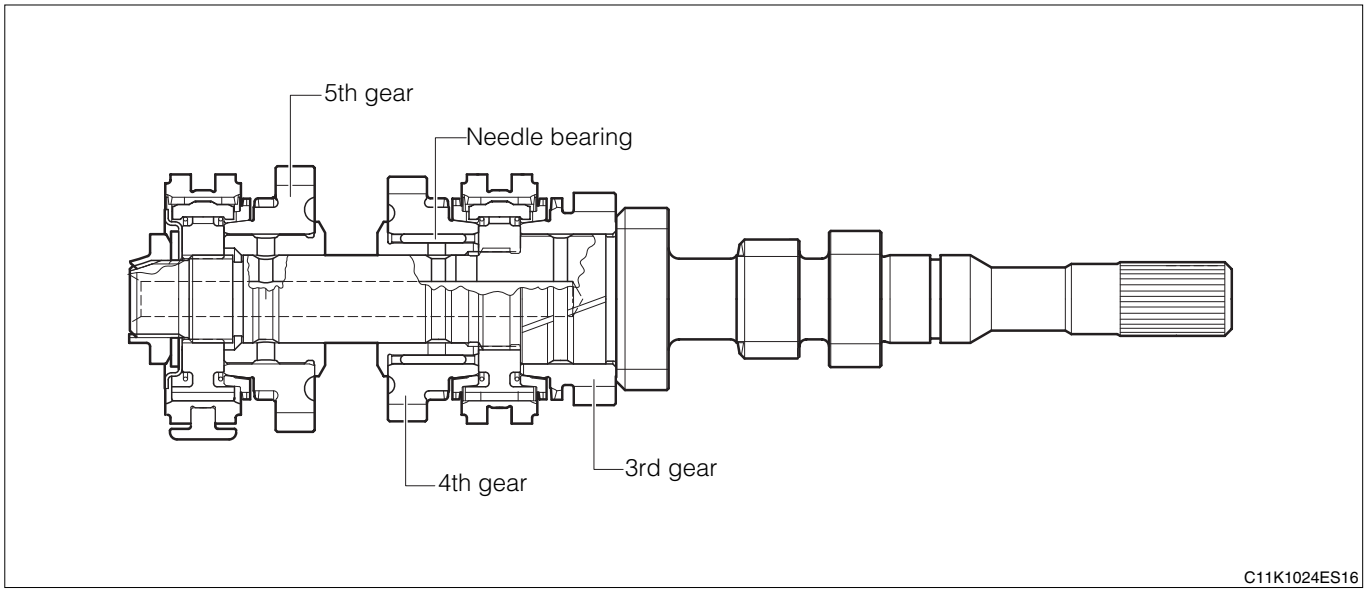
1	Input shaft	7	4th gear
2	Reverse idler gear shaft	8	5th gear
3	Reverse idler gear	9	Output shaft
4	1st gear	10	Sub-gear
5	2nd gear	11	Differential
6	3rd gear		

2 CONSTRUCTION AND OPERATION

2-1 POWER TRAIN MECHANISM

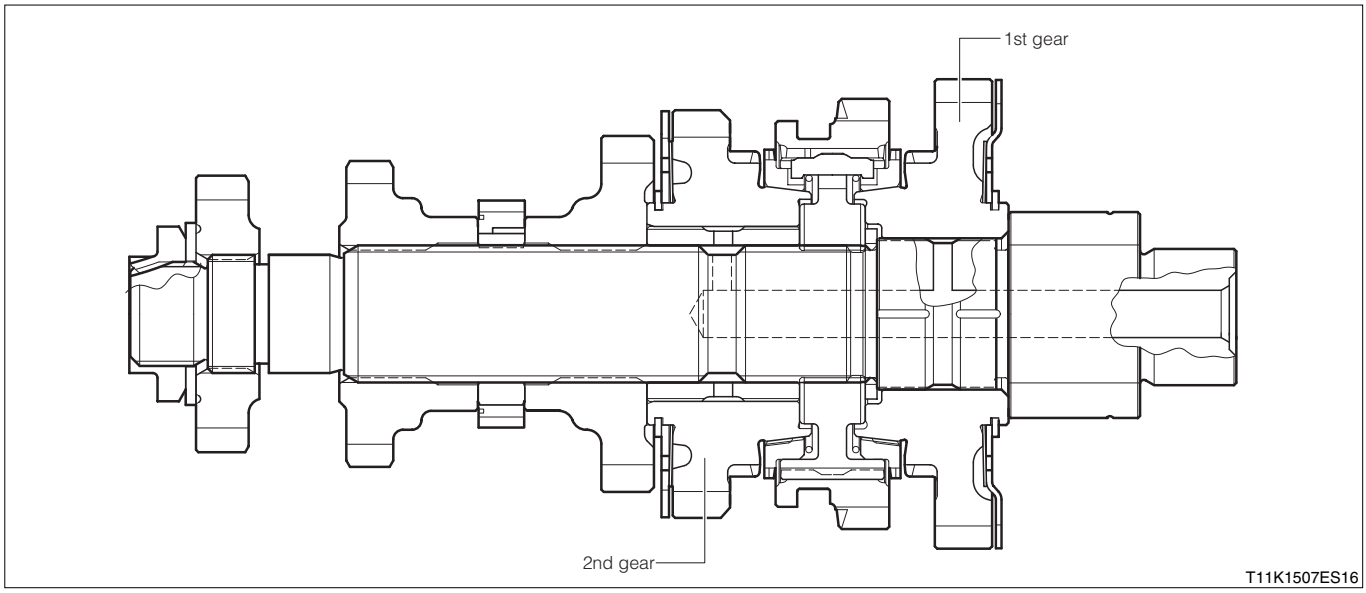
2-1-1 INPUT SHAFT

1. The input shaft transmits the power inputted from the clutch disc to the output shaft. The input shaft is incorporated in a case by means of the radial ball bearing.
2. The 3rd gear, 4th gear and 5th gear are incorporated on the input shaft. The bearing for the 4th gear employs needle bearings.



2-1-2 OUTPUT SHAFT

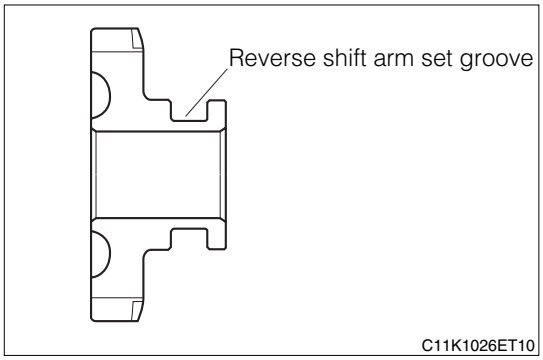
1. The output shaft transmits the power inputted from the input shaft to the differential. The output shaft is also incorporated in a case as the input shaft is so incorporated.
2. The 1st gear and 2nd gears are incorporated on the output shaft.
3. Sub-gears are provided on the 1st gear and 2nd gear so as to reduce rattle sound during the idling.



2-1-3 REVERSE IDLER GEAR

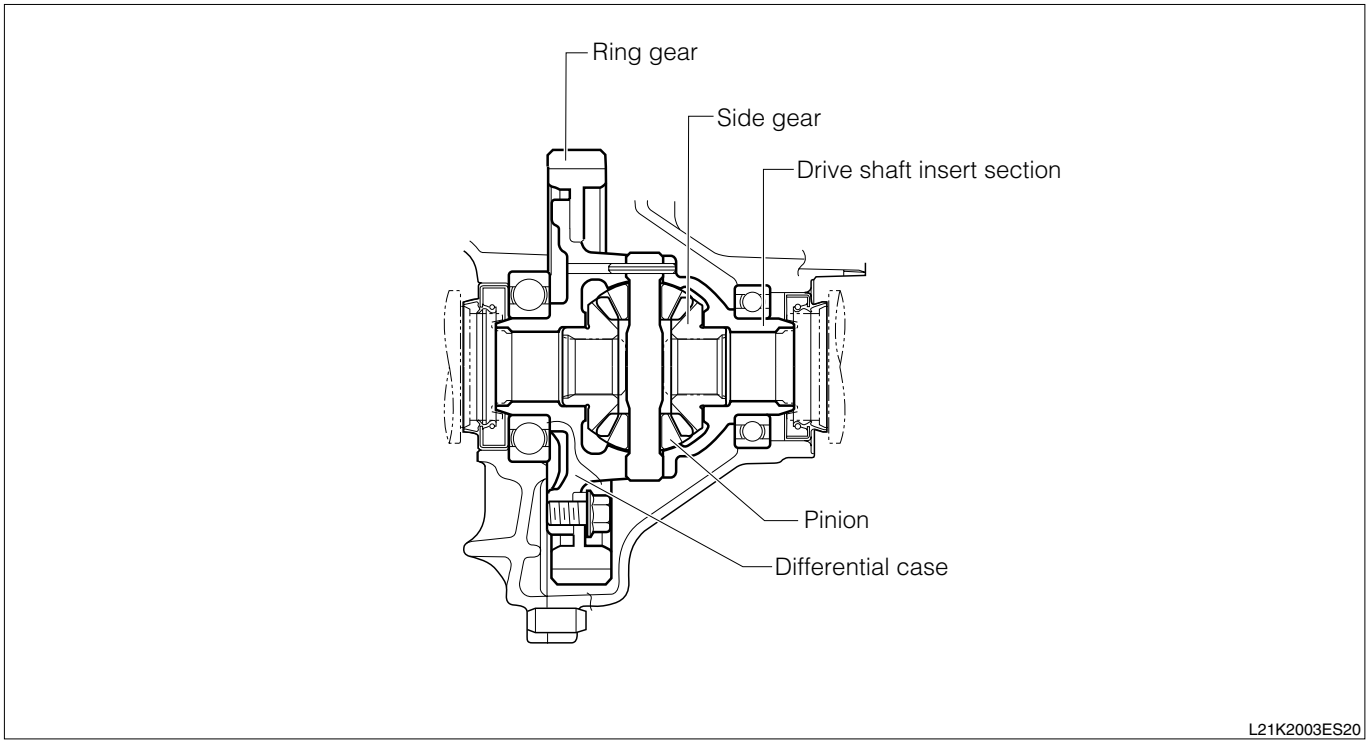
1. The reverse idler gear is installed to the reverse idler gear shaft through a bush.

2. The reverse idler gear has a groove for setting the reverse shift arm. By means of the arm operation, engagement with the reverse gear of the input shaft and output shaft takes place.



2-1-4 DIFFERENTIAL

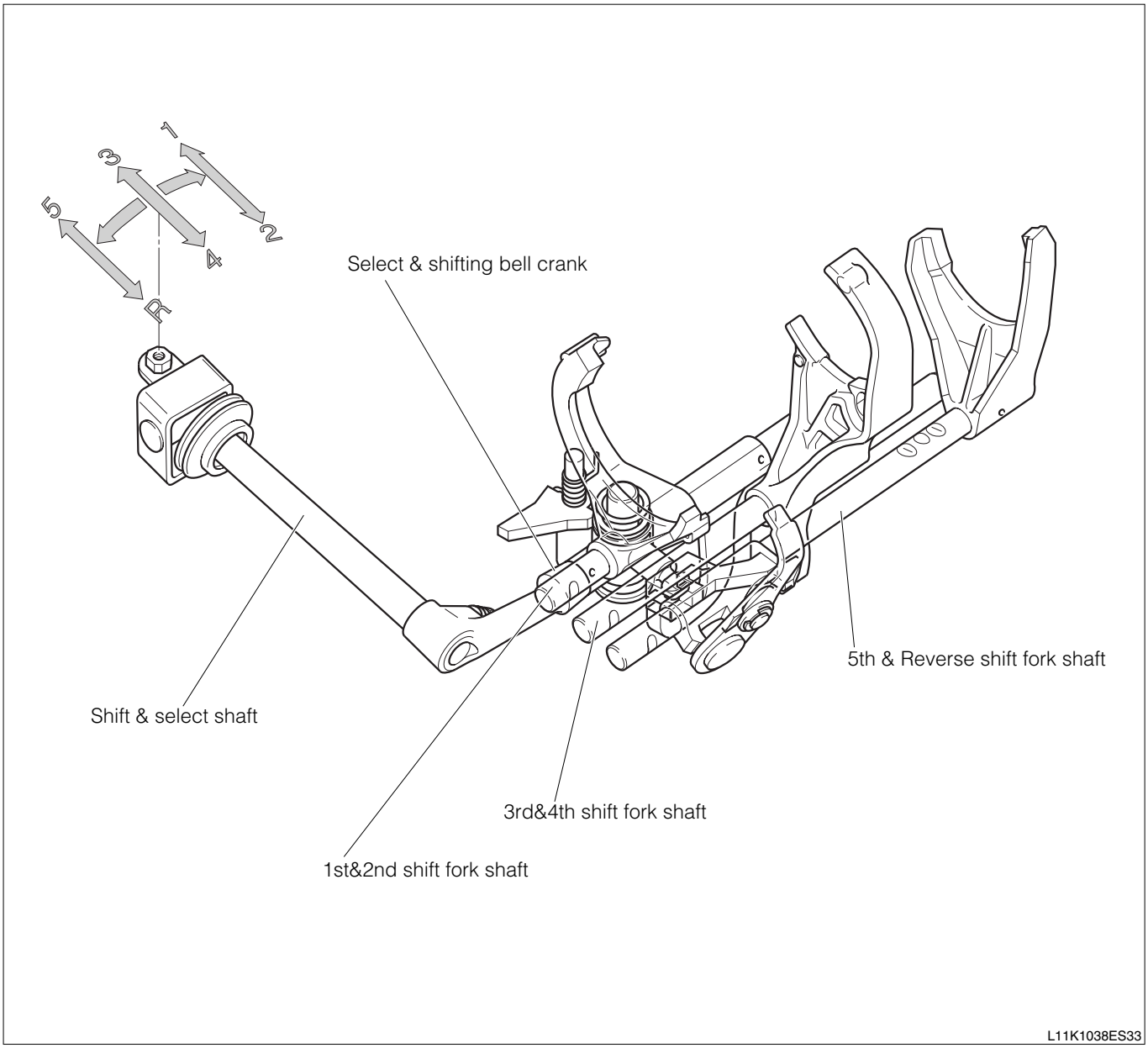
1. The differential case transmits power from the output shaft to the drive shaft. The differential case is composed of two side gears, two pinions, a differential case, etc.



2-2 SHIFT AND SELECT MECHANISM

2-2-1 DESCRIPTION

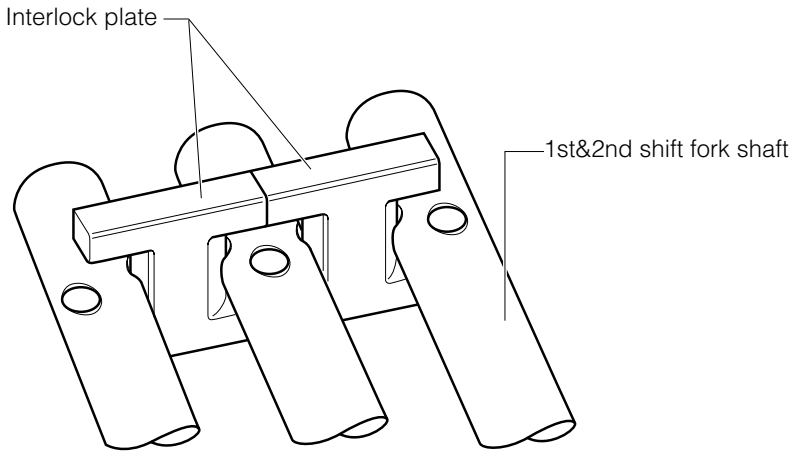
1. The shift & select mechanism adopts the remote control floor shift method that uses three shift fork shafts.
2. The shift & select shaft is connected with the shift & select shaft rod of the control mechanism.
3. When the select operation is performed, the shift & select rod turns in a right-and-left direction. This movement is transmitted through the shift & select shaft into the select & shifting bell crank. As a result, the select & shifting bell crank moves in an up-and-down direction. Meanwhile, when the shift operation is performed, the shift & select rod moves in a fore-and-aft direction. Then, the select & shifting bell crank turns, and the corresponding shift fork shaft slides in a fore-and-aft direction. Hence, the sleeve moves.
4. Furthermore, the shift & select mechanism is provided with a double-engagement preventing mechanism that prevents shifting into two or more gears at the same time. Moreover, the shift & select mechanism is provided with a reverse mis-shift preventing mechanism that prevents gear shifting from being made from the 5th gear directly to the reverse gear during running.



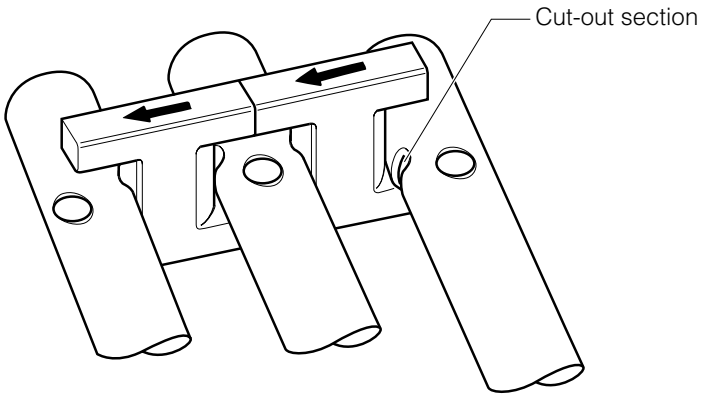
2-2-2 DOUBLE-ENGAGEMENT PREVENTING MECHANISM

(1) Construction and operation

1. The double-engagement preventing mechanism is composed of two interlock plates.
2. When the 1st & 2nd shift fork shaft slides from the neutral condition to the axial direction, the interlock plate that was in the cutout section of the 1st & 2nd shift fork shaft is pushed out. Then, the cutout section of the 3rd & 4th shift fork shaft is pushed. Furthermore, as a result of this operation, another interlock plate pushes the cutout section of the 5th & reverse shift fork shaft at the same time. Consequently, the 3rd & 4th and 5th & reverse shift fork shafts are locked, thus preventing double-engagement.



At time of neutral position



At time of shifting to 2nd gear

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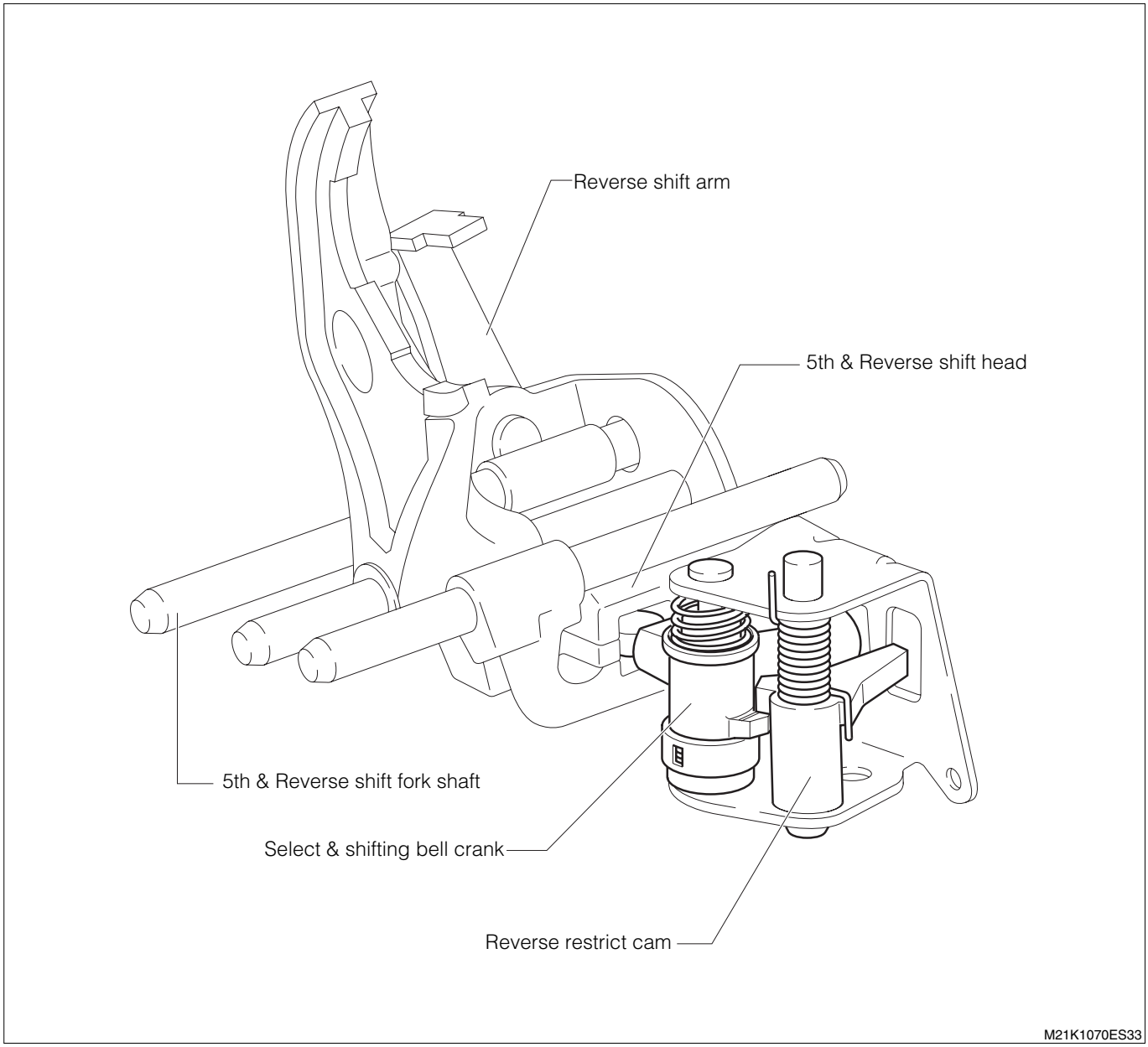
2-2-3 REVERSE MISS-SHIFT PREVENTING MECHANISM

(1) Construction

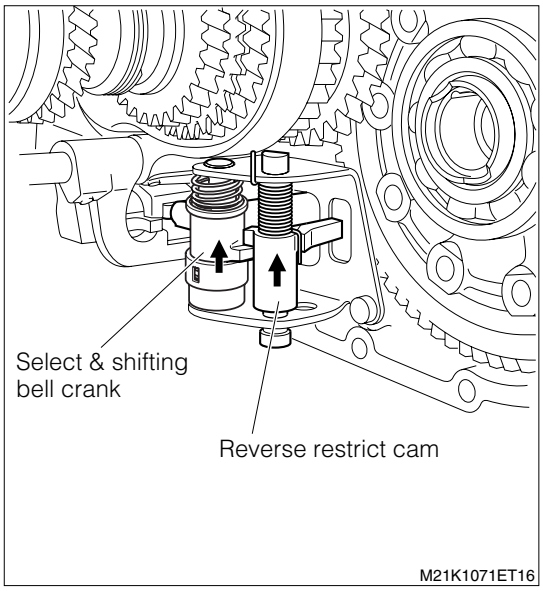
The reverse mis-shift preventing mechanism is composed of a select & shifting bell crank, a reverse restrict cam, a 5th & reverse shift fork shaft, and a 5th & reverse shift head.



(2) Operation

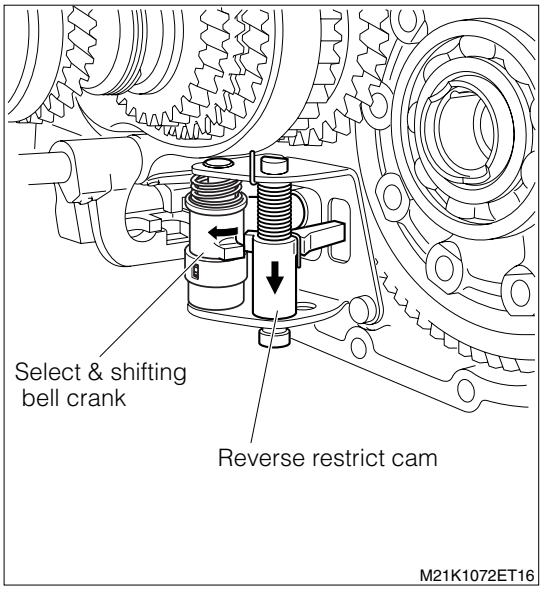
① When selecting 5th gear

When selection is made in the 5th or reverse direction, the select & shifting bell crank pushes the reverse restrict cam upward.



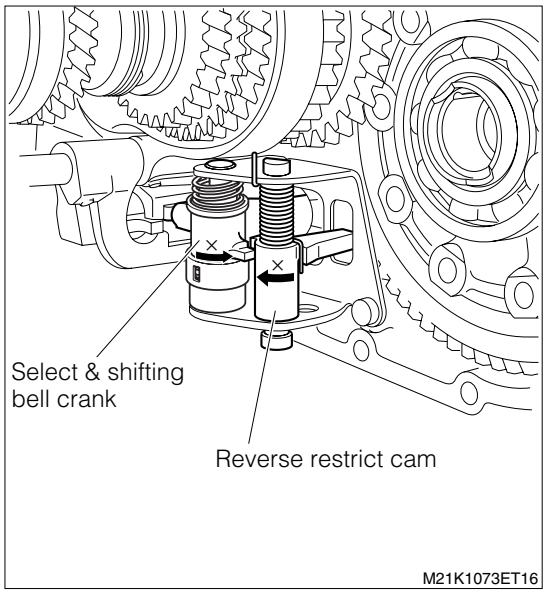
② When shifting to 5th gear

When shifting is made to 5th gear, the select & shifting bell crank is disengaged from the reverse restrict cam. As a result, the reverse restrict cam is returned by the spring.



③ At time of shifting from 5th gear to reverse gear

When an attempt is made to perform shifting from the 5th gear directly to the reverse gear, the select & shifting bell crank contacts with the reverse restrict cam. The reverse restrict cam can turn only until its lever section comes in contact with the hole end of the select & shifting bell crank support. Therefore, the bell crank also is unable to turn any further. Consequently, mis-shifting from the 5th gear directly to the reverse gear can be prevented.

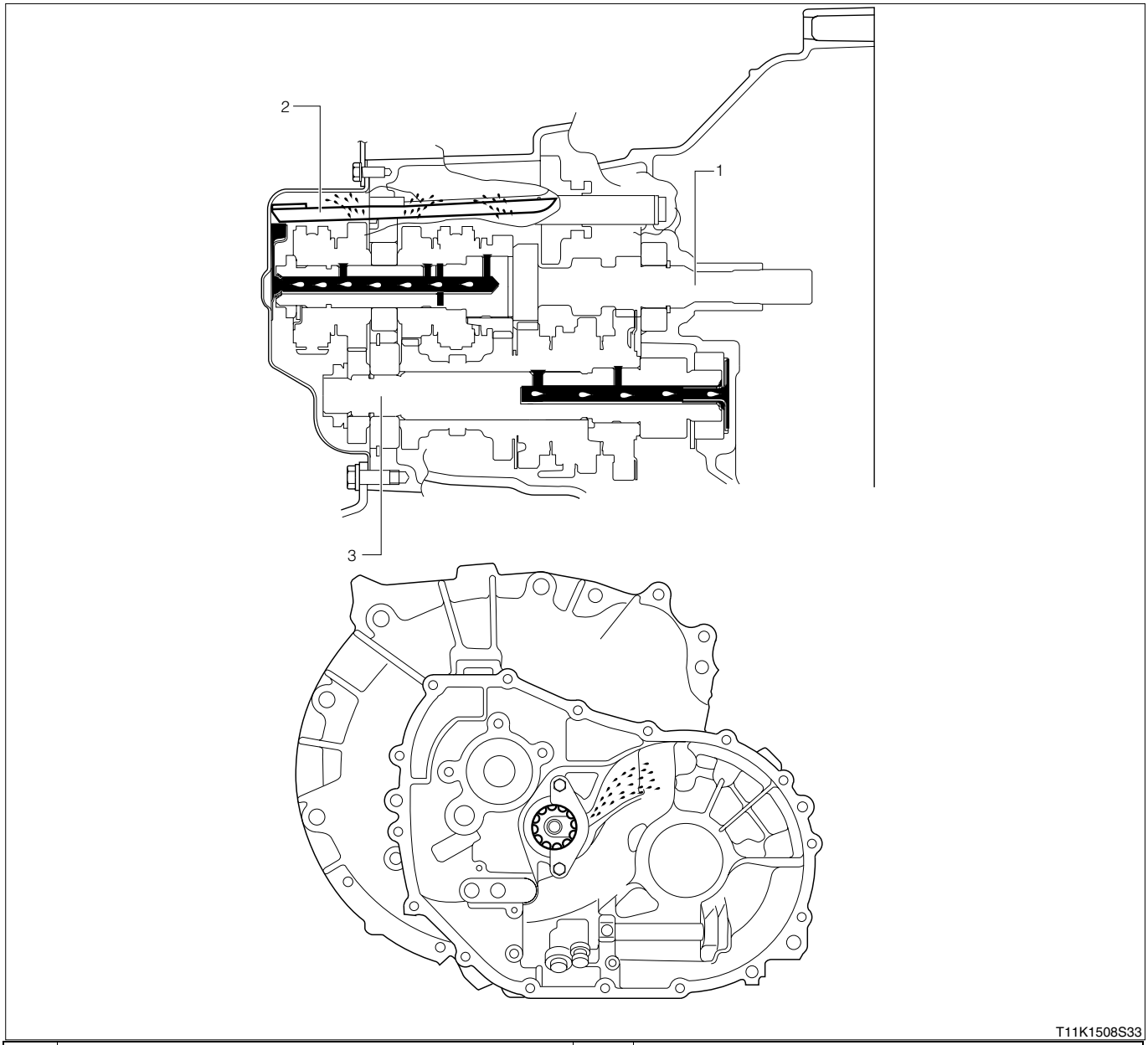


2-3 LUBRICATION MECHANISM

2-3-1 DESCRIPTION

The oil lubrication uses the shaft center lubricating method that features excellent lubricating efficiency. The oil brought up by the ring gear goes through the center of the output shaft, and lubricates the 1st gear, 2nd gear and synchronizer ring.

Furthermore, the oil brought up by the gear on the output shaft goes through the oil guide pipe and the center of the input shaft. Then, the oil lubricates the 3rd gear, 4th gear, 5th gear and synchronizer ring.

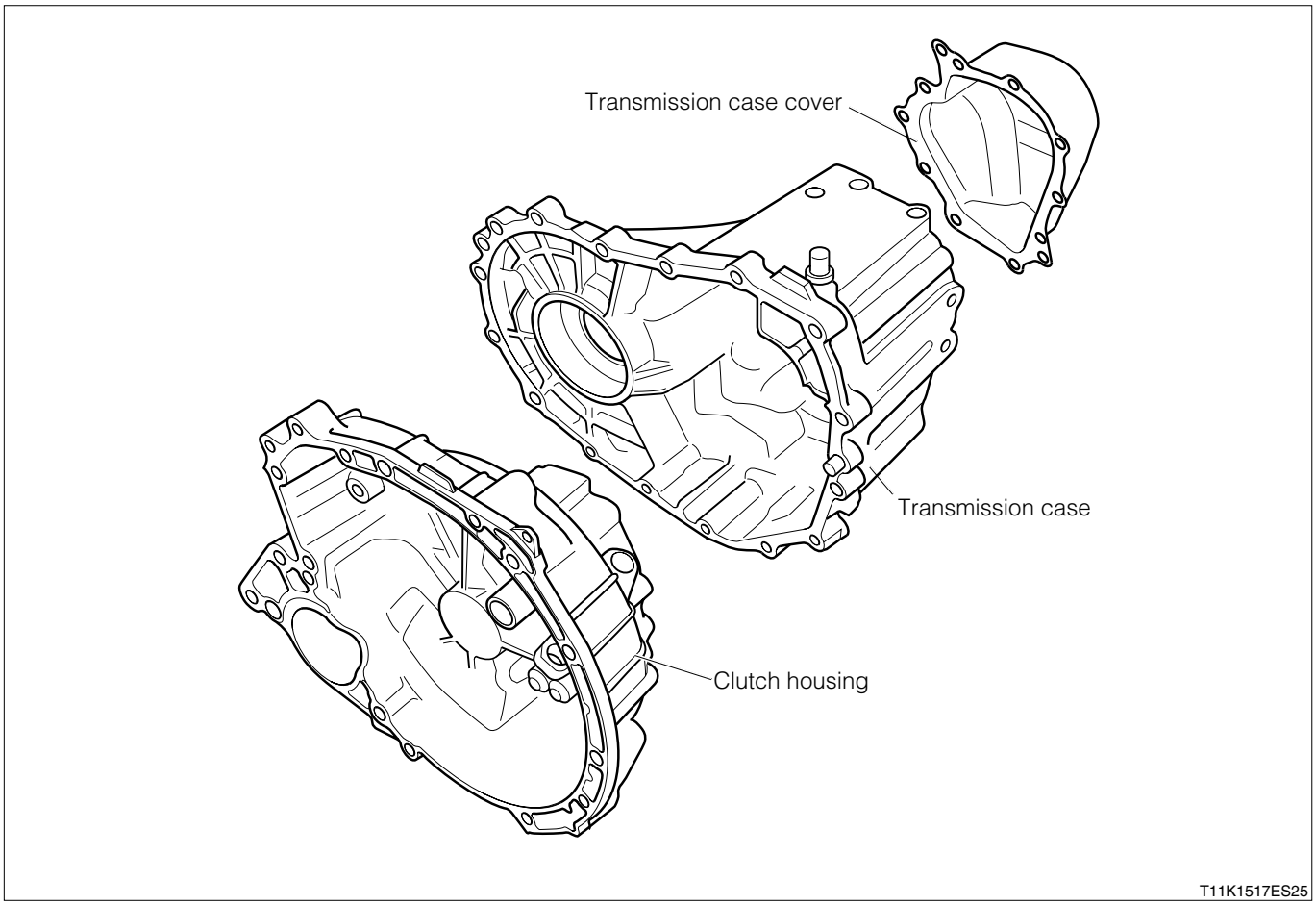


T11K1508S33

1	Input shaft	3	Output shaft
2	Oil guide pipe		

2-4 CASE AND COVER

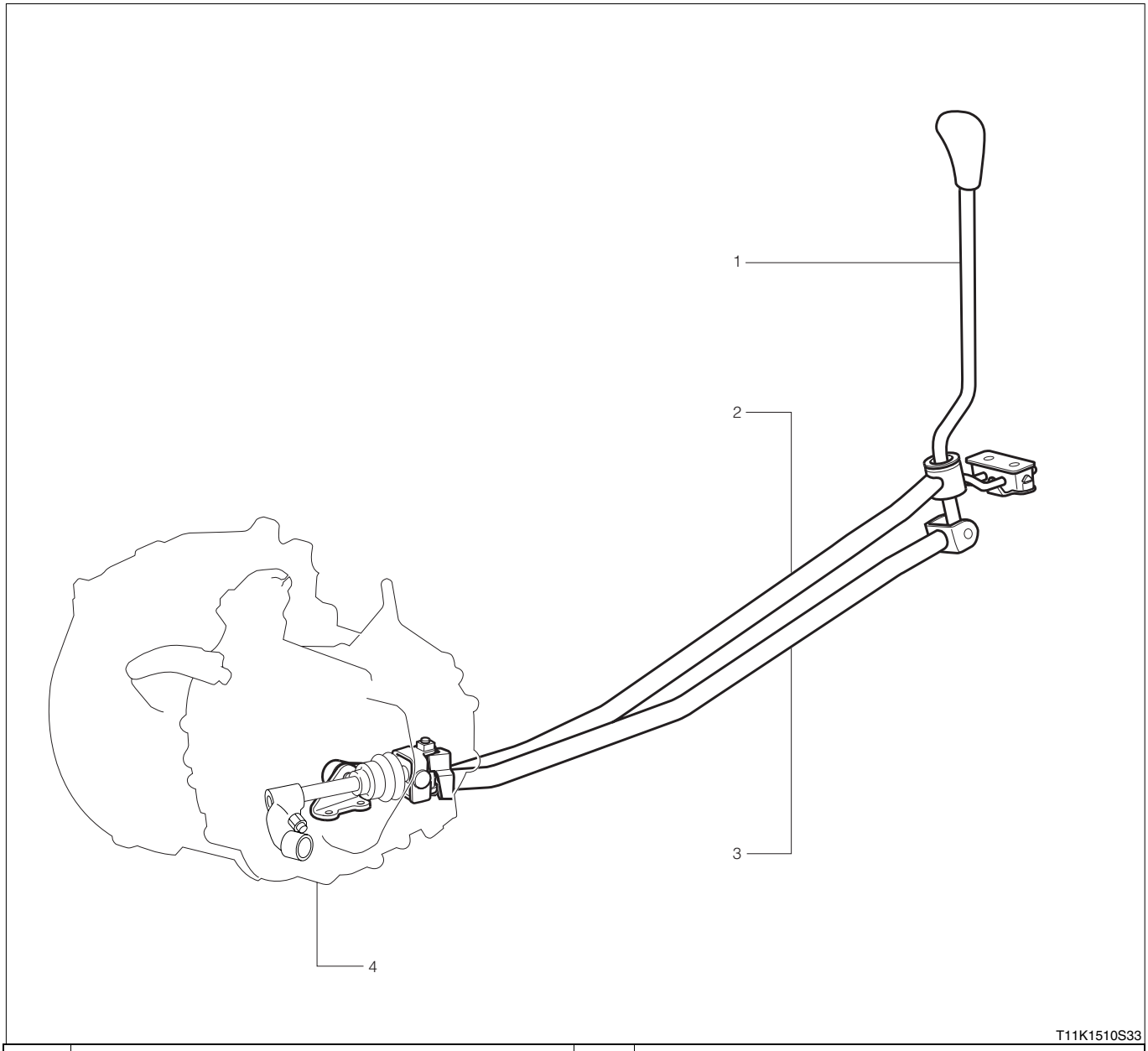
1. The transaxle transmission case can be separated crosswise, and is composed of three portions: a clutch housing, a transmission case, and a transmission case cover.
2. To achieve a lightweight and compact design, the clutch housing and transmission case are made of aluminum alloy, whereas the transmission case cover is made of sheet metal.



2-5 CONTROL MECHANISM

2-5-1 DESCRIPTION

The control mechanism has employed a two-division type by means of the shift & select rod and the extension rod.



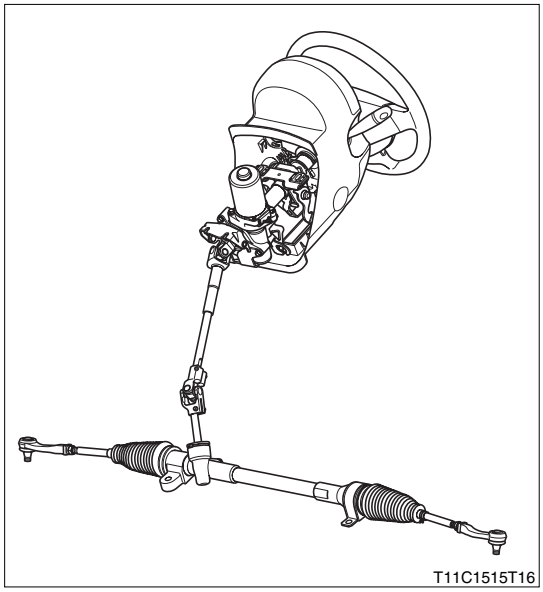
1	Shift lever	3	Shift & select rod
2	Extension rod	4	Transaxle

G1 STEERING

1 OUTLINE

1-1 DESCRIPTION

1. All vehicles employ an electric power steering (EPS).
2. A steering wheel with a built-in SRS airbag has been adopted as standard equipment on all models. For enhanced safety of occupants in the event of vehicle collision, etc., an impact absorption construction is employed on the steering column shaft and intermediate shaft.
3. All vehicles employ a tilt steering. Using this system, the driver can set the steering wheel to their desired position.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1-2 SPECIFICATIONS

1-2-1 STEERING SPECIFICATION

RHD vehicles

Vehicle model	M300RF
Power steering	Electric
Provided or not provided with tilt steering	Provided
Number of lock-to-lock turns	3.8*1 3.5*2
Front wheel turning angle (inside)	45°42′*1 40°00′*2
Front wheel turning angle (outside)	37°00′*1 33°48′*2
Minimum turning radius [m]	4.3*1 4.7*2

*1: Vehicles equipped with 13-inch tire *2: Vehicles equipped with 14-inch tire

LHD vehicles

Vehicle model	M300LF
Power steering	Electric
Provided or not provided with tilt steering	Provided
Number of lock-to-lock turns	3.8*1 3.5*2
Front wheel turning angle (inside)	45°42′*1 40°00′*2
Front wheel turning angle (outside)	37°00′*1 33°48′*2
Minimum turning radius [m]	4.3*1 4.7*2

*1: Vehicles equipped with 13-inch tire *2: Vehicles equipped with 14-inch tire

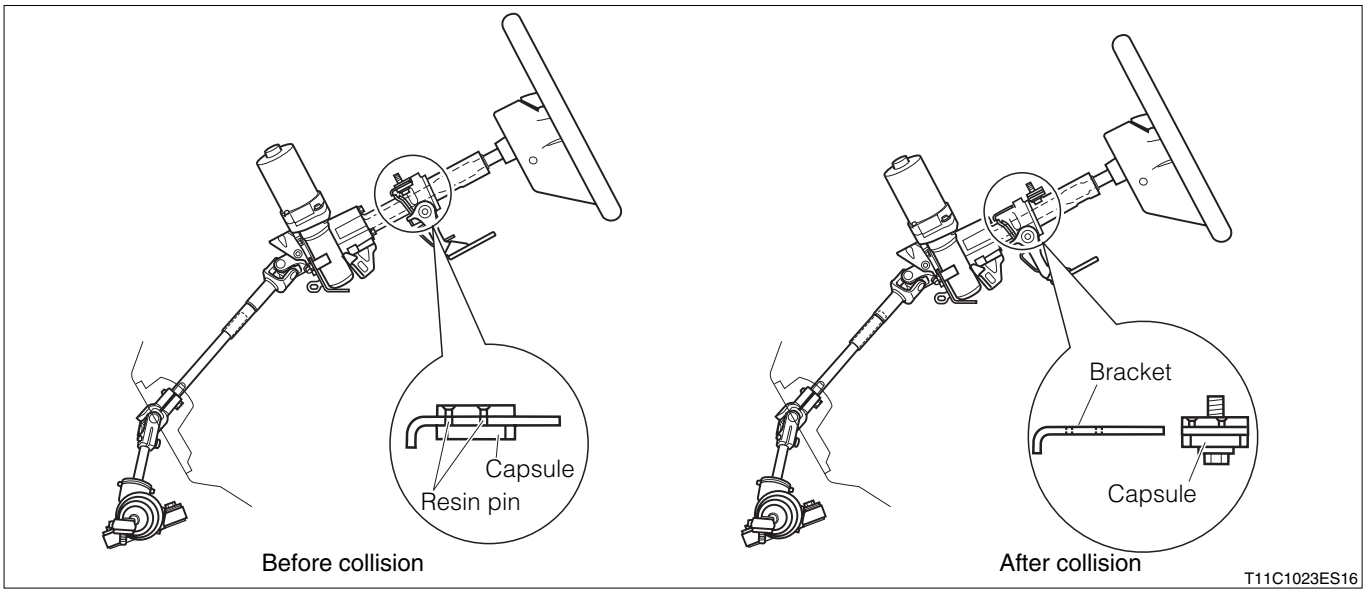
1-3 STEERING COLUMN

1-3-1 DESCRIPTION

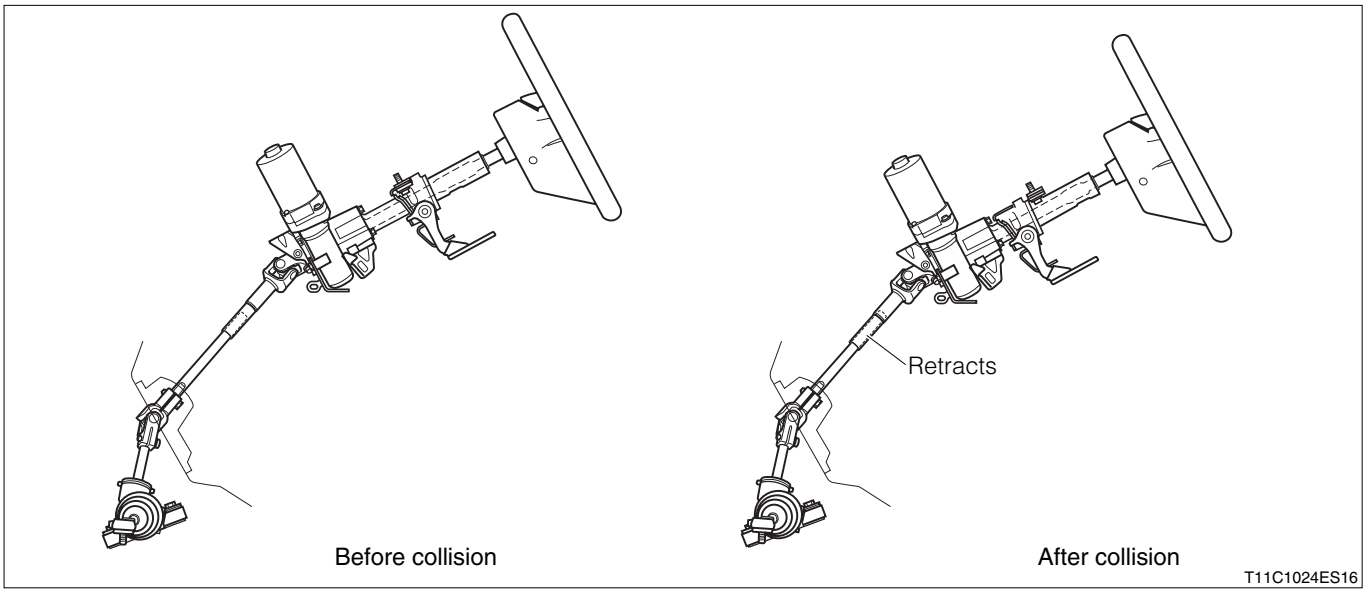
All vehicles employ a tilt mechanism and a impact absorption construction.

1-3-2 IMPACT ABSORPTION CONSTRUCTION

1. The upper and lower sections of the steering main shaft are joined by a serration section. As regards the steering column, the inner tube has been press-fitted to the outer side.
2. When the impact is transmitted to the steering column, the steering column tube at the inner side flares open the outer side, while shrinking. Thus, the steering main shaft shrinks while it receives the sliding resistance at the serration fitting section. In this way the impact is absorbed.
3. In addition to the above, the impact absorption construction employs a breakaway method for the collision (secondary collision) of the occupant against the steering wheel.
4. A flange is provided on the upper section of the steering column tube for attaching the steering column to the vehicle. A plastic capsule is attached to the flange by a plastic pin. When an impact is applied to the steering column, the plastic pin breaks and the plastic capsule is detached from the flange.Thus, the impact is absorbed as the steering column cover and the steering main shaft slide and shrink.

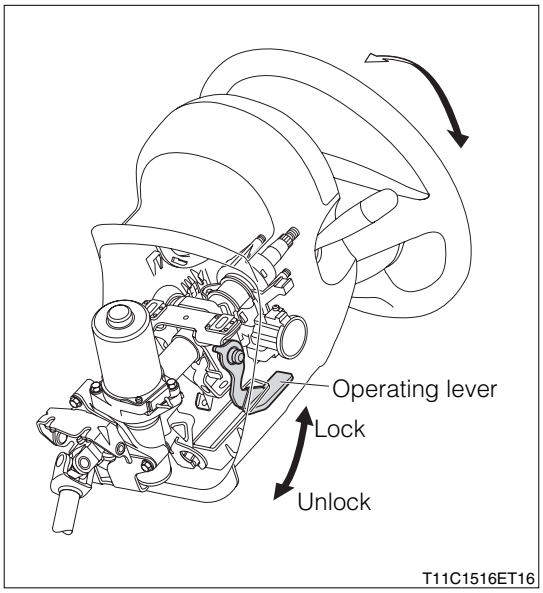


5. The upper and lower sections of the intermediate shaft are joined by a serration section.
6. In the event of impact, the shrinking takes place with the sliding resistance at the serration fitting section. This mechanism thus restrains the displacement of the steering column.



1-3-3 TILT MECHANISM

This is a mechanism which allows the steering wheel position to be adjusted up and down. The locking and unlocking operation is performed by means of the lever on the left-hand side of the steering column.



1-4 STEERING GEAR

1-4-1 DESCRIPTION

All vehicles employ a rack and pinion steering gear.

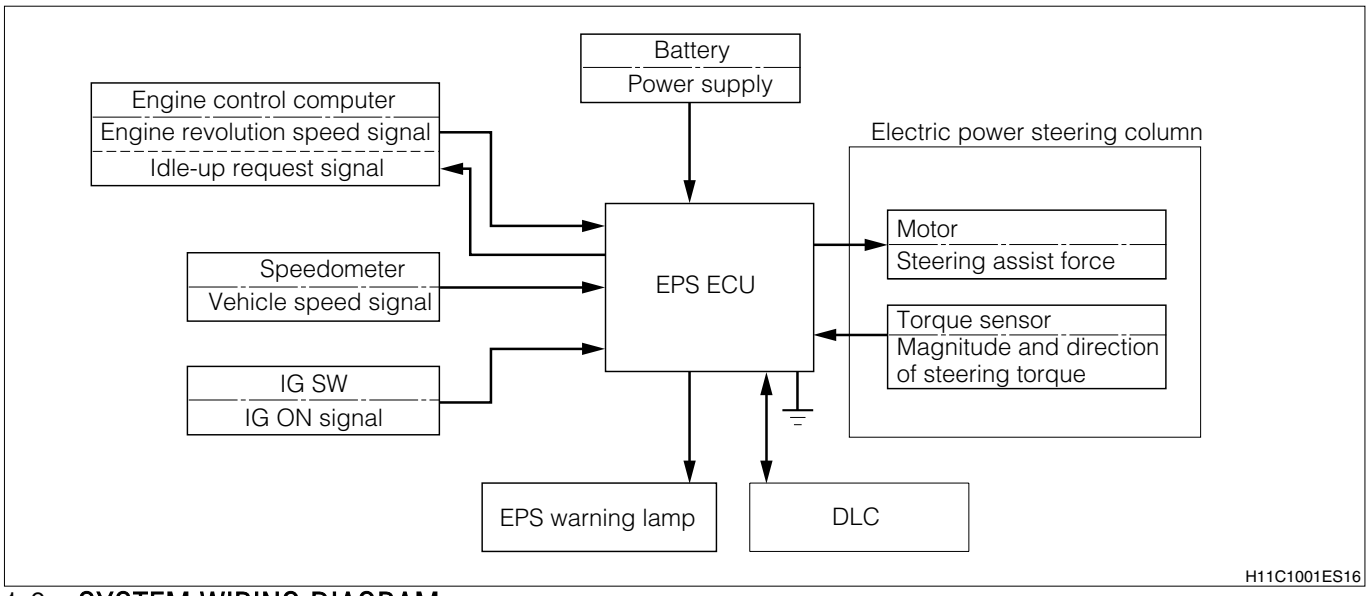
G2 POWER STEERING

■ ELECTRIC POWER STEERING

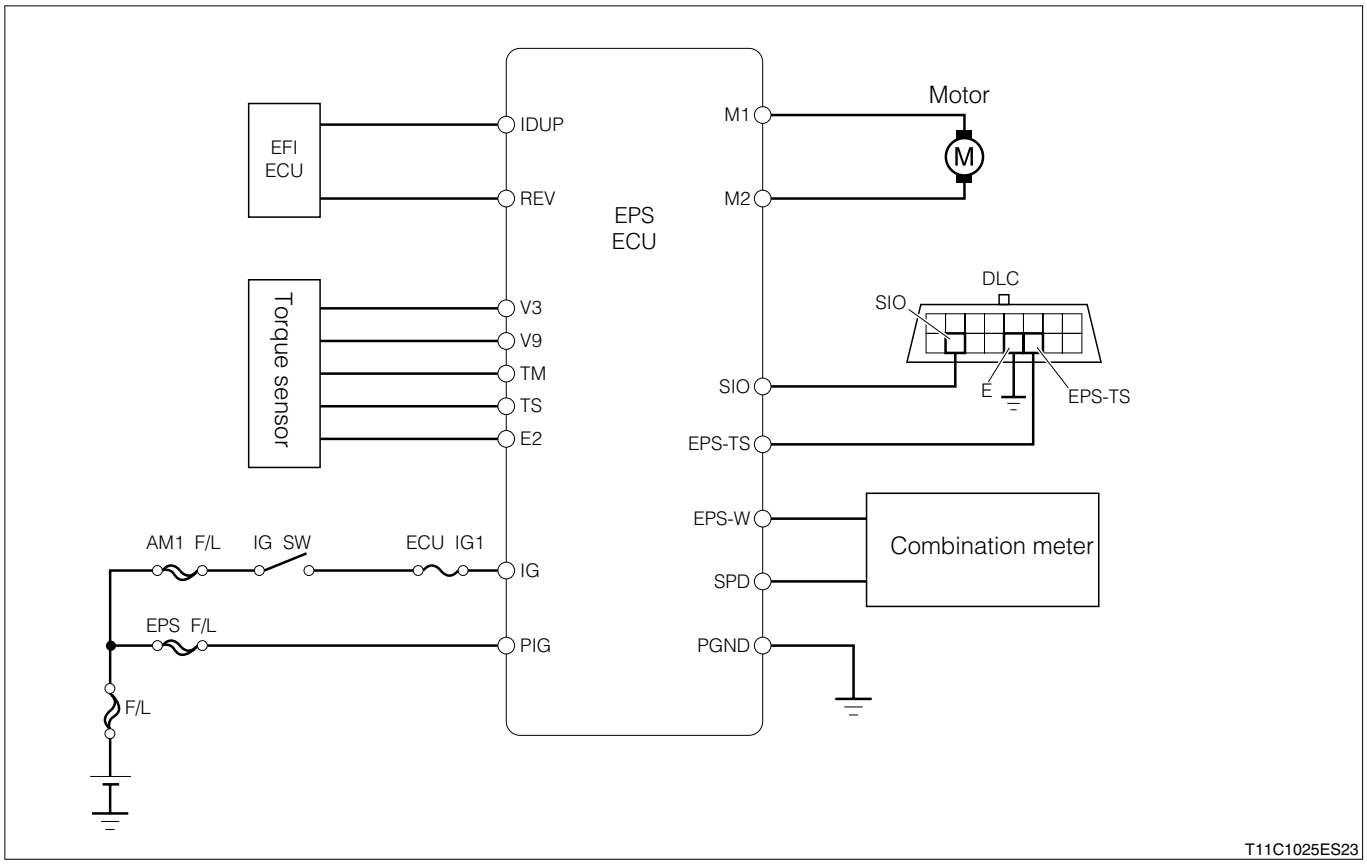
1 OUTLINE

1. A vehicle speed-responding type electric power steering (EPS), featuring a good response and straight-line vehicle stability, has been employed in all vehicles. This power steering can provide a lighter steering effort while the steering wheel is turned when the vehicle is stationary or is running at low speeds, and an appropriately heavy steering effort when the vehicle is running at medium or high speeds.

1-1 SYSTEM DRAWING

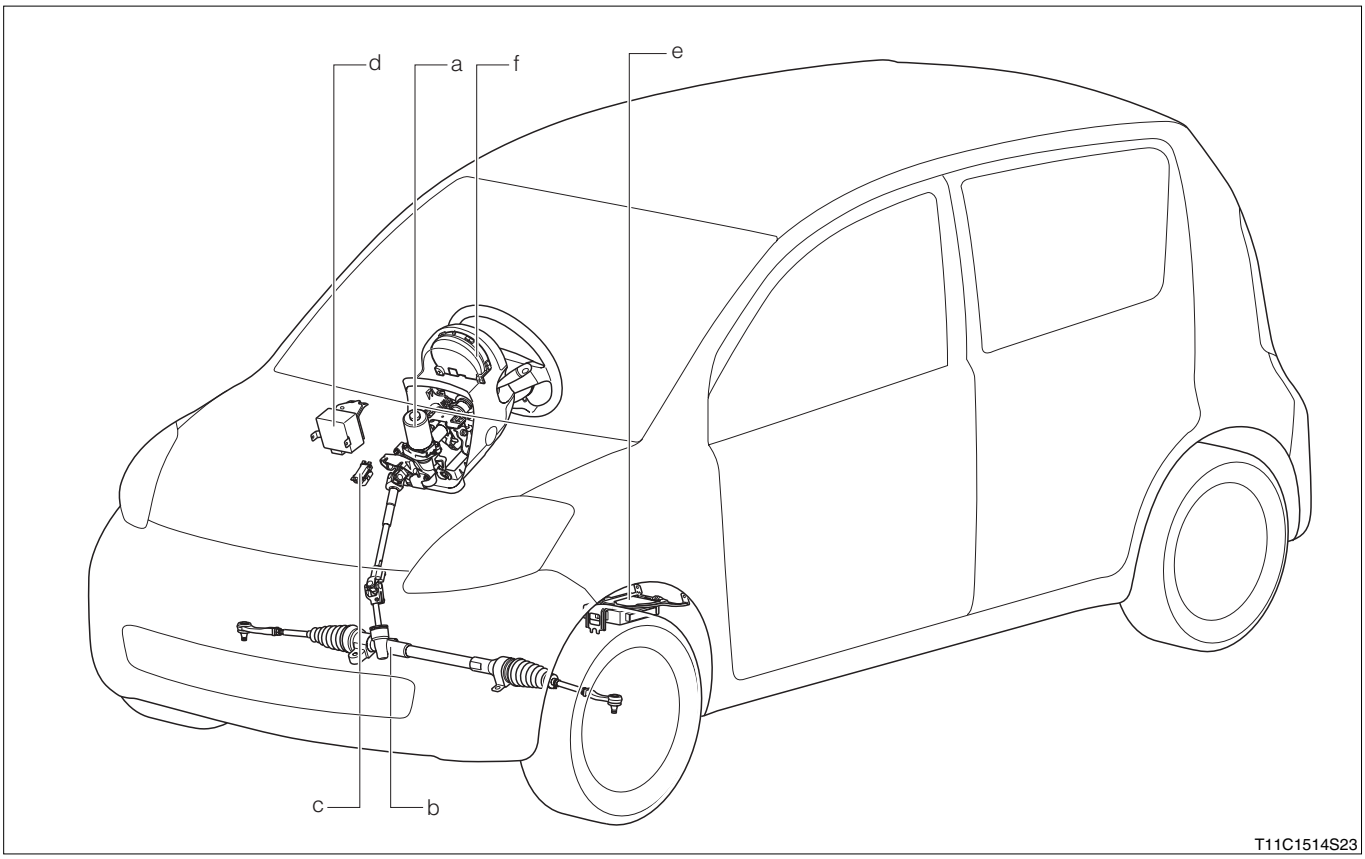


1-2 SYSTEM WIRING DIAGRAM

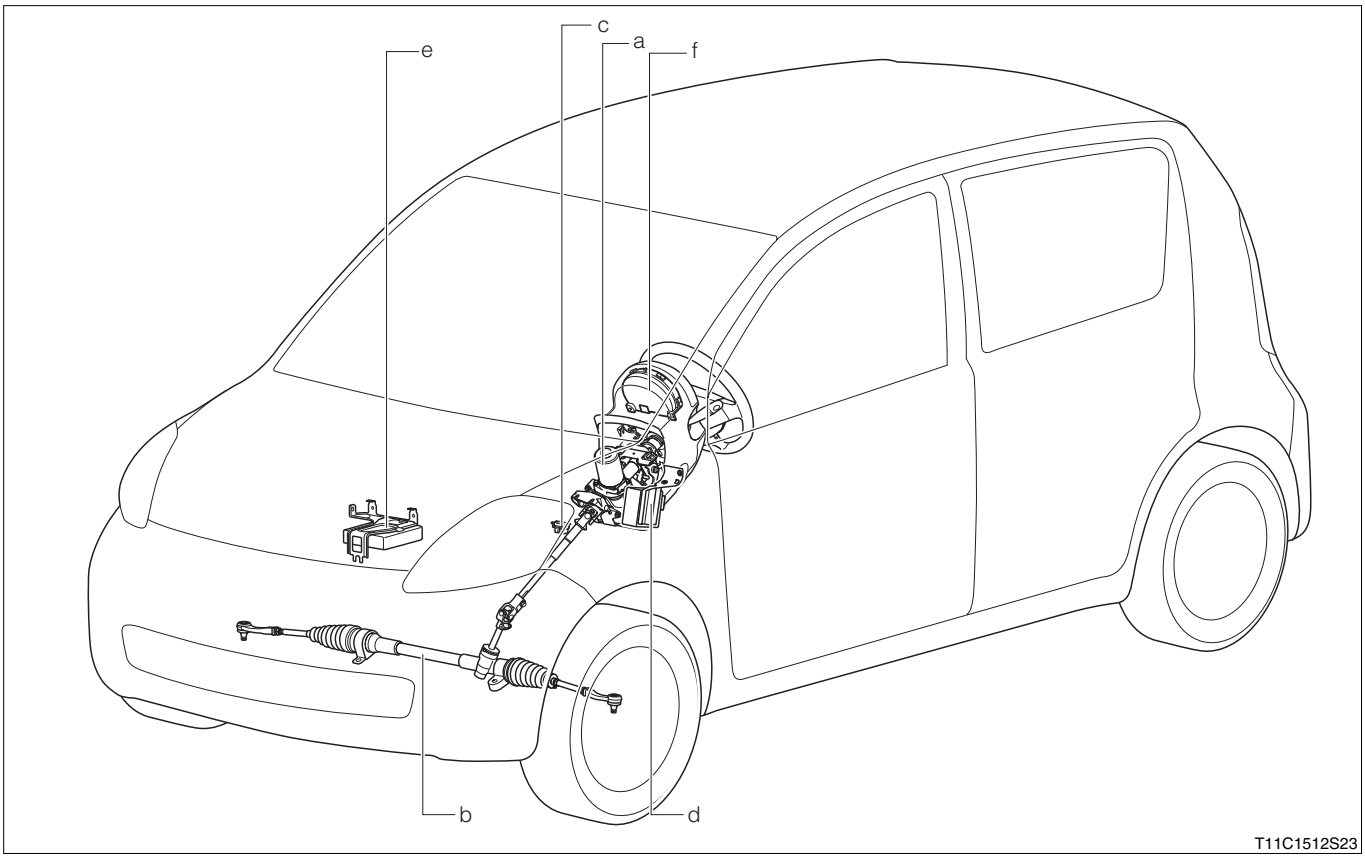


1-3 LOCATION OF COMPONENTS

RHD vehicles



LHD vehicles



a	Steering column
b	Steering gear
c	DLC
d	EPS ECU
e	EFI ECU
f	Combination meter (warning lamp, speedometer)

2 CONTROL

2-1 BASIC THEORY

The power steering is assisted by the following method. The motor, provided at the center of the steering column, drives the steering shaft. The steering effort is assisted by transmitting this driving force to the steering rack. Furthermore, the EPS ECU controls the assisting direction and assisting force to optimum values, based on the signals sent from the vehicle speed sensors, torque sensors, and EFI ECU.

2-2 ASSIST CONTOL

The EPS ECU calculates an optimum assisting force each time, based on the vehicle speed signal from the vehicle speed sensors, steering force and steering direction from the torque sensors. In this way, the output signal to the motor is controlled.

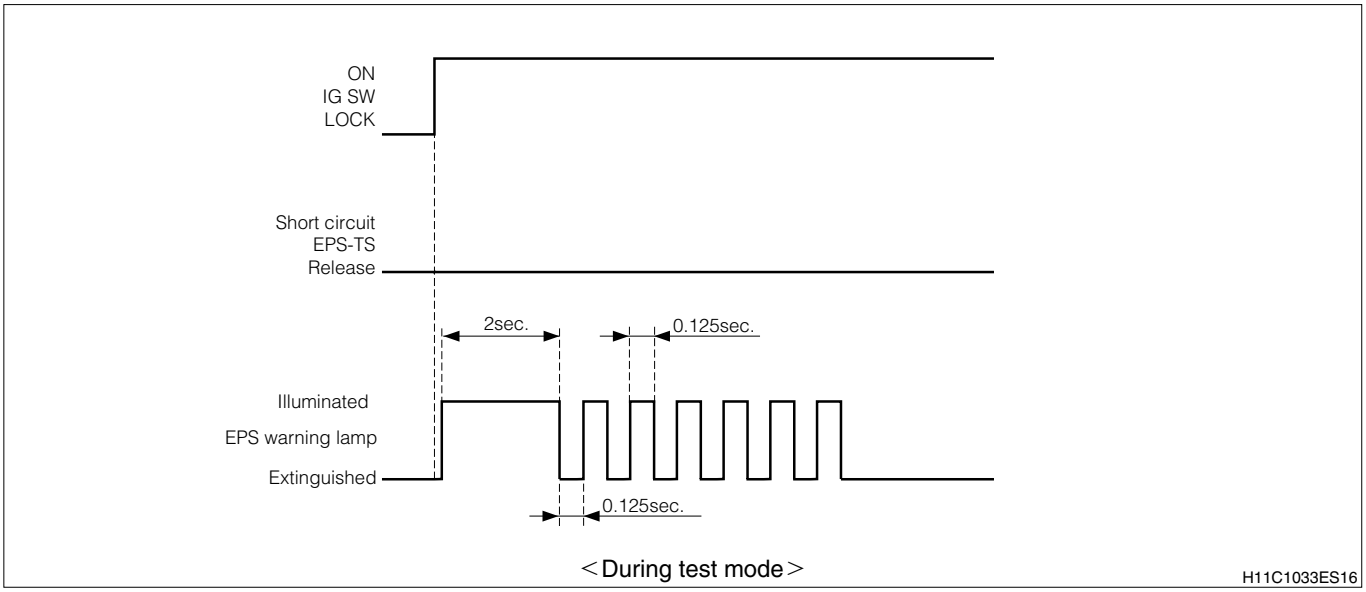
2-3 DIAGNOSIS

2-3-1 DESCRIPTION

Diagnosis means is a function in which the ECU informs the inspector of abnormal items if any abnormality exists in the input/output system. When an abnormality takes place, the ECU memorizes the abnormal item. Moreover, this memory function is written into a non-volatile ROM(EEPROM) so that the diagnosis results will remain in the memory even if the power is switched off.
Please refer to the repair manual for more detail of the diagnosis.

2-4 TEST MODE FUNCTION(SENSOR CHECK FUNCTION)

1. The test mode function (sensor check function) evaluates whether the sensor and signal systems are functioning normally or not by checking the output of the vehicle speed sensor signal and engine revolution speed signal. Thus, this function informs the inspection worker of the results by making the EPS warning lamp flash.
2. The test mode is performed when an elimination operation by the DLC is performed. The test mode code is memorized.
3. When the test mode is set, the EPS ECU causes a warning lamp to flash, thus indicating that the test mode is set. Next, the engine is started. The EPS warning lamp goes out and the test mode codes are automatically erased when each signal output has been judged to be {{}}normal˝ after the vehicle has run at a speed of 20 km/h or more for at least 2 seconds. When the check results reveal an abnormality or no test can be carried out because the check conditions were not satisfied, the EPS warning lamp will continue to flash. In this case, the test mode code will not be erased. Return the IG SW to the "LOCK" position once and check/repair the vehicle speed sensor signal system and the engine speed signal system.



Test mode code table

Code No.		Test mode	
2-digit	4-digit	Check system	Releasing conditions
71	C1571	Vehicle speed signal	The meter vehicle speed signal is above 20 km/h for over 2 seconds.
73	C1573	Engine revolution speed signal	The engine revolution speed signal continues above 360rpm for over 2 seconds

2-5 FAIL-SAFE FUNCTION

1. This is a function to perform the control so that the steer ability may not be lost even when an abnormality is encountered in the input/output signal system.
2. During the fail-safe operation, the EPS warning lamp inside the combination meter goes on, thus informing the driver of the abnormality. At the same time, the following control takes place.
3. When an abnormality was detected once, the diagnosis code for it remains memorized even if the system returns to the normal condition, the fail-safe function is released and the normal assisting condition has been restored.

List of fail-safe control functions

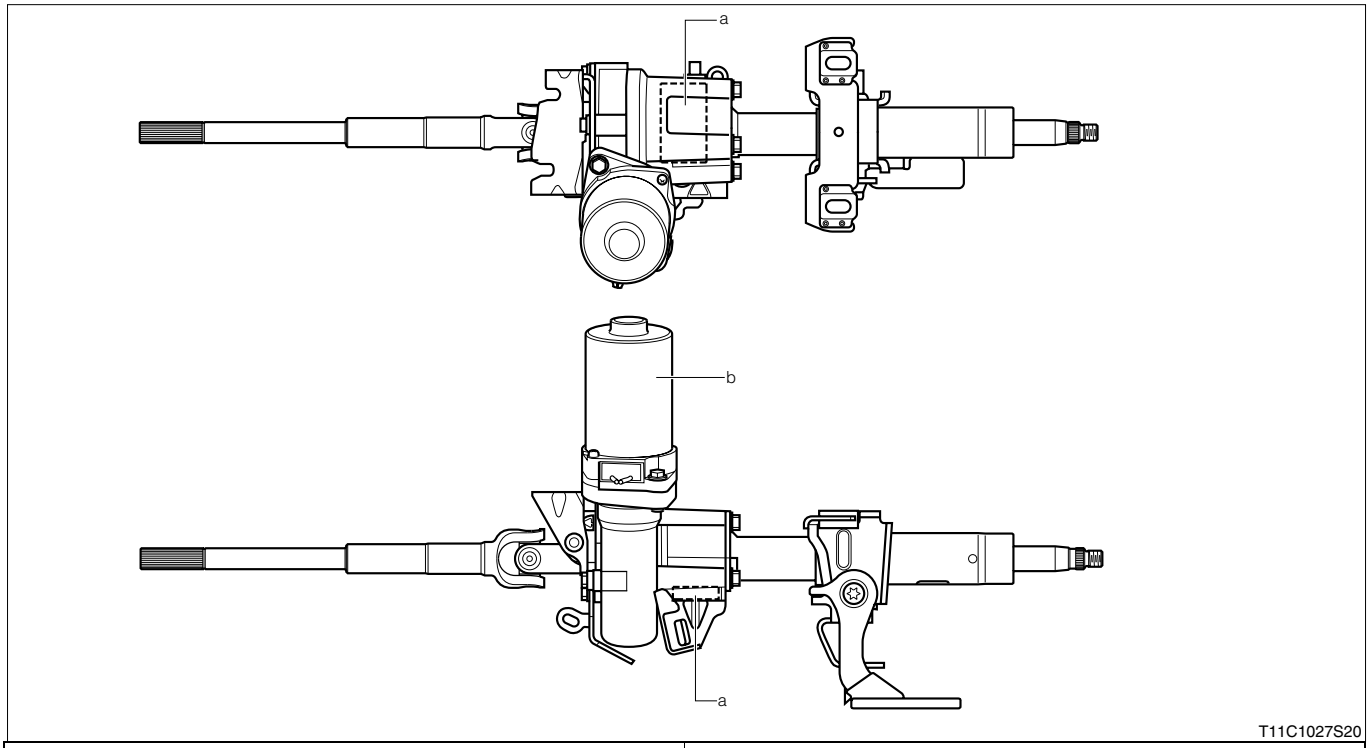
System diagnosed	Contents of diagnosis	Fail-safe	
		Contents of control	Control Release Conditions
Main torque sensor	Open wire, short circuit, poor sensor characteristics	Stopping of assistance	Released if IG SW is switched once from LOCK to ON after resuming the normal operation.
Sub torque sensor	Open wire, short circuit, poor sensor characteristics		
Torque sensor	Excessive difference between output value of main sensor and output value of sub-sensor		
Torque sensor	Abnormality of 9V power supply voltage of sensor		
Motor	Overcurrent		
Motor	Open wire between both terminals of the motor		
Motor	Short circuit, low voltage or overvoltage across both terminals of the motor		
EPS ECU	Malfunctioning of CPU in ECU		
EPS ECU	Abnormality of ECU inner circuit		
EPS ECU	Abnormality of temperature sensor inside ECU	Assistance continues.	The fail-safe function is released when the system returns to the normal condition.
EPS ECU	Abnormality of non-volatile ROM inside ECU		Released if IG SW is switched once from LOCK to ON after resuming the normal operation.
Vehicle speed signal (When stopped)	·Open wire or short circuit ·Vehicle speed sensor malfunctioning		The fail-safe function is released when the system returns to the normal condition.
Engine revolution speed signal	·Engine revolution (REV) signal missing ·Open wire, short circuit		
Power supply	Abnormal rise in battery voltage	Stopping of assistance	
Power supply	·Battery voltage abnormally dropped ·PIG power supply voltage abnormally dropped		
Power supply	Malfunctioning of power supply relay in ECU		Released if IG SW is switched once from LOCK to ON after resuming the normal operation.
EPS ECU	Malfunctioning of motor relay in ECU		

3 COMPONENTS

3-1 ELECTRIC POWER STEERING COLUMN ASSEMBLY

3-1-1 DESCRIPTION

1. The electric power steering column Ay has the following functions in addition to the functions of a normal steering column.
   (1) Torque sensor for measuring rotating torque of steering shaft
   (2) Motor for assisting the steering effort by moving the steering shaft, etc.



T11C1027S20

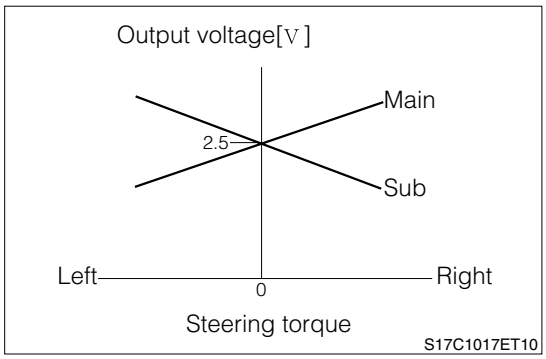
a	Torque sensor
b	Motor

3-1-2 CONSTRUCTION AND OPERATION

(1) Torque sensor

① Output characteristics

1. The output signals of the torque sensor consist of two torque signals, i.e. those from double circuits of a main circuit and a sub circuit.
2. When there is no rotating torque applied to the steering (neutral position), the output values of the main and sub are 2.5V, respectively.
3. The torque signal changes when a rotating torque is generated due to the steering operation. When the steering wheel is turned to the right, the main output voltage increases from 2.5V and the sub output voltage decreases from 2.5V.
4. The voltage change is outputted to the EPS ECU as a steering signal.



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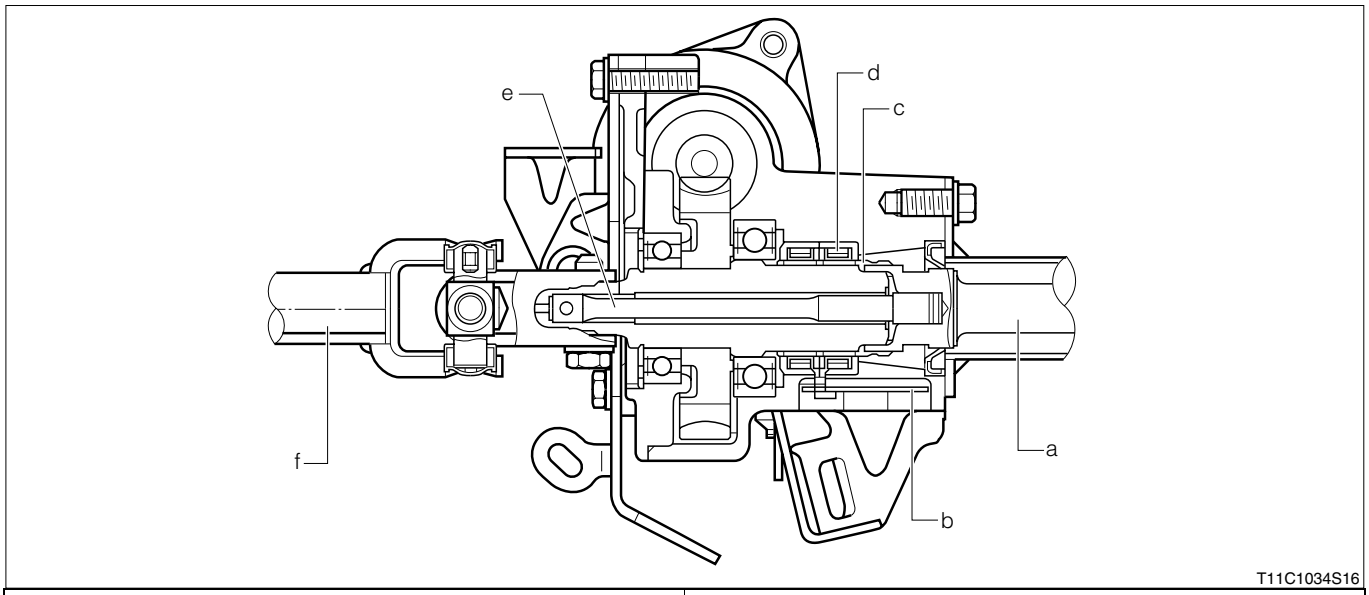
② Construction

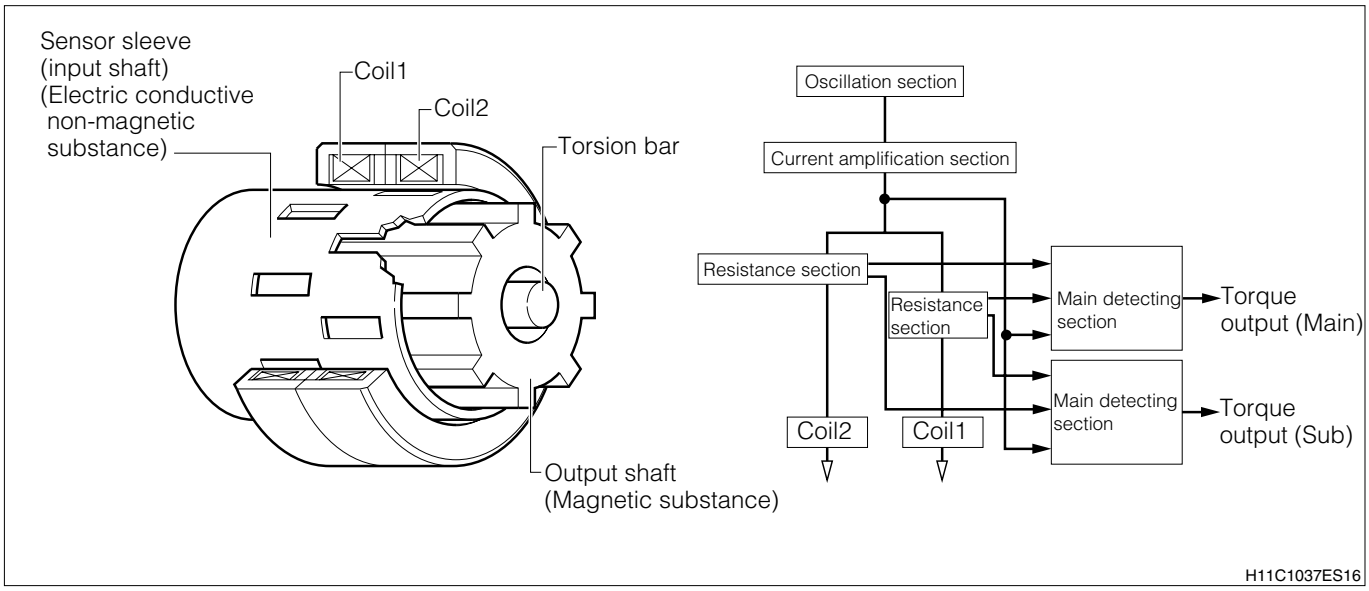
1. The input from the steering wheel is inputted to the input shaft. The input shaft and output shaft are connected by means of the torsion bar. When the output shaft is difficult to turn because the reaction force of the road surface is great, a difference in rotation occurs between the input shaft and the output shaft. Consequently, the torsion bar is twisted.
2. The sensor sleeve provided with a slit is secured on the input shaft. Also, a spline groove is provided on the output shaft.
3. The change in torque is detected from the twisted about of the torsion bar by this and by the two coils fitted to the column tube and also by the detection circuit.



a	Input shaft
b	Torque sensor
c	Sensor sleeve
d	Coil
e	Torsion bar
f	Output shaft

③ Operation

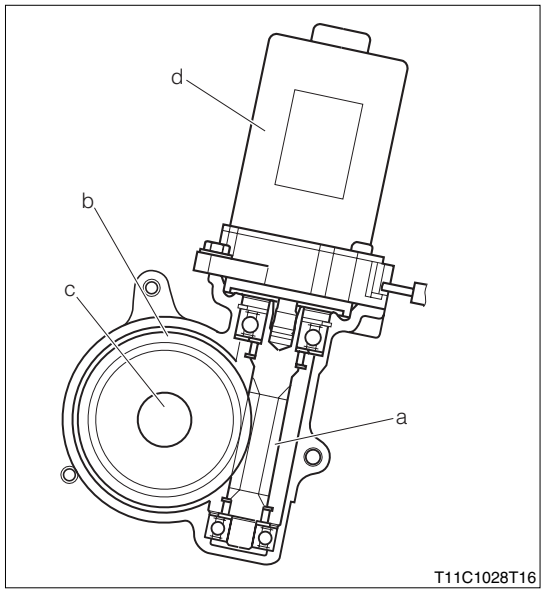
1. When the torsion bar is twisted by the input from the steering wheel, a difference in rotation occurs between the input shaft and the output shaft.
2. The change in facing area is caused by the difference in rotation between the slit of the sensor sleeve secured on the input shaft and the groove on the output shaft.
3. The change of the facing area becomes the change in magnetic flux density between the slit and the groove. As a result, the inductance of the energized coil (self-induced voltage) changes and this change is taken out as a voltage signal.
4. The voltage signal that has been obtained is input into the detection circuit. Thus, the twisted amount of the torsion bar is output as the change in torque.



(2) Motor

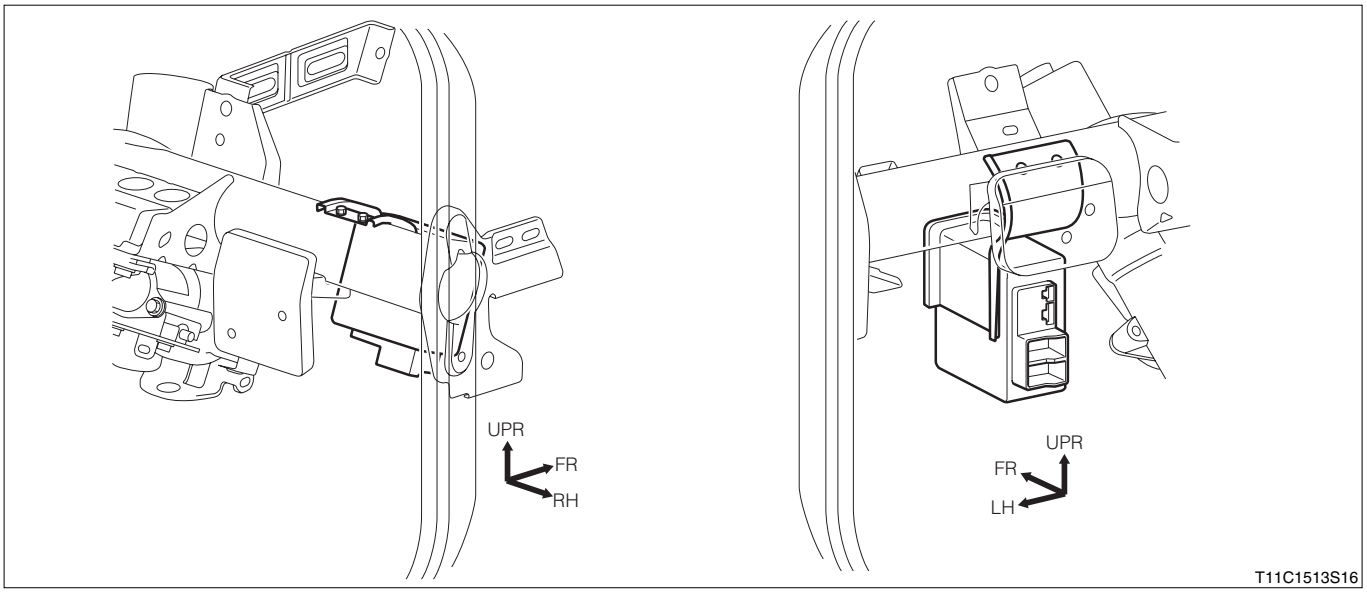
The torque due to the motor rotation is generated by a signal from the EPS ECU. Its speed is slowed by the worm gear and is transmitted to the output shaft.

a	Worm gear
b	Worm wheel gear
c	Worm wheel shaft
d	Motor



(3) EPS ECU

1. It is installed on the pillar-to-pillar member on the driver's seat side.



Left figure: RHD vehicle; Right figure: LHD vehicle

2. The assisting force is determined from the output values from the vehicle speed sensor and torque sensor. In this way, the direction and amount of the current sent to the motor is regulated.
3. The system is always monitored. If any abnormality is detected, the EPS warning lamp goes on and the fail-safe function is executed.

3-2 SPEEDOMETER

The speedometer receives a vehicle speed signal from the ABS ECU and calculates the vehicle speed. The vehicle speed signal outputted from the speedometer is inputted into the EPS ECU.

3-3 EFI ECU

3-3-1 ENGINE REVOLUTION SPEED SIGNAL

The signal (pulse signal) from the EFI ECU is inputted into the EPS ECU.

3-3-2 IDLE-UP REQUEST SIGNAL

In order to prevent the engine revolution speed from fluctuating (especially prevent the idle speed from dropping) due to excessive consuming power of the EPS system, an ON/OFF signal is outputted to the EFI ECU when the motor current exceeds a certain value.

3-4 EPS WARNING LAMP

1. The EPS warning lamp is provided in the combination meter. The following functions are provided:
   (1) When the system is running normally, the lamp goes on when the IG SW is turned on and, after a lapse of two seconds, it will go out.

   NOTE

   - Even if the engine starts immediately after the IG SW has been turned on, the lamp goes on for about 2 seconds for an initial check.

   (2) When the system is encountered with an abnormality, the lamp remains illuminated at all time or the lamp will not go on even if the IG SW is turned on.
   (3) Output of diagnosis code

H1 SRS AIRBAG SYSTEM

1 OUTLINE

1-1 DESCRIPTION

The following *equipment is provided to assure enhanced safety in the event of an accident which may affect the passengers' lives seriously.

*: The side airbag, curtain shield airbag, three-point type ELR seat belt with RH/LH pretensioner + force limiter mechanism are equipped or not equipped depending upon the specifications.

1. Driver's seat airbag, front passenger seat airbag
   (1) This occupant protection system is activated in the event of a frontal collision in order to soften the shock on the occupant, which is an added function to the seatbelt protection. The front airbag sensor and the sensor in the airbag ECU detect an impact by the frontal collision, and if the impact exceeds a predetermined value, the airbags accommodated in the steering wheel pad and the instrument panel will deploy immediately to reduce impacts to the heads and faces of the front seat passengers.
2. Side airbag
   (1) This is an occupant protection system that is activated in the event of a side collision to reduce impacts to the occupant. The side airbag sensor detects a side impact caused by the side collision, and if the impact exceeds a predetermined value, the airbag mounted inside the seatback on the side of impact will deploy immediately to provide protection for the chest of the occupant.
3. Curtain shield airbag (to be equipped concurrently with the side airbag)
   (1) This is an occupant protection system that is activated in the event of a side collision to reduce impacts to the occupant. The side airbag rear sensor detect a side impact, and if the impact exceeds a predetermined value, the airbag extending from the front pillar to the roof side rail on the side of the impact will deploy immediately to reduce impacts to the heads of the front and back seat passengers.
4. Three-point ELR seatbelts with the RH/LH pretensioner and the force limiter mechanism
   (1) The pre-tensioner is activated along with the airbag in the event of a collision, which instantly winds the seatbelts to hold the occupants.
   (2) After the pretensioner mechanism has operated, the force limiter mechanism extends the belt when a certain load is applied to the seat belt, thus reducing impacts to the chest of a passenger.

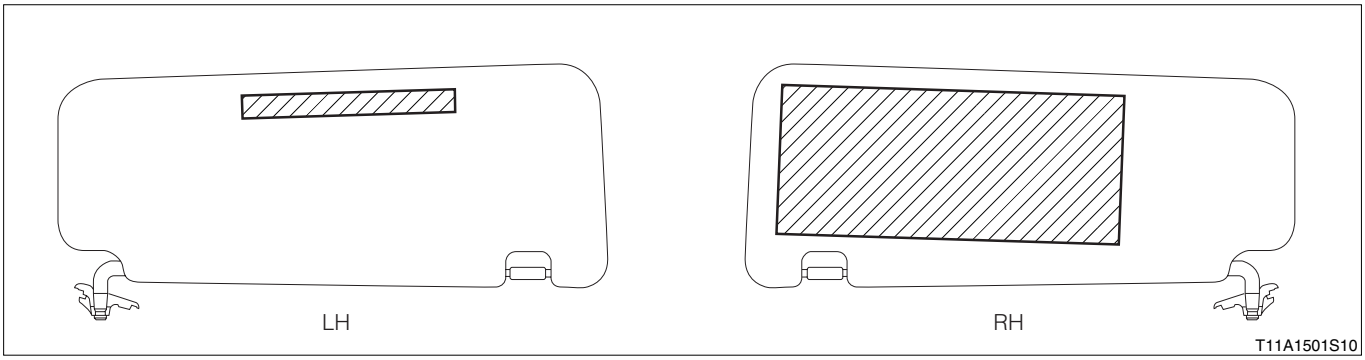
1-2 PRECAUTION

1-2-1 ITEMS TO BE OBSERVED FOR SYSTEM

1. The airbag system properly functions when the occupants wear the seatbelts correctly in correct riding posture.
2. To ensure proper operation of the airbag system, do not apply any stickers or place a cover on the airbag deployment zones.
3. Do not place any objects over the airbag deployment zones. Failure to observe this caution pauses risk of injuries to the occupants due to airbag deployment.
4. The airbag system may not be activated in cases where the airbag warning lamp remains lit, or the airbag warning lamp does not light up after the IG SW is turned ON even if the sensor has detected the impact. The system must be checked.

1-2-2 CAUTION PLATE FOR USERS

Caution plates for users are installed to the sun visors for both the driver and front passenger seats.

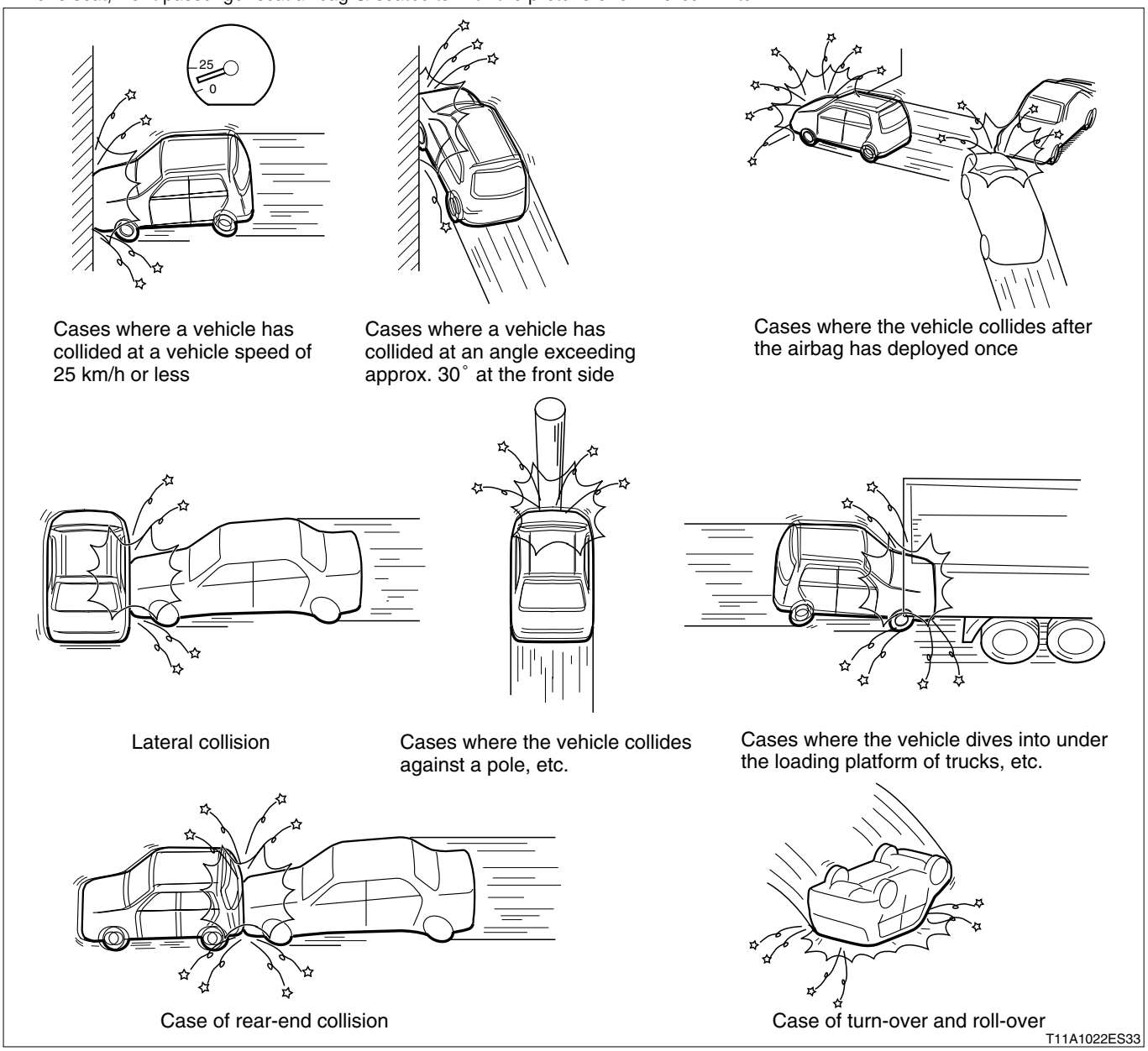


The illustration represents the RHD vehicle.

1-2-3 ITEMS TO BE OBSERVED IN CASE OF NON-OPERATION

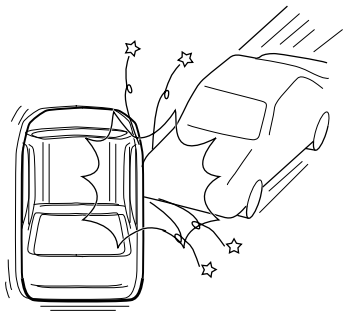
Under certain conditions given below, the airbag system may not be activated due to the structure of the sensor, and the operation determination requirements of the airbag ECU.

Driver's seat, front passenger seat airbag & seatbelts with the pretensioner + force limiter

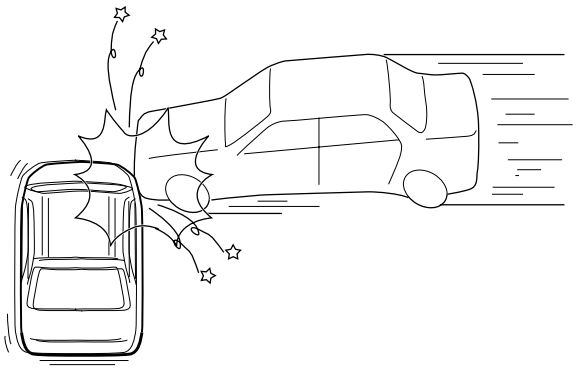


The airbag ECU and the front airbag sensor determine whether the airbag should be deployed based on the impact from the front at time of a collision. Therefore, the airbag may not be deployed in cases where the magnitude of the frontal impact is small despite the massive damage to the vehicle, or the vehicle body has absorbed the impact.

Curtain shield airbag & side airbag



Cases where a vehicle has collided diagonally



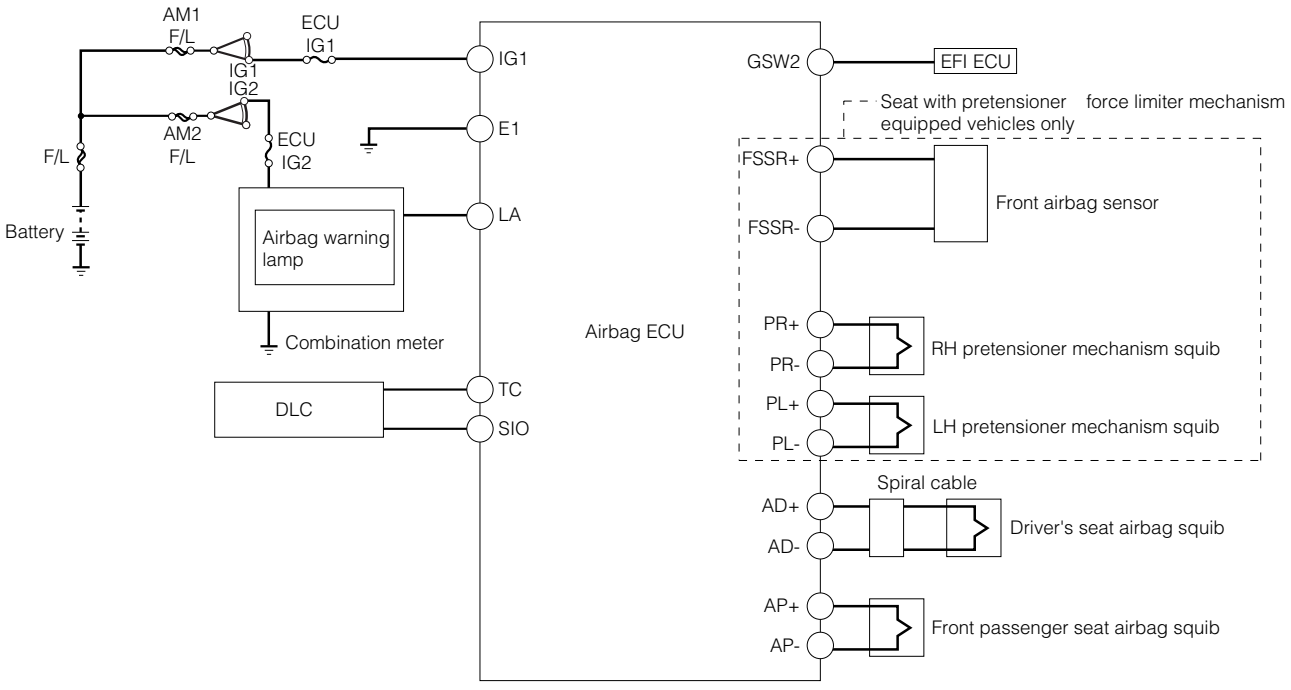
Cases where a vehicle has collided at a section except the passenger compartment

T04A1004ES16

The side airbag sensor and the side airbag rear sensor determine whether the airbag should be deployed based on the impact from the side at time of a collision. Therefore, the airbag may not be deployed in cases where the magnitude of the side impact is small despite the massive damage to the vehicle, or the vehicle body has absorbed the impact.

1-3 SYSTEM WIRING DIAGRAM

Vehicles without the curtain shield airbag & side airbag



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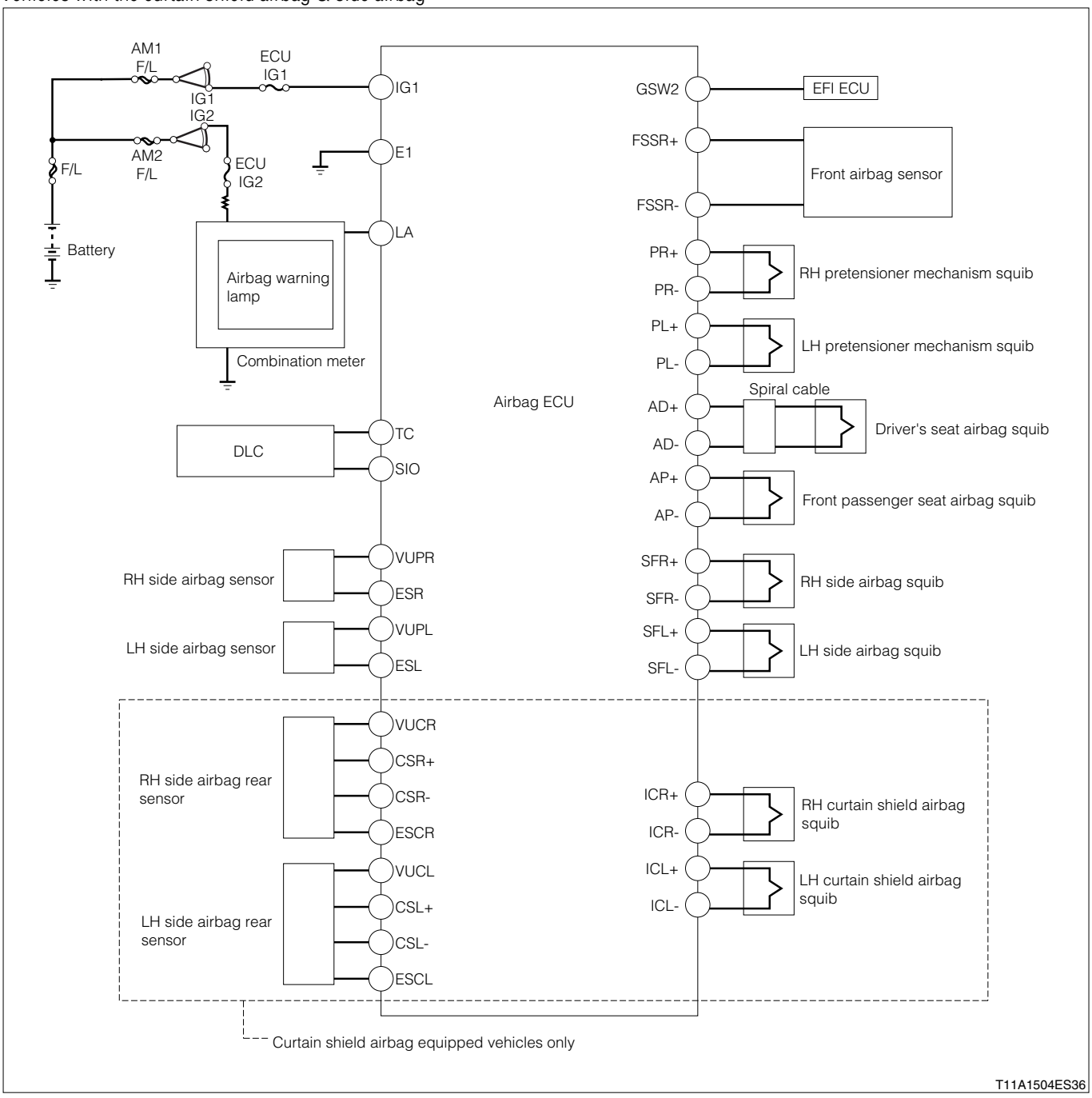
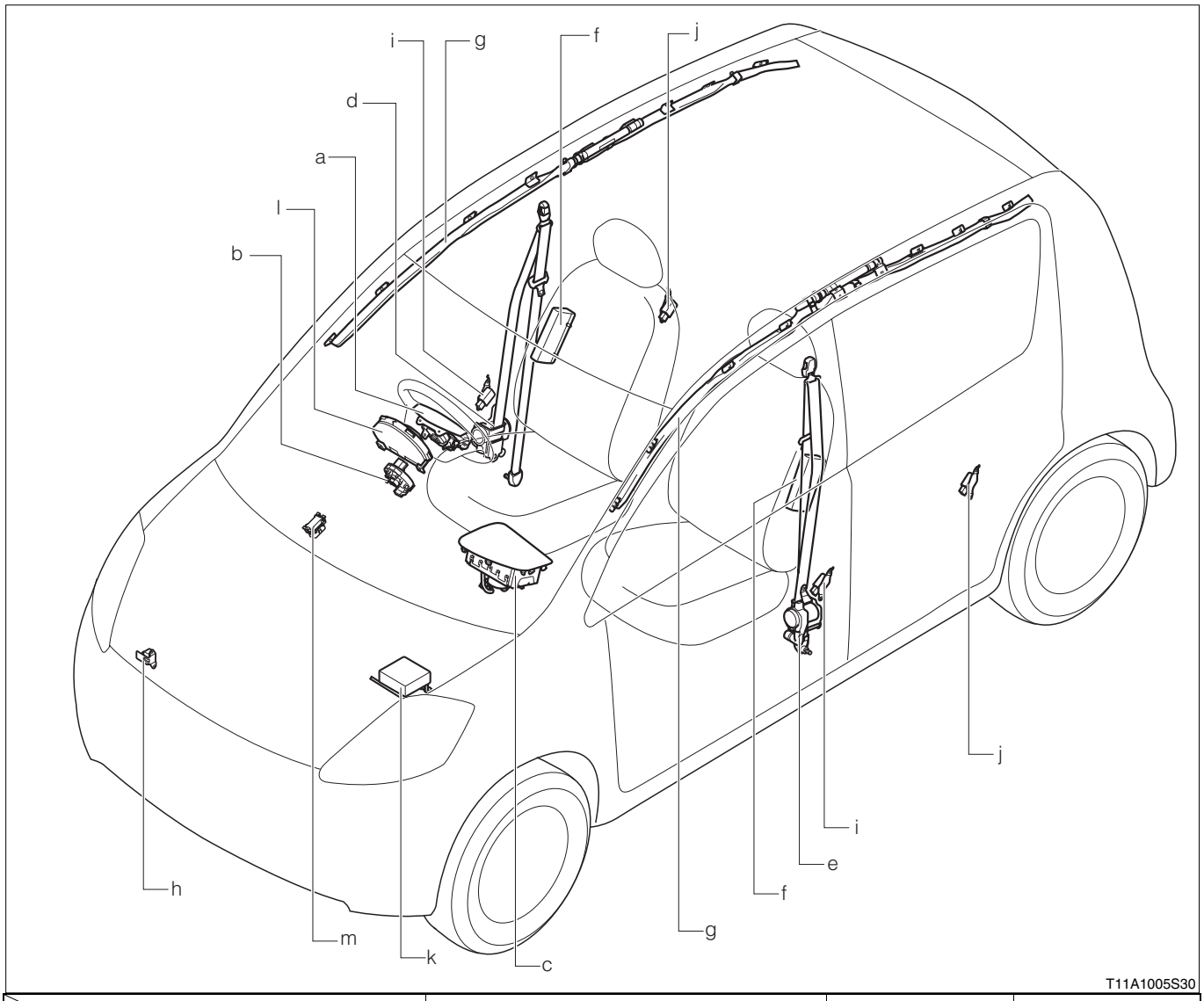
Vehicles with the curtain shield airbag & side airbag



1-4 LOCATION OF COMPONENTS



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		Vehicles with the airbags at the driver's seat and front passenger seat		Vehicles with the side airbag	Vehicles with the curtain shield airbag & side airbag
		Vehicles with RH, LH pretensioner + force limiter mechanism equipped seat belt	Vehicles without RH, LH pretensioner + force limiter mechanism equipped seat belt		
a	Driver's seat airbag	○	○	○	○
b	Spiral cable	○	○	○	○
c	Front passenger-side airbag	○	○	○	○
d	Seatbelts with the RH pretensioner and the force limiter mechanism	○	–	○	○
e	Seatbelts with the LH pretensioner and the force limiter mechanism	○	–	○	○
f	Side airbag RH/LH	–	–	○	○
g	Curtain Shield Airbag RH/LH	–	–	–	○
h	Front Airbag Sensor	○	–	○	○
i	Side Airbag Sensor RH/LH	–	–	○	○
j	Side airbag rear sensor RH/LH	–	–	–	○
k	Airbag ECU	○	○	○	○
l	Combination Meter (air bag warning lamp)	○	○	○	○
m	DLC	○	○	○	○

○: Provided –: Not provided

2 CONTROL

2-1 OPERATION

2-1-1 DRIVER'S SEAT, FRONT PASSENGER SEAT AIRBAG & SEATBELTS WITH THE PRETENTIONER + FORCE LIMITER

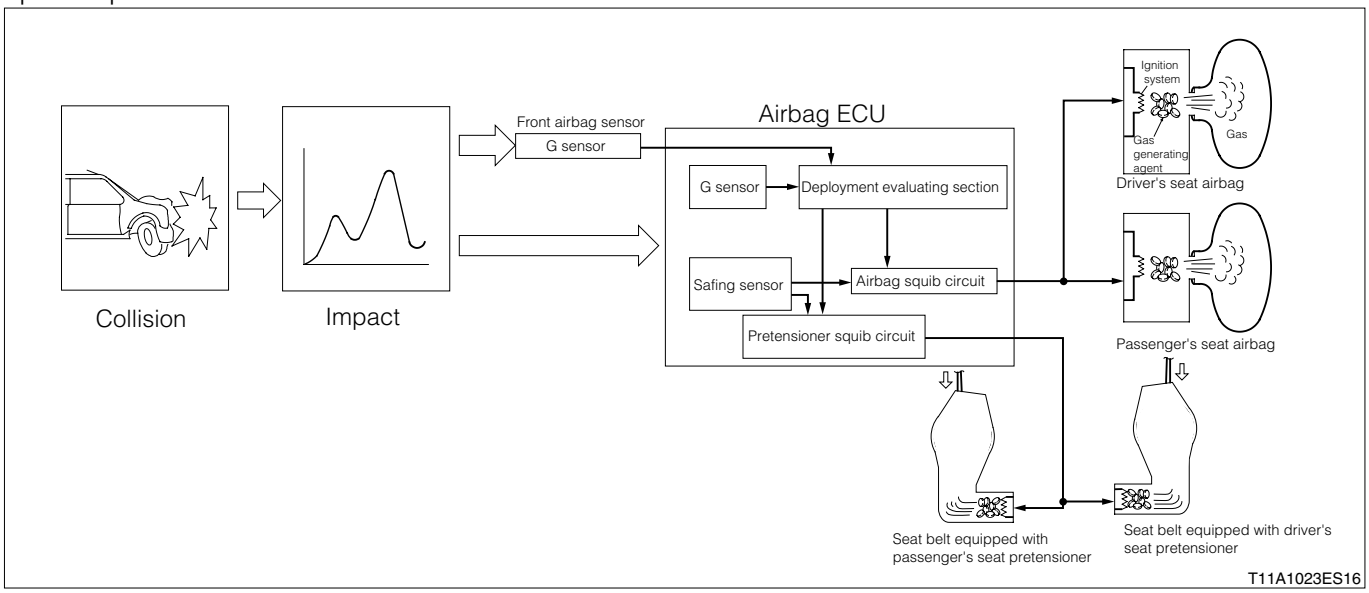
1. When an impact from the front of the vehicle is applied, the G sensor in the front airbag sensor, the safing sensor in the airbag ECU, and the G sensor will detect the impact.
   (1) The G sensor in the front airbag sensor and the safing sensor in the airbag ECU are turned ON when the vehicle experiences a certain level of deceleration due to the collision impact.
   (2) The G sensor mounted in the airbag ECU transmits a G waveform to the airbag ECU.
2. The output of the front airbag sensor and the G waveform of the G sensor in the airbag ECU determine whether or not the airbag should be activated.

NOTE

- The airbag ECU judges that a collision has occurred, when the value calculated according to the predetermined formula exceeds a set value.

3. When the safing sensor is turned ON, and the airbag ECU judges that a collision has occurred, current flows through the pretensioner ignition circuit and the airbag ignition circuit to deploy the airbag.

Operation process



2-1-2 SIDE AIRBAG

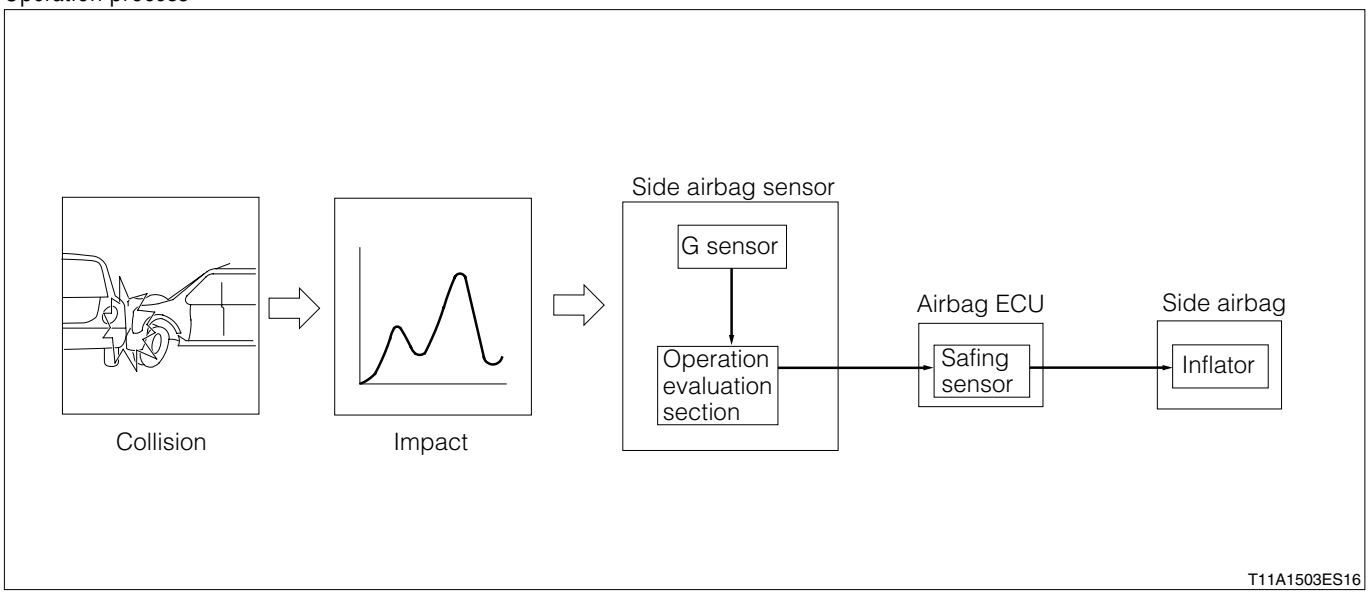
1. When an impact from the side of the vehicle is applied, the G sensor in the side airbag sensor and the safing sensor in the airbag ECU will detect the impact.
   (1) The side airbag sensor transmits a G waveform generated by the G sensor in the sensor to the operation determination section.
   (2) The operation determination section uses a G waveform to determine whether to activate.

NOTE

- The side airbag sensor judges that a collision has occurred when the value calculated according to the predetermined formula exceeds a set value.

2. The safing sensor mounted in the airbag ECU is turned ON when the vehicle experiences a certain level of deceleration.
3. When the safing sensor in the airbag ECU is turned ON, and the side airbag sensor judges that a collision has occurred, current flows through the side airbag ignition circuit to deploy the airbag.

Operation process



2-1-3 CURTAIN SHIELD AIRBAG & SIDE AIRBAG

(1) Side airbag

(2) Curtain Shield Airbag

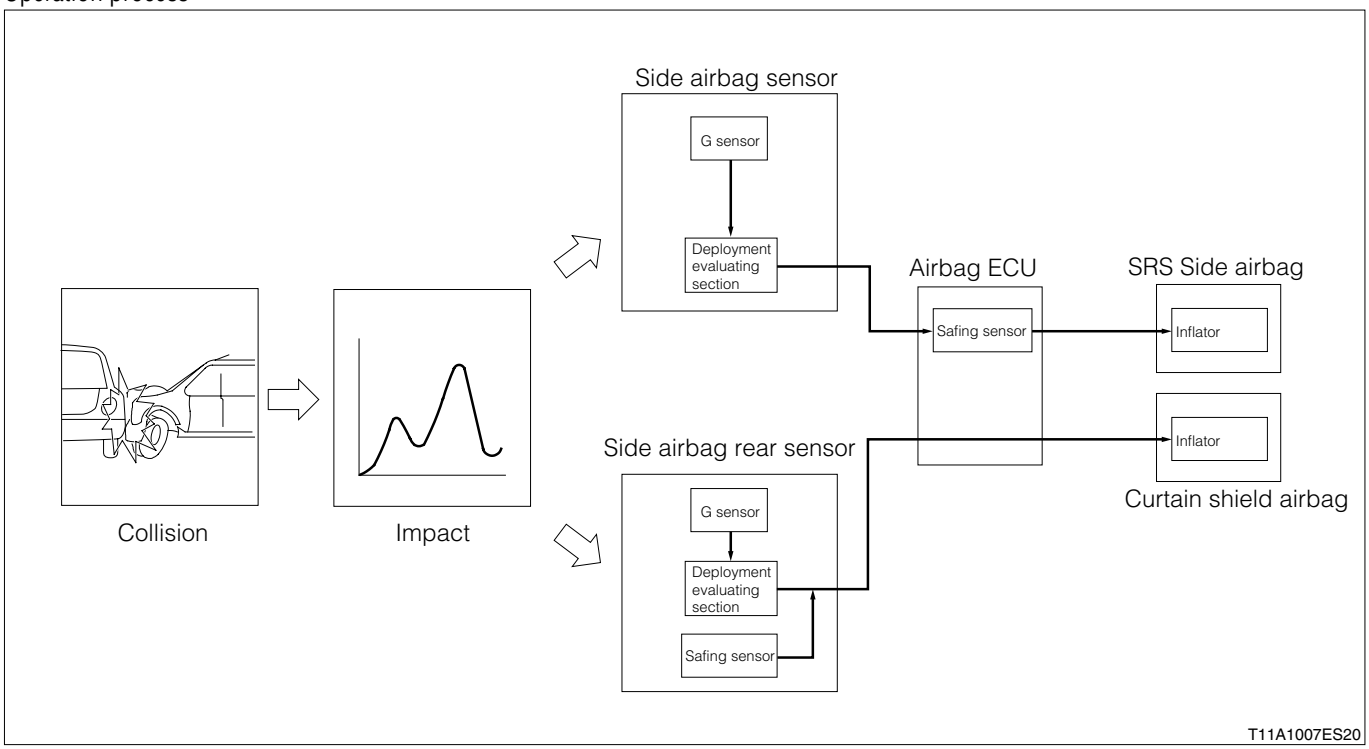
1. When an impact from the side of the vehicle is applied, the G sensor and safing sensor mounted in the side airbag rear sensor will detect the impact.
   (1) The G waveform of the G sensor mounted in the sensor is outputted to the operation determination section.
   (2) The operation determination section uses a G waveform to determine whether to activate.
   (3) The safing sensor mounted in the sensor is turned ON when the vehicle experiences a certain level of deceleration.

NOTE

- The side airbag rear sensor judges that a collision has occurred when the value calculated according to the predetermined formula exceeds a set value.

2. When the side airbag rear sensor judges that a collision has occurred and the safing sensor mounted in the sensor is turned ON, current flows into the curtain shield airbag ignition circuit to deploy the airbag.
3. When the side airbag is activated, the curtain shield airbag will be activated, in addition to the above components.

Operation process



Even if the side airbag rear sensor detests the impact, the side airbag will not be deployed.

2-2 DIAGNOSIS FUNCTION (SELF-DIAGNOSIS FUNCTION)

2-2-1 DESCRIPTION

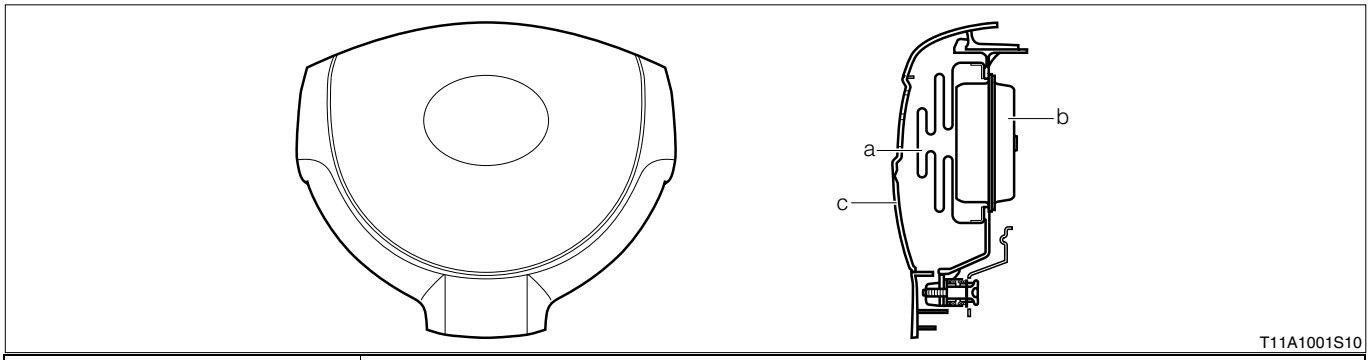
1. Diagnosis literally means {{}} failure diagnosis ″, which provides the function that allows the airbag ECU to notify an operator of the fault that has occurred in the input and output system. The airbag ECU stores faulty conditions when a fault occurs. The information is stored in the nonvolatile ROM (EEPROM), therefore the diagnosis result will be stored even when a power supply is shut down.
   As for the details of the diagnosis, refer to the service manual.
2. In the airbag system, by using the diagnosis mode function that uses the diagnosis tester (DS-21/DS-Ⅱ), you can choose between the normal mode and test mode. When the test mode is selected, the detection sensitivity of diagnosis will be increased.
   (1) Refer to the diagnosis code list in the service manual for the diagnosis codes which correspond to each test mode.

3 COMPONENTS

3-1 SRS AIRBAG AT DRIVER'S SEAT SIDE

3-1-1 DESCRIPTION

Consists of a bag, an inflator, a steering wheel pad, etc. All of these main components are located in the steering wheel.



a	BAG
b	Inflator
c	Steering Wheel Pad

3-1-2 BAG

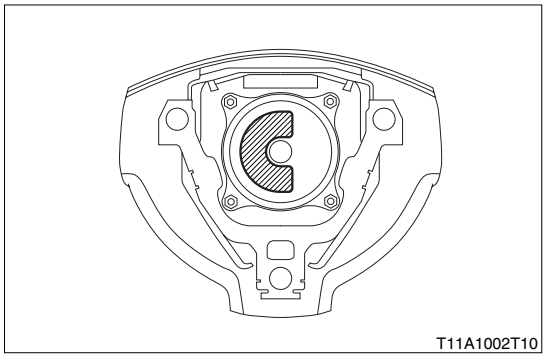
The gas filled in the bag instantly breaks a thin portion of the steering center pad to deploy the airbag. The airbag absorbs the impact on the occupant's head and discharges gas from the two air outlets on the back of the airbag to soften the impact to the occupant.

3-1-3 INFLATOR

1. The inflator consists of a squib, propagating agent, gas generating agent, etc. The gas generating agent is the source to generate nitrogen gas to deploy the airbag in the event of a collision. The inflator has a tightly-sealed structure.
2. When the squib is energized due to the deceleration caused by a collision, the filament located inside the squib will be heated.Consequently, the firing agent is ignited.Then, the flame propagates to the propagating agent and gas generating agent in an extremely short length of time. Thus, a great amount of nitrogen gas is generated from the gas generating agent.Nitrogen gas passes through the filter to be cooled down and to remove burnt debris. Thus, the bag is filled with gas.

3-1-4 CAUTION PLATE

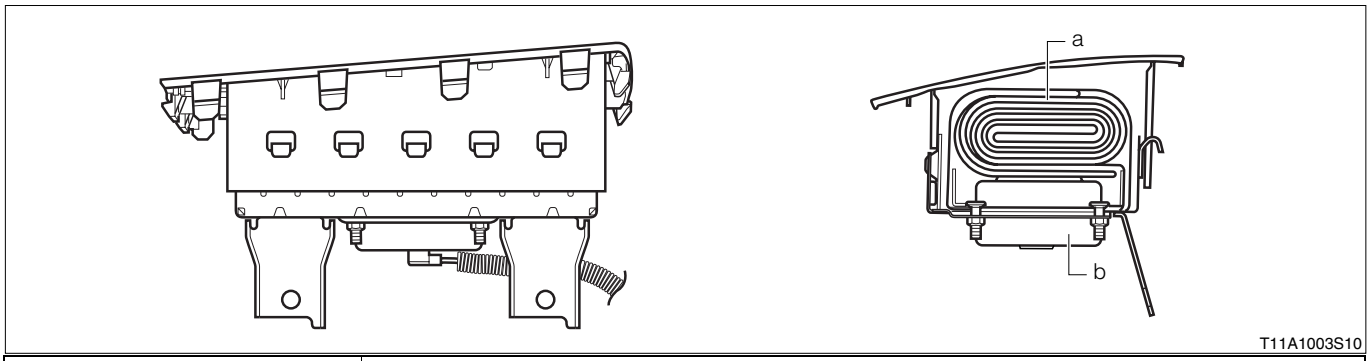
A caution plate is placed at the location shown in the figure.



3-2 SRS AIRBAG AT FRONT PASSENGER SEAT SIDE

3-2-1 DESCRIPTION

Consists of a bag, an inflator, etc. All of these main components are located in the airbag.



a	BAG
b	Inflator

3-2-2 BAG

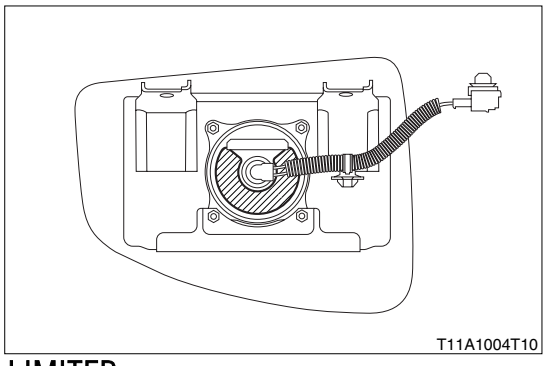
The bag deploys momentarily when the gas filled in the bag ruptures the bag protective cloth provided at the upper surface of the SRS airbag at the front passenger seat side, and the retainer and instrument panel are cracked in an H-shape. After impacts to the head of the front passenger has been sustained, the gas is released through the discharge port provided both at the right and left sides of the back side of the bag. Consequently, the impacts to the front passenger are alleviated.

3-2-3 INFLATOR

1. The inflator consists of a squib, propagating agent, gas generating agent, etc. The gas generating agent is the source to generate nitrogen gas to deploy the airbag in the event of a collision. The inflator has a tightly-sealed structure.
2. When the squib is energized due to the deceleration caused by a collision, the filament located inside the squib will be heated.Consequently, the firing agent is ignited.Then, the flame propagates to the propagating agent and gas generating agent in an extremely short length of time. Thus, a great amount of nitrogen gas is generated from the gas generating agent.Nitrogen gas passes through the filter to be cooled down and to remove burnt debris. Thus, the bag is filled with gas.

3-2-4 CAUTION PLATE

A caution plate is placed at the location shown in the figure.



3-3 SEATBELTS WITH THE PRETENSIONER AND THE FORCE LIMITER

3-3-1 DESCRIPTION

1. Seatbelts with the pretensioner＋ force limiter are mounted to the driver and front passenger seats.

3-3-2 CONSTRUCTION

1. The pretensioner mechanism consists of a generator gas, cartridge base, piston, pinion, roller, sleeve, etc.
2. The force limiter mechanism consists of an torsion shaft, etc.

3-3-3 PRETENSIONER MECHANISM

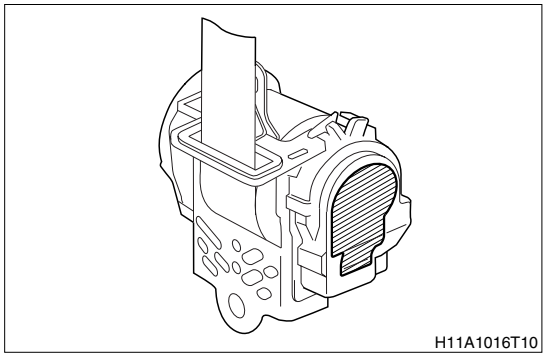
1. This mechanism is activated simultaneously with the airbag by the ignition signal from the airbag ECU in the event of a collision. This mechanism rewinds a certain amount of the seatbelts to hold occupants in position earlier and faster .
2. The system activates even when the seatbelts are not worn.

3-3-4 FORCE LIMITER MECHANISM

When the tension of the seatbelt exceeds a predetermined value in the event of a collision, the system loosens the seatbelt while maintaining a constant tension on the belt in order to protect the occupants from excessive forces.

3-3-5 CAUTION PLATE

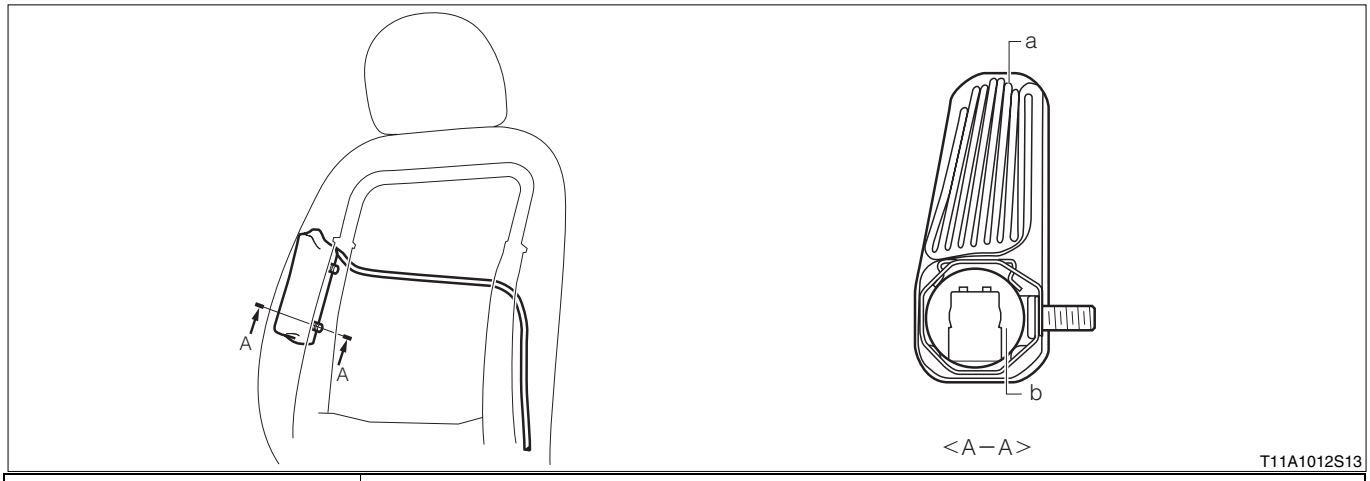
A caution plate is placed at the location shown in the figure.


H11A1016T10

3-4 SIDE AIRBAG

3-4-1 DESCRIPTION

Consists of a bag, an inflator, etc. All of these main components are located in the seat back.



a	BAG
b	Inflator

3-4-2 BAG

The bag deploys momentarily when the gas filled in the bag ruptures the sewed section of the seatback. After impacts to the chest of the passenger has been sustained, the gas is released through the opening section for the wire harness installation at the rear edge of the airbag. Consequently, the impacts to the passenger are alleviated.

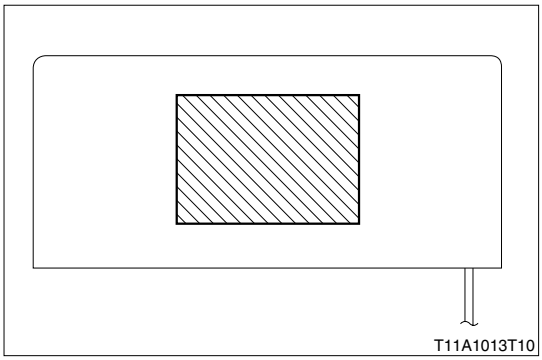
3-4-3 INFLATOR

The inflator consists of an ignition equipment, heating agent, and the pressure container that holds compression gas, etc. The inflator has a tightly-sealed structure.

When the squib device is energized by the deceleration in the event of a collision, the squib device is ignited. As a result, the heating agent is burnt, thus generating gas. Because of this gas, the pressure of the compressed gas inside the pressure container rises. Consequently, the bulkhead is broken by this pressure, thus discharging gas into the bag.

3-4-4 CAUTION PLATE

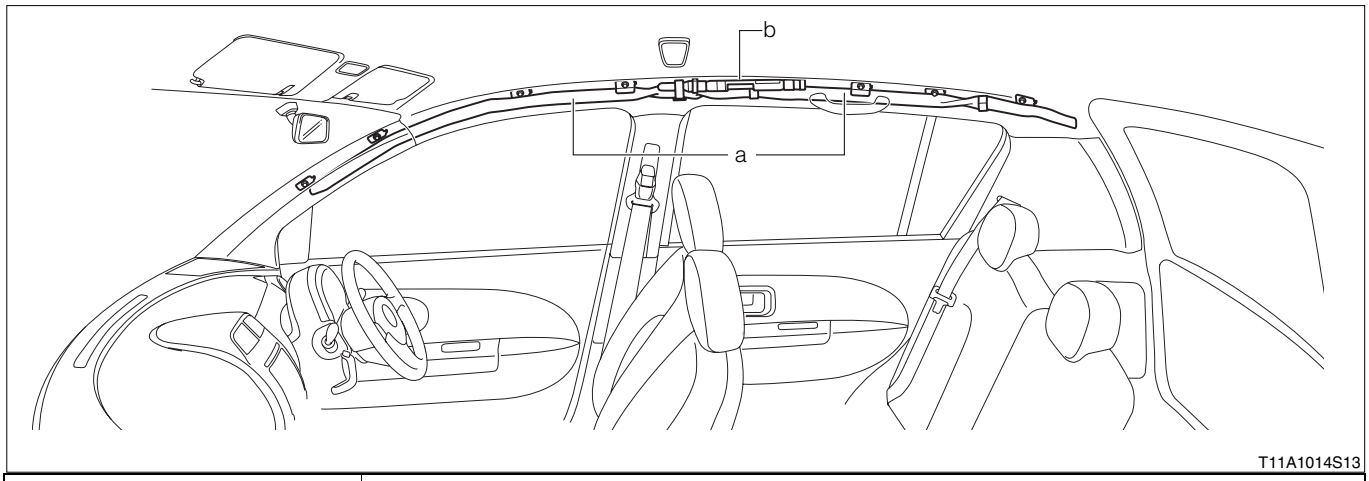
A caution plate is placed at the location shown in the figure.



3-5 CURTAIN SHIELD AIRBAG

3-5-1 DESCRIPTION

Consists of a bag, an inflator, etc. All of these main components are located in the area between the front pillar and the central section of the roof side.



a	BAG
b	Inflator

3-5-2 BAG

The gas filled in the bag instantly breaks the front pillar garnish and the roof head lining to deploy the airbag. The airbag absorbs the impact on the occupant's head and reduces the impact to the occupant by discharging gas from the seams of the bag.

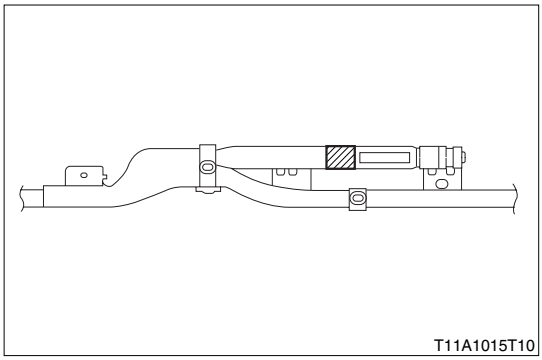
3-5-3 INFLATOR

The inflator consists of an ignition equipment, heating agent, and the pressure container that holds compression gas, etc. The inflator has a tightly-sealed structure.

When the squib device is energized by the deceleration in the event of a collision, the squib device is ignited. As a result, the heating agent is burnt, thus generating gas. Because of this gas, the pressure of the compressed gas inside the pressure container rises. Consequently, the bulkhead is broken by this pressure, thus discharging gas into the bag.

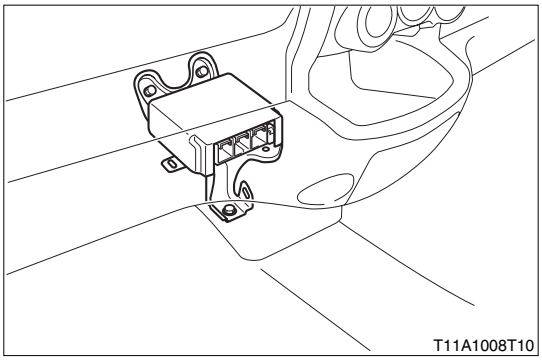
3-5-4 CAUTION PLATE

A caution plate is placed at the location shown in the figure.



3-6 AIRBAG ECU

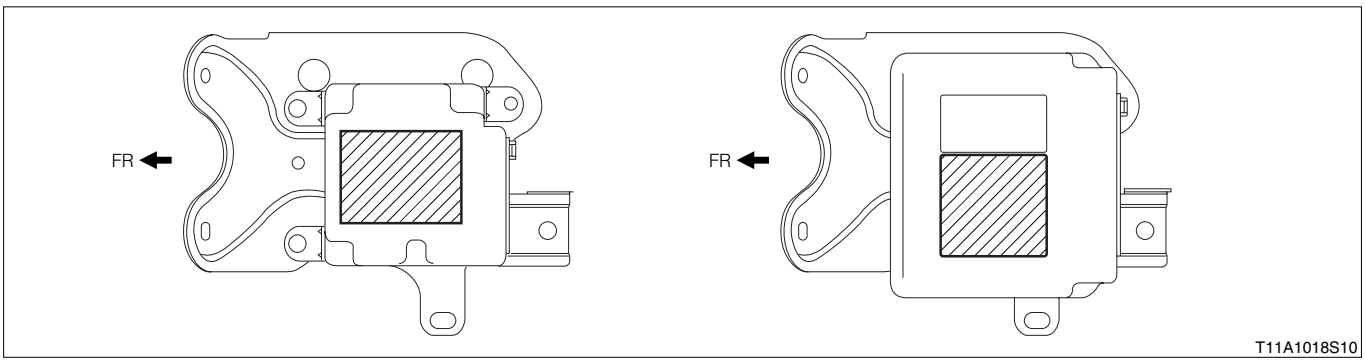
3-6-1 DESCRIPTION



1. Consists of a G sensor, safing sensor, back-up power supply, diagnostic circuit, etc. The system is designed to provide highly reliable construction so that one failure will not lead to catastrophic failure of the entire system.
2. The G sensor in the airbag ECU also functions as a sensor for the fuel cut system. The airbag ECU constantly communicates with EFI ECU.

3-6-2 CAUTION PLATE

A caution plate is placed at the location shown in the figure.

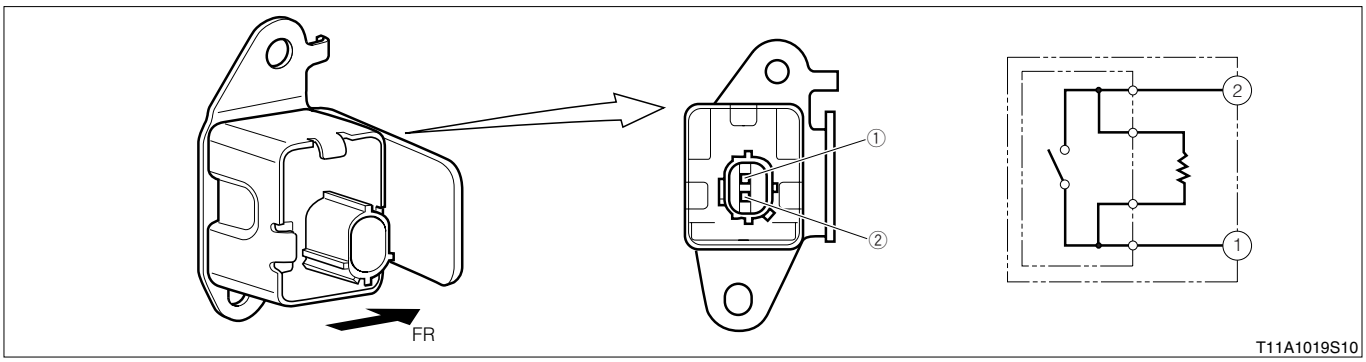


Left: Vehicle without side airbag Right: Vehicle with side airbag

3-7 FRONT AIRBAG SENSOR

3-7-1 OUTLINE

It is installed at the front side of the vehicle at the driver's seat side (on the side of the side member), which consists of the G sensor, etc.



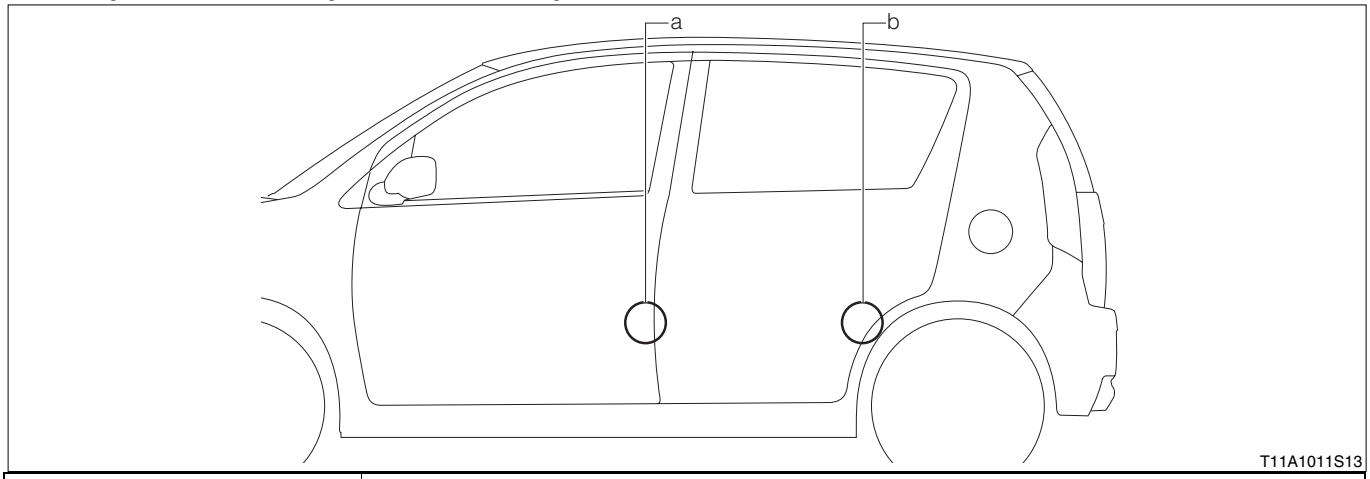
Left: External view Right: Circuit diagram

3-8 SIDE AIRBAG SENSOR & SIDE AIRBAG REAR SENSOR

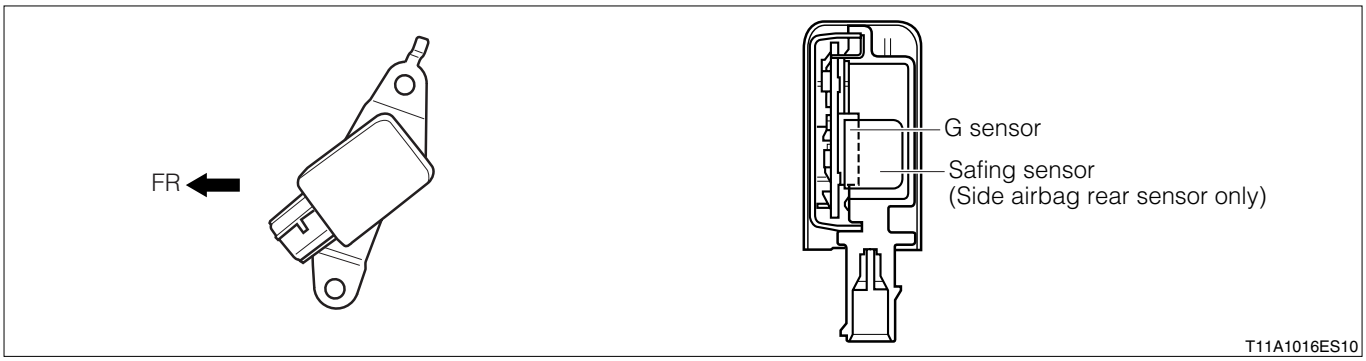
3-8-1 DESCRIPTION

1. The side airbag sensor is installed in the lower part of the center pillar RH/LH. The side airbag sensor consists of a semiconductor G sensor, a collision determination circuit, a communication circuit, etc., and transmits an ignition signal from the side airbag and the curtain shield airbag to the airbag ECU.
2. The side airbag rear sensor is installed in the quarter wheel house. The side airbag rear sensor consists of a semiconductor G sensor, a safing sensor, a collision detection circuit, a communication circuit, etc., and transmits an ignition signal from the curtain shield airbag to the airbag ECU.

Side airbag sensor & side airbag rear sensor mounting locations

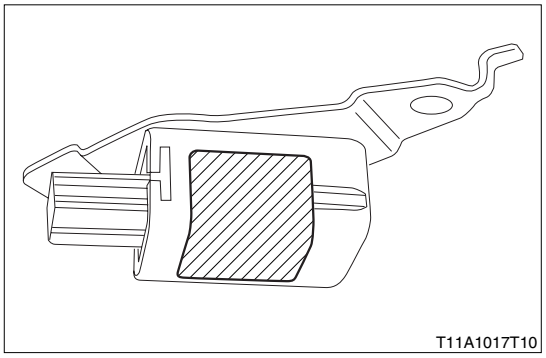


a	Side airbag sensor
b	Side airbag rear sensor



3-8-2 CAUTION PLATE

A caution plate is placed at the location shown in the figure.



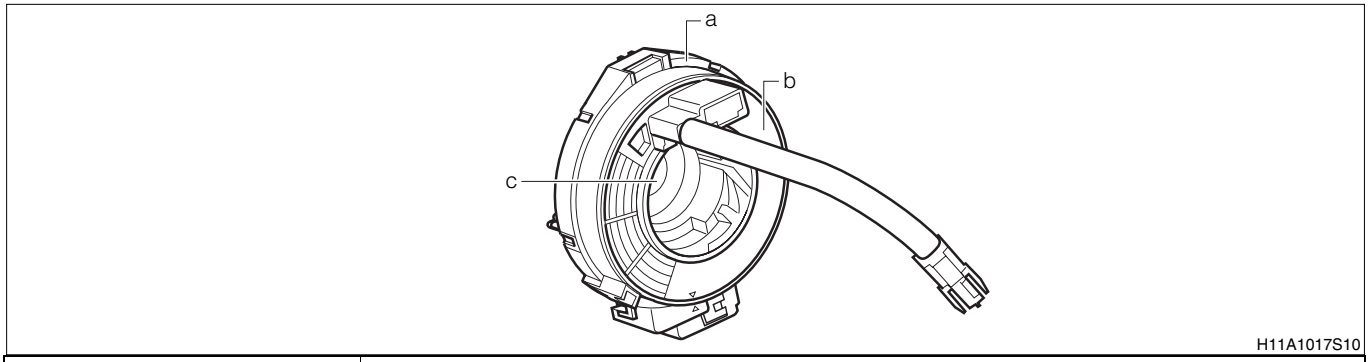
3-9 SPIRAL CABLE

3-9-1 DESCRIPTION

1. The non-contact point type spiral cable is used for wiring connection extending from the cowl wire harness to the driver's seat airbag.
2. The structure provides one-touch snap-on installation.

3-9-2 CONSTRUCTION

1. Consists of a rotator, case, cable, bearing, canceling cam, etc. They are integrated by engagement of the projection in the steering wheel with the groove in the canceling cam. When the steering wheel turns, the rotator turns together with the canceling cam.
2. The cable is folded in half and rolled in the case through the bearing. The rotator is given some allowance for three turns both to the right and the left from the neutral position.



a	Case
b	Rotator
c	Cancel cam

3-10 AIRBAG WARNING LAMP

Airbag warning lamp is installed in the combination meter, with the following functions provided.

(1) When the system is normal, the lamp lights up for approx. 6 seconds after the IG SW is turned on, and then turned off.
(2) When a malfunction occurs in the system, the lamp remains unlit without continuous lighting or lighting for 6 seconds.
(3) After the system started operation, the lamp remains blinking.
(4) Diagnosis code is outputted.

I1 BODY

1 OUTLINE

1. The vehicle features compatibility body frame structure to enhance passive safety, offering protection in all directions in a collision with a vehicle weighing more.

   NOTE

   - Compatibility body: This refers to the body structure that is designed to pursue compatibility in a collision between two vehicles of different weights and offer optimum protection for both vehicles, through an improvement in passive safety for the lighter vehicle and a reduction in aggressiveness of the heavier vehicle.

2. The vehicle features Total Advanced Function "TAF" to secure cabin space for survival in the event of a collision and to protect the occupants. "TAF" meets the Japan's passive safety standard (50 km/h frontal, side, and rear collisions) and the European passive safety standard (40% offset frontal collision at 56 km/h, side collision at 50 km/h). Moreover, SUBARU Motor sets up our own stricter target levels to provide a highest level of protection for occupants in this class of the vehicles.

   NOTE

   - "TAF"(Total Advanced Function body) refers to a collision safety body that has been evolved totally.

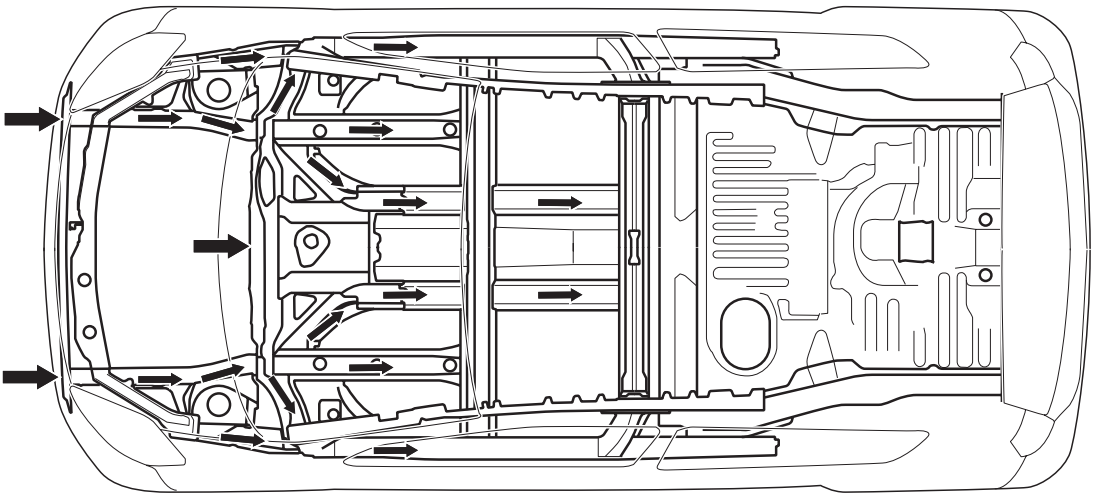
3. High-tension steel sheets have been employed on principal structure, thereby realizing a body that features light weight and high rigidity.

2 CONSTRUCTION AND OPERATION

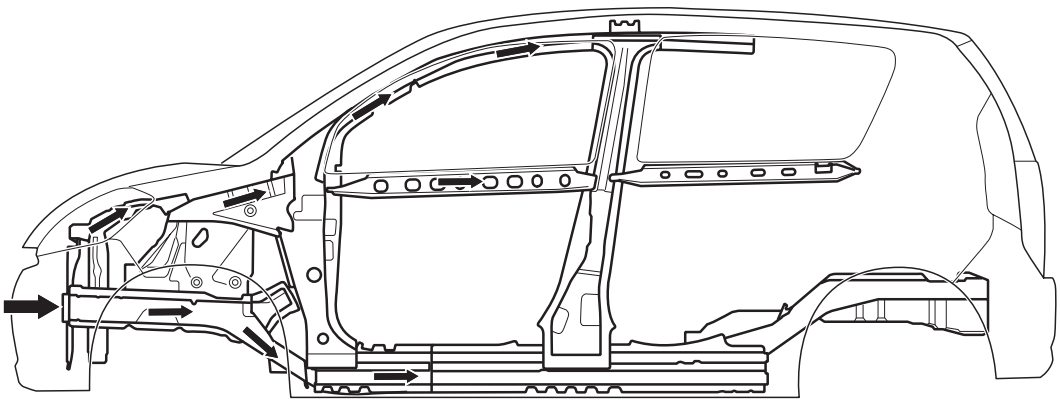
2-1 SAFETY PERFORMANCE

2-1-1 FRONT ENERGY ABSORPTION CONSTRUCTION

The vehicle features body frame structure that efficiently dissipates energy in a frontal impact from the front side member front to the front side member rear, front body pillar, locker panel, side door belt line, etc., to secure cabin space for occupant protection.



<Top view>



<Side view>

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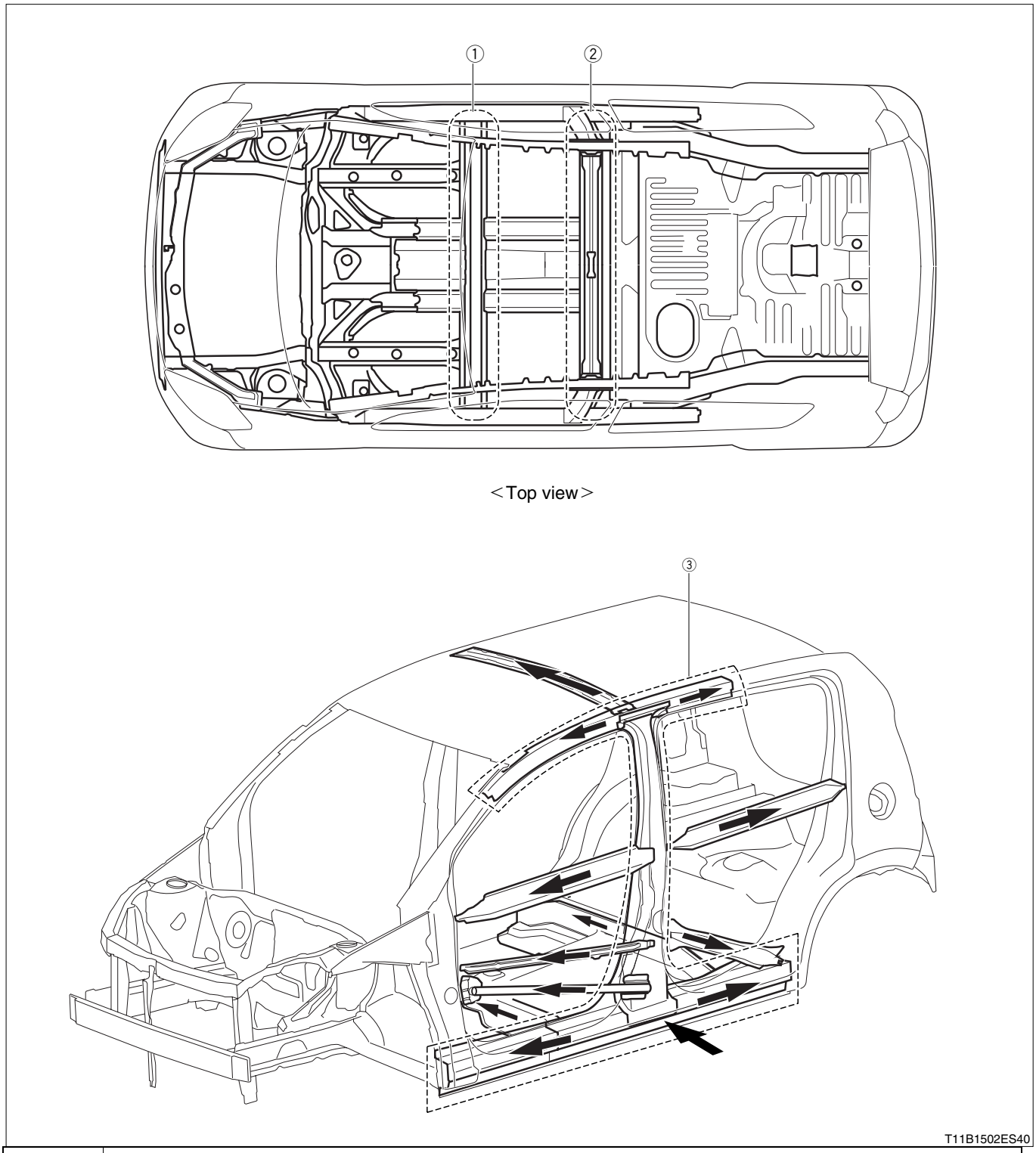
2-1-2 SIDE ENERGY ABSORPTION CONSTRUCTION

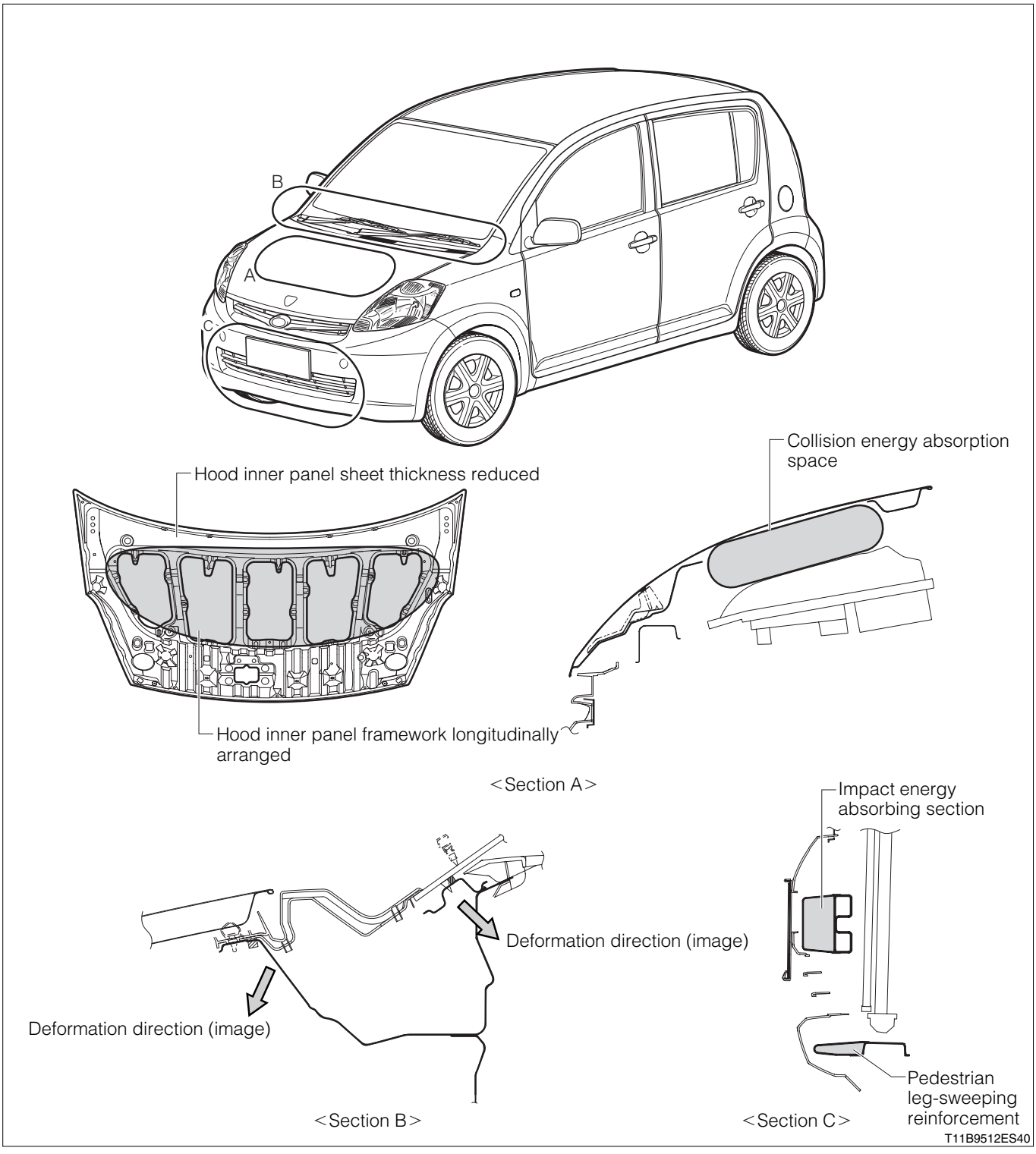
The collision energy from the side can be dispersed effectively to the center body pillars, roof side rails and locker panels. Consequently, the passenger compartment space for protecting occupants has been assured.



①	The front seat body mounting area (the joint section of the front floor cross member to the front floor tunnel, and the joint section of the front floor cross member to the rocker inner panel) has been reinforced in order to secure the cabin space for survival of the occupants in the event of a collision.
②	The rear floor cross member has been straightened to absorb side impact forces.
③	The bearing forces of the rocker panel, center pillar, and roof side rail are optimized to reduce the amount of body deformation and to secure survival space for occupants.

2-1-3 PEDESTRIAN INJURY REDUCTION BODY CONSTRUCTION

1. The vehicle features body structure to reduce the injuries to pedestrians in the event of a collision involving a pedestrian.
2. Regarding the hood panel, the thickness of the inner panel is reduced and the frame is arranged longitudinally, while allowing space to the components in the engine compartment so that the injuries to pedestrians can be reduced.
3. A crushable structure has been adopted for the cowl panel to reduce the injuries to pedestrians.
4. In order to reduce injury to the pedestrian legs, an impact energy absorbing section is provided on the upper reinforcement of the front bumper of certain specifications and a pedestrian leg-sweeping reinforcement is provided at the lower section.



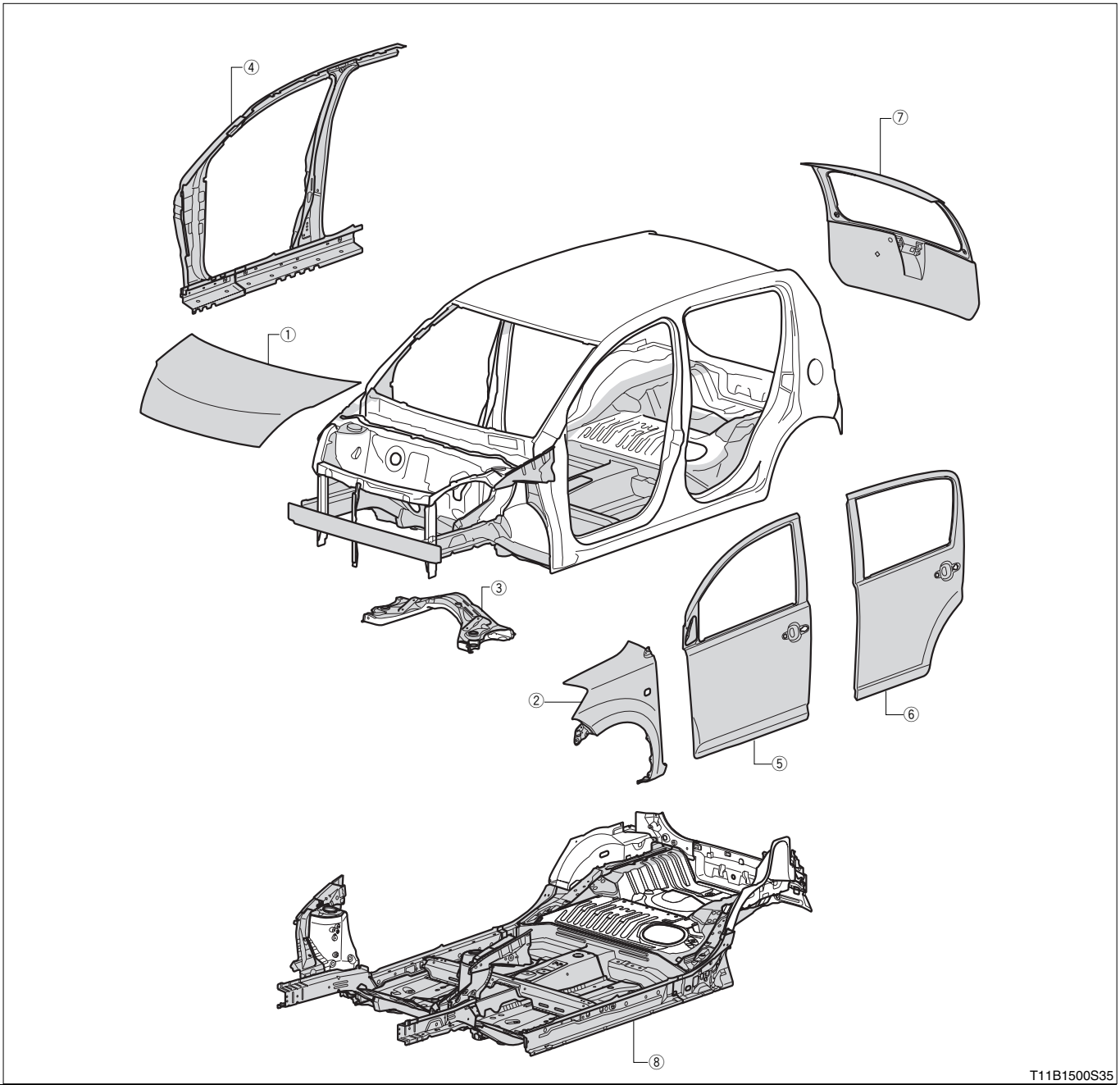
2-2 BODY SHELL

2-2-1 PARTS WHERE HIGH-TENSILE STEEL SHEETS ARE USED

High-tension steel sheets that features light weight and dent-resistance for local external forces have been employed at various sections so that weight reduction and high rigidity may be attained.

NOTE

- Dent-resistance properties: When external forces (e.g. finger pressure during door opening or closing periods or flying stones) are locally applied to outer panels of motor vehicles, very small dents may be formed (Dentability). Properties that have resistance to these dents are called dent-resistance properties.



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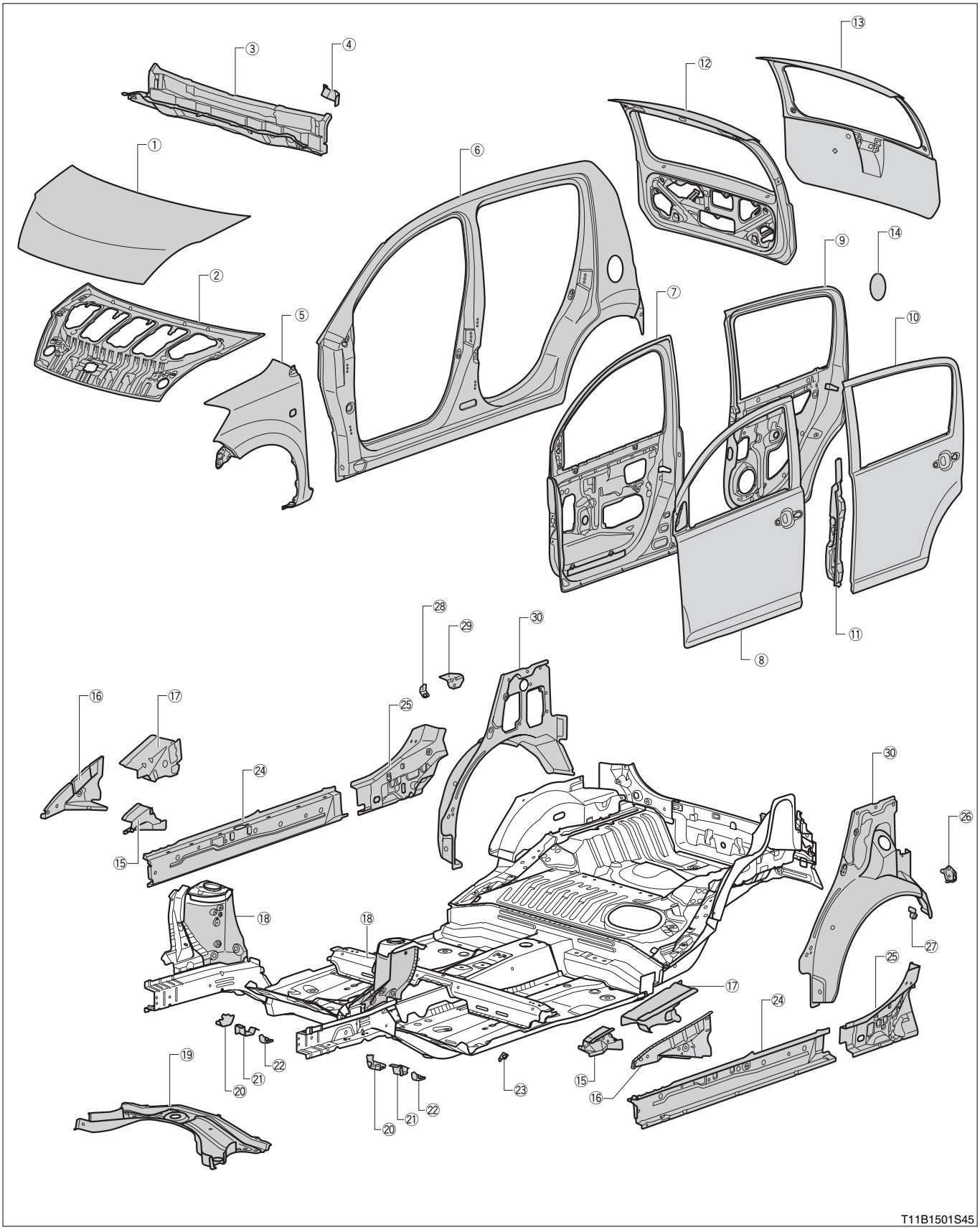
	Applicable components		Applicable components
①	Hood panel	⑤	Front door outside panel RH/LH
②	Front fender panel	⑥	Rear door outside panel RH/LH
③	Suspension Member	⑦	Back door outside panel
④	Reinforcement around front door	⑧	Front floor side member

2-2-2 PARTS WHERE ANTI-RUST STEEL SHEETS ARE USED

For better anti-rust effect, the corrosion-resistant steel plate has been adopted for components that require more stringent conditions concerning rust formation.

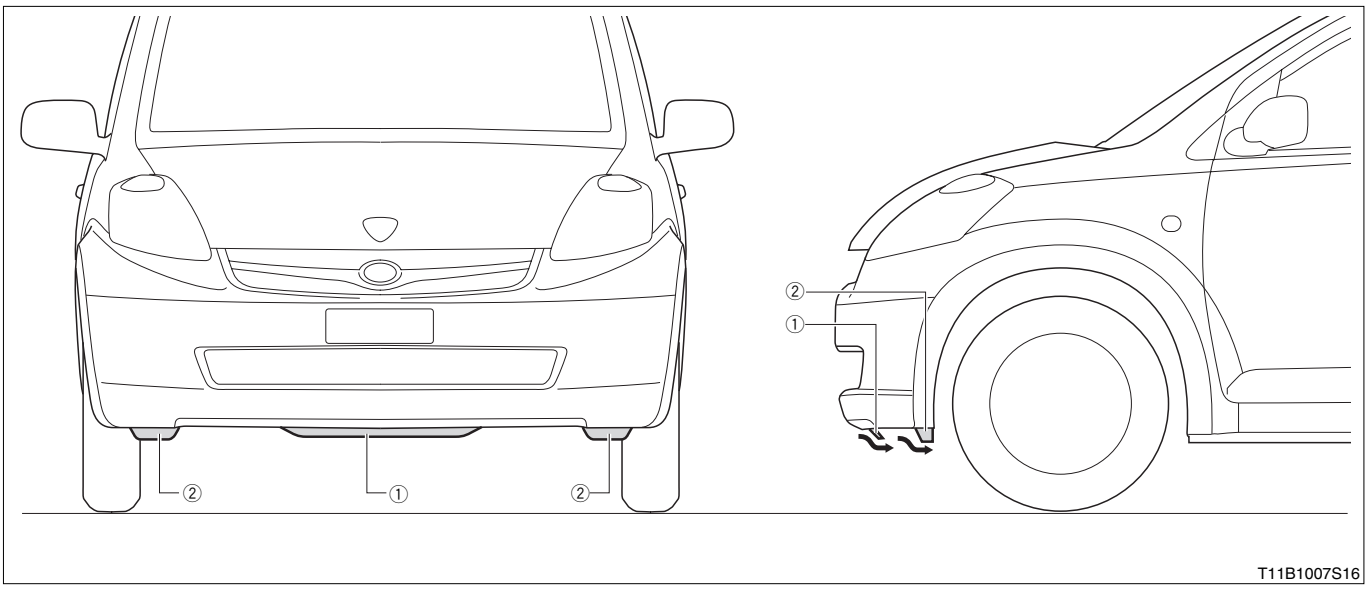


	Part name		Part name
①	Hood panel	⑯	Cowl top side panel RH/LH
②	Hood inner panel	⑰	Cowl top side inner panel RH/LH
③	Cowl top inner panel	⑱	Front fender apron RH/LH
④	Wiper shaft side retainer	⑲	Front suspension lower
⑤	Front fender panel RH/LH	⑳	Brake actuator mounting reinforcement No.1 RH/LH
⑥	Side outer panel RH/LH	㉑	Front suspension member mounting bracket RH/LH
⑦	Front door inside panel RH/LH	㉒	Suspension member spacer reinforcement RH/LH
⑧	Front door outside panel RH/LH	㉓	Flexible hose bracket No.1
⑨	Rear door inside panel RH/LH	㉔	Floor side inner member RH/LH
⑩	Rear door outside panel RH/LH	㉕	Floor side inner rear member RH/LH
⑪	Rear door hinge side panel RH/LH	㉖	Parking brake cable guide bracket No.2 LH
⑫	Back door inside panel	㉗	Parking brake cable guide bracket No.4
⑬	Back door outside panel	㉘	Floor brake hose rear bracket RH
⑭	Fuel filler opening outer lid	㉙	Rear absorber mounting reinforcement
⑮	Front apron to cowl side upper member RH/LH	㉚	Quarter inner panel lower RH/LH

2-3 AERODYNAMIC PERFORMANCE

2-3-1 UNDERBODY AIR FLOW REGULATING ITEM

1. As for the front bumper of the aero-bumper equipped vehicles, its front end has been lowered to rectify the air stream under the floor so that the air resistance may be reduced.
2. The front bumper for the vehicle equipped with the standard bumper features the lip spoiler shape while lowering the front end to control under floor air stream and help reduce air resistance. (Figure below ①) Also the fender liner for the vehicle equipped with the standard-bumper features the spats-like shape at the front end lower to control air stream in front of the tires and help reduce air flow into the tires. (Figure below ②)

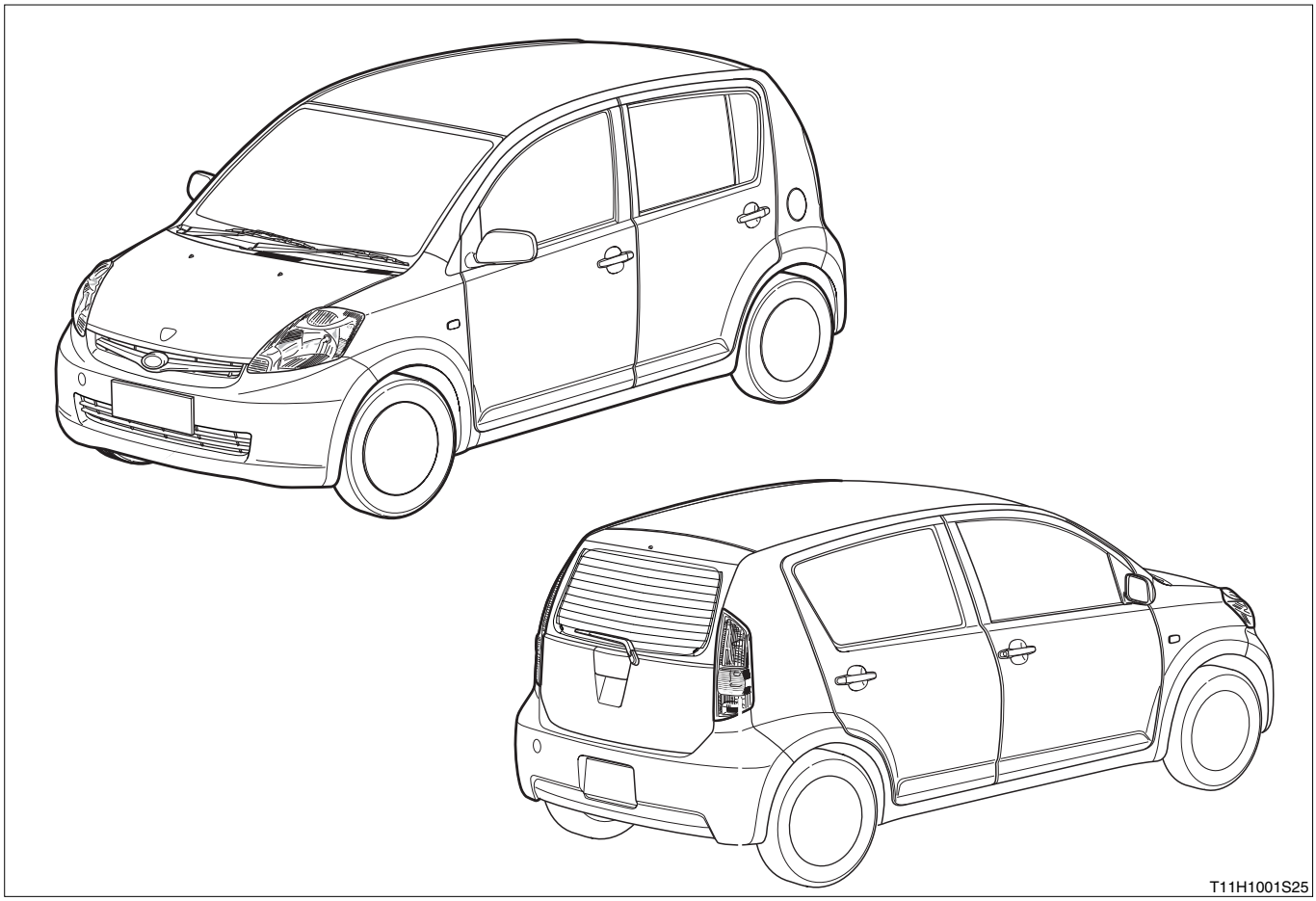


I2 EXTERIOR/INTERIOR

■ EXTERIOR

1 OUTLINE

1. An impression of a big cabin is given with a new image featuring a very short nose and short overhang.
2. In addition to the short overhang, an overwhelming robustness and a feeling of realism are expressed by the flare shape having a feeling of oneness with the bumper, emphasizing the wide tread.
3. Taking into consideration comfortable use of the rear seats and for easier entry/exit of passengers, the rear doors employ a door which opens as widely as approx. 80 degrees.



The illustration represents a major example.

2 CONSTRUCTION AND OPERATION

2-1 BODY COLOR

2-1-1 DESCRIPTION

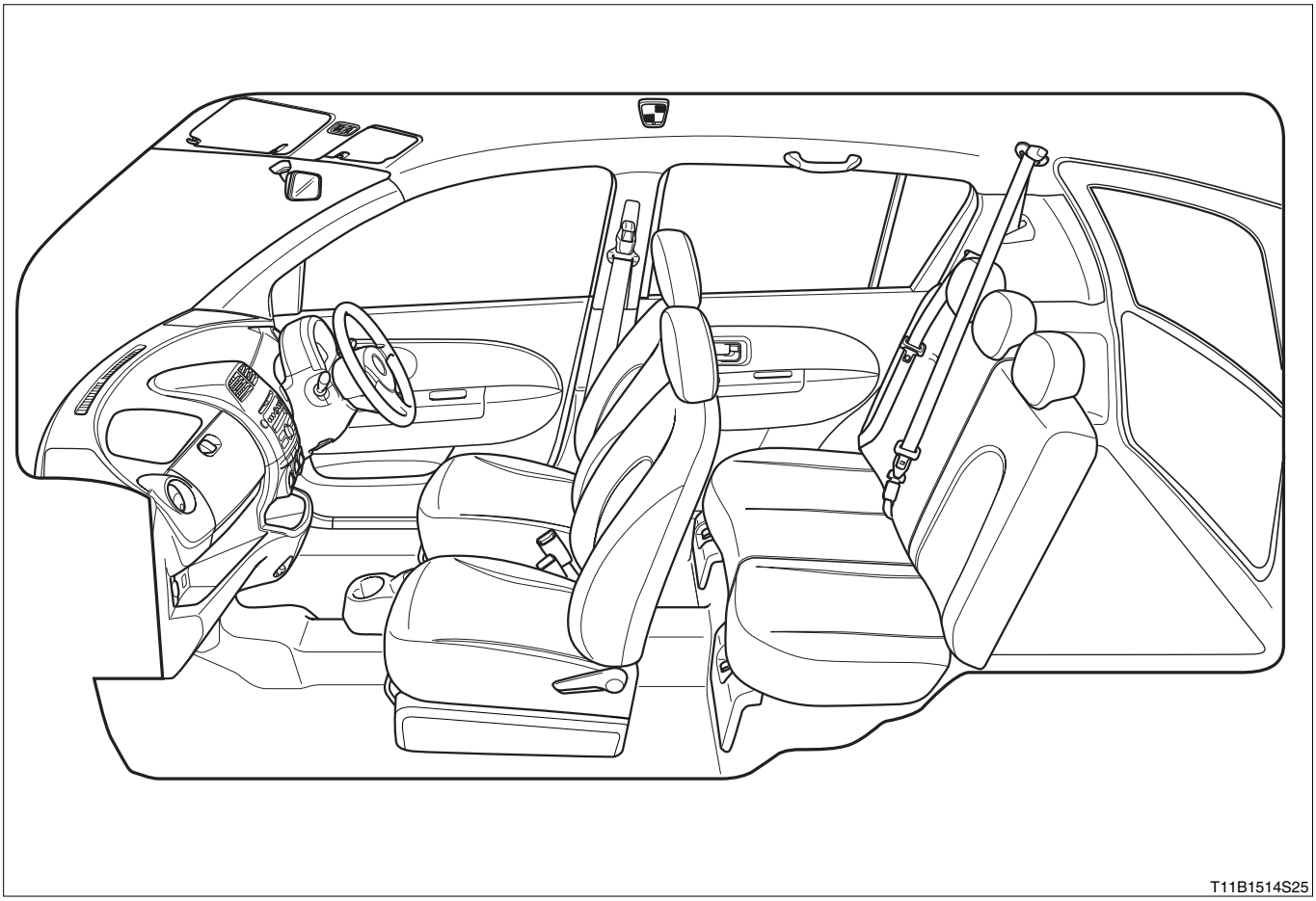
There are a total of eleven colors for the body outer panel color.

2-1-2 COLOR NO.

Body color name	Color code
White	W09
Pearl white I	W16
Brigth silver metallic	S28
Black mica metallic	X07
Shining Red	R40
Champagne metallic opal	T17
Mint blue metallic opal	B57
Gray metallic	S30
Yellow green mica metallic	G43
Maroon mica	R56
Yellow metallic	Y08

■ INTERIOR
1 OUTLINE

1. A simple, clean, lively, smart life-partner has been created.
2. The large round extending from the instrument panel to the door trim creates an impression of a spacious vehicle interior and an open feeling.
3. The three-point type ELR-VW seat belt is provided on the rear central seat on some specifications.
4. A headrest is provided at the center of the rear seat of some specifications.

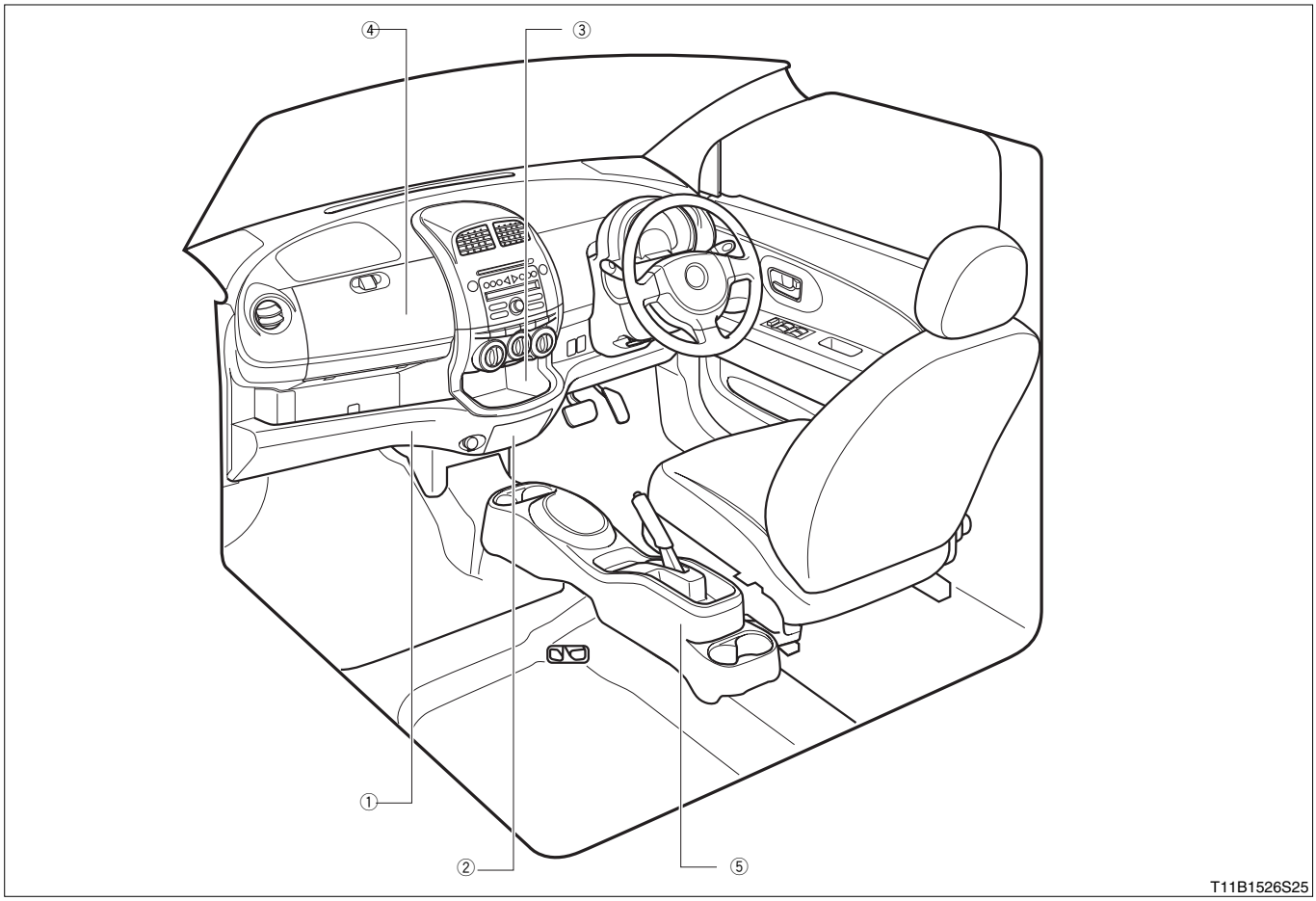


The illustration represents a major example.

2 CONSTRUCTION AND OPERATION

2-1 INSTRUMENT PANEL

2-1-1 DESCRIPTION



The illustration represents a major example.

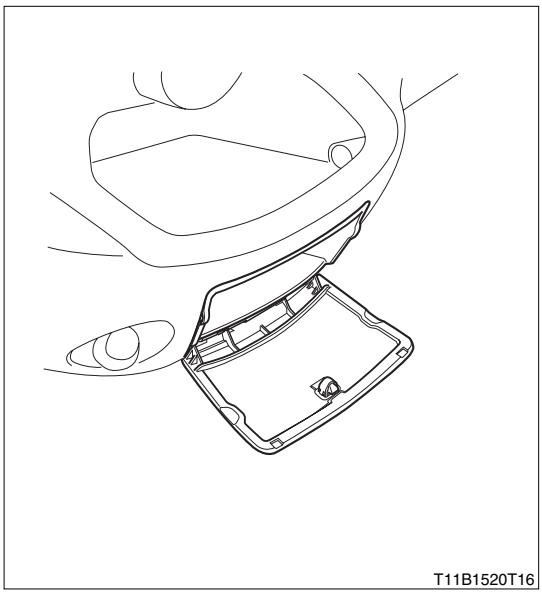
①	Wide free rack
②	Utility box
③	Multi tray
④	Upper-and-lower divided glove box
⑤	Console box

2-1-2 WIDE FREE RACK

For improved convenience, a wide free rack is provided at the lower part of the glove box.

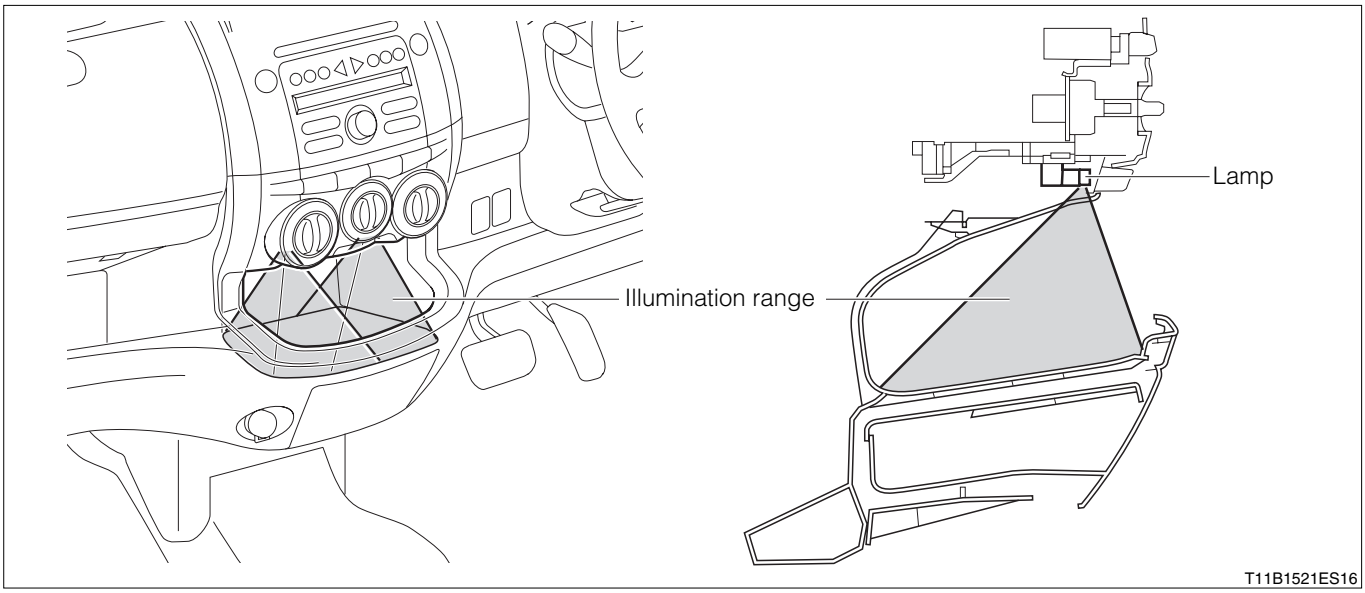
2-1-3 UTILITY BOX

For improved convenience, a utility box has been provided at the center cluster lower section (just below the multi-tray).



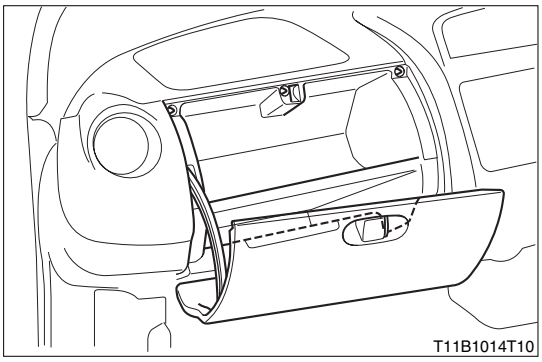
2-1-4 MULTI-TRAY

For improved convenience, a multi-tray with a night-illumination is provided at the lower section of the center cluster.



2-1-5 UPPER-AND-LOWER DIVIDED GLOVE BOX

For improved convenience, the glove box storage section is divided into two levels of an upper section and a lower section.

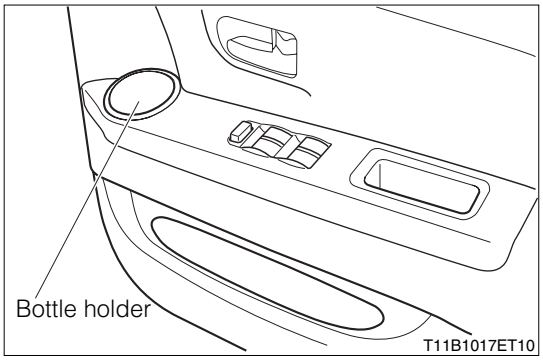


2-1-6 CONSOLE BOX

For improved convenience, a console box is provided between the front seats, which can serve as a bottle holder for the front seat·rear seat.

2-2 DOOR TRIM

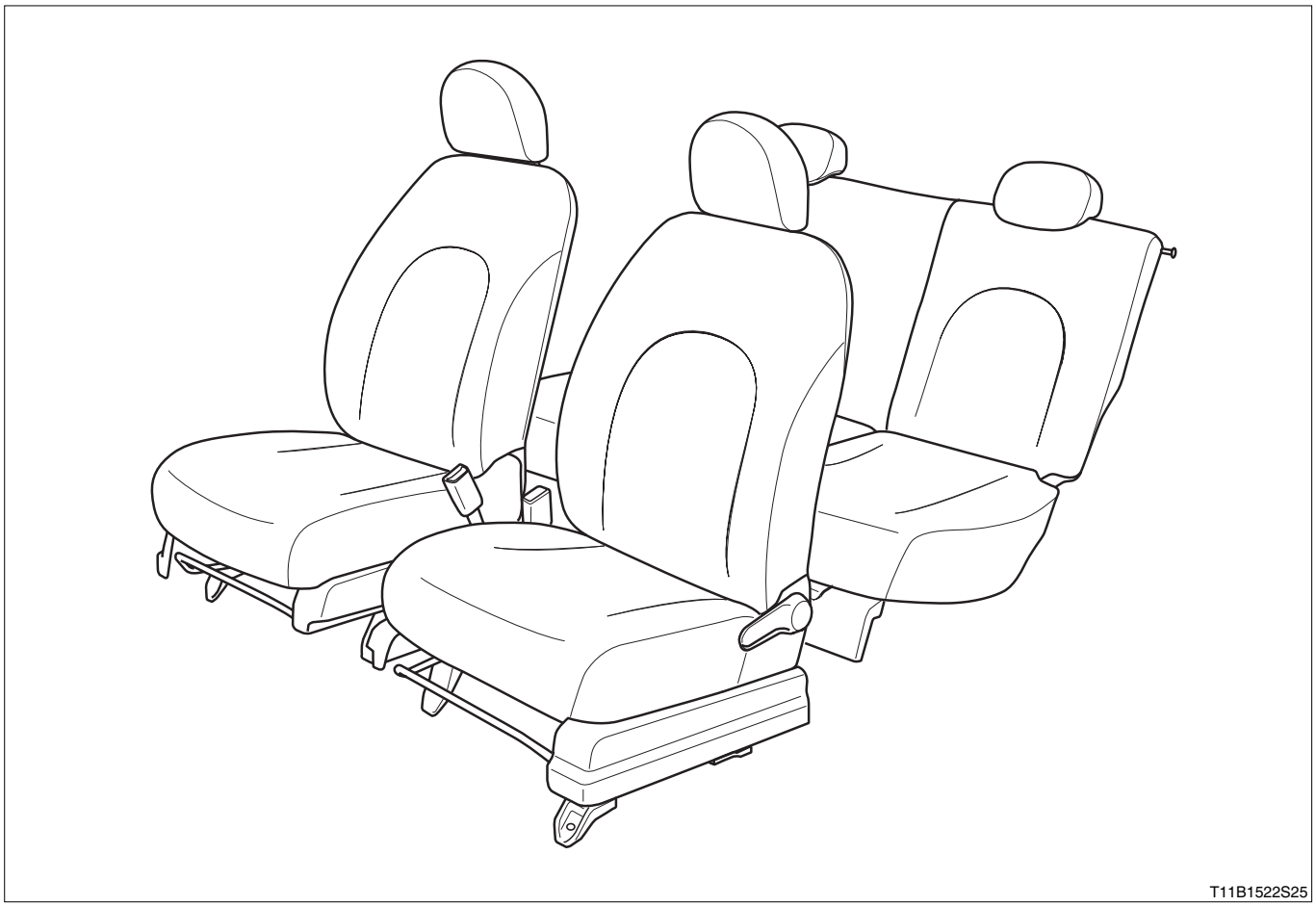
For improved convenience, a bottle holder is provided in the front door trim.



2-3 SEAT

2-3-1 DESCRIPTION

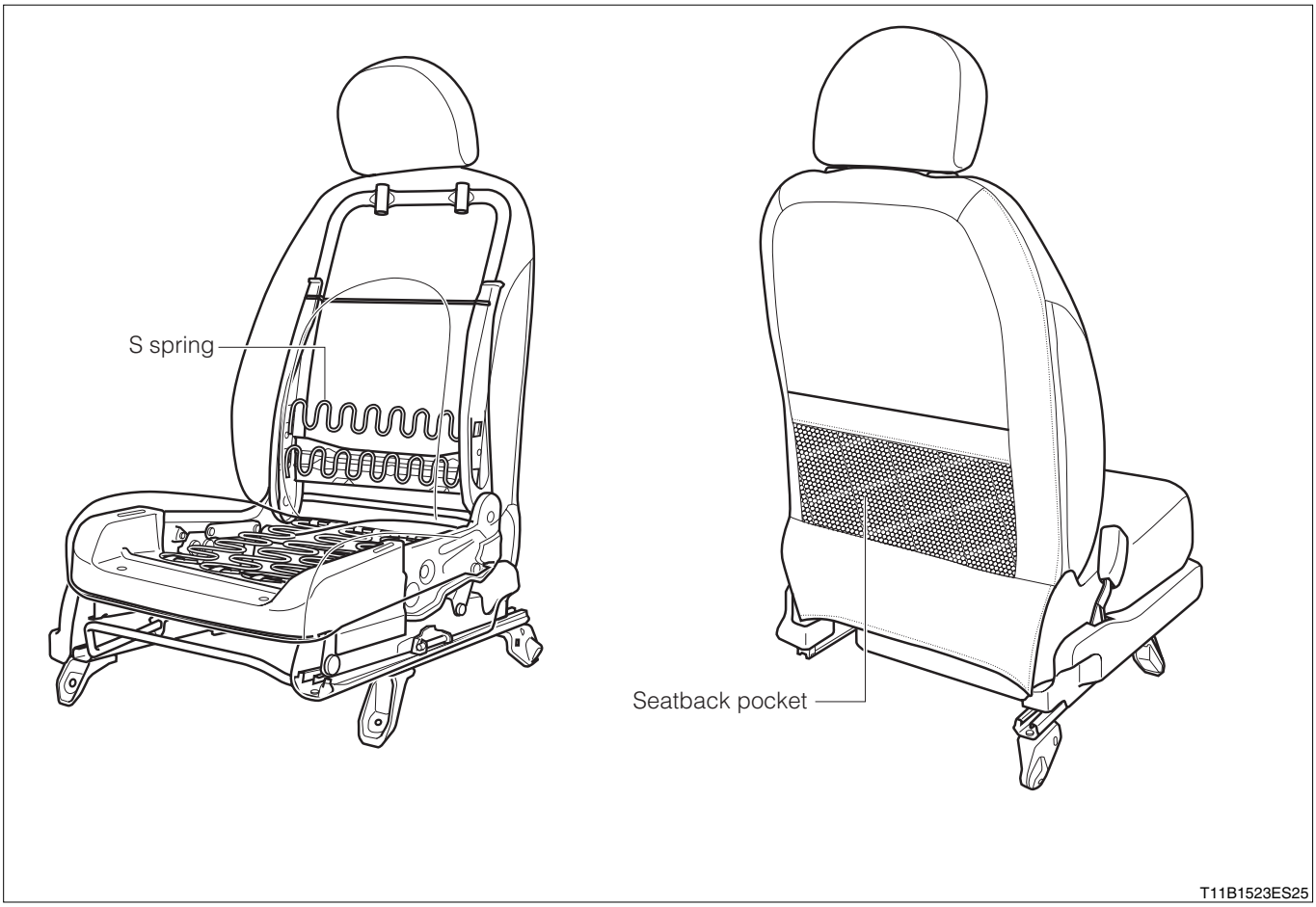
1. In order to achieve a light, stylish design, a simple and natural shape is employed.
2. For easier access from the front seat to the rear seat, the shoulder section of the seatback of the front seats has been rounded off.
3. All vehicles have employed a 6:4 dividing rear seats with a reclining mechanism, capable of the flat luggage mode and long cushion mode.
4. The ISOFIX bar for securing child seat and anchor bracket are provided at the rear seat of some specifications.



2-3-2 FRONT SEAT

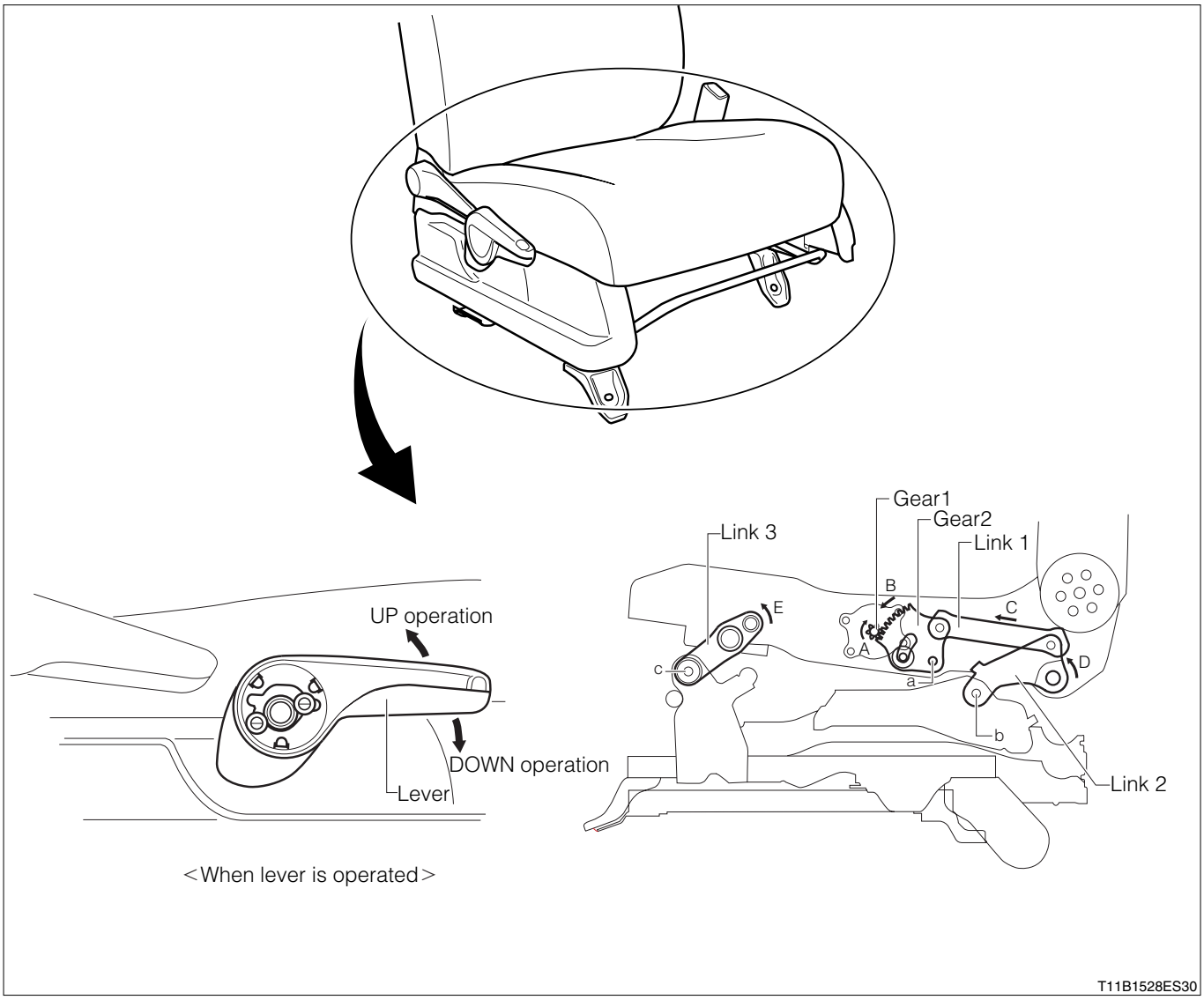
(1) Seatback pocket

1. For enhanced absorption of the cushion vibration, the cushion support mechanism is of an S-spring construction.
2. A seatback pocket is provided on the back of the passenger seat, depending on the specifications.



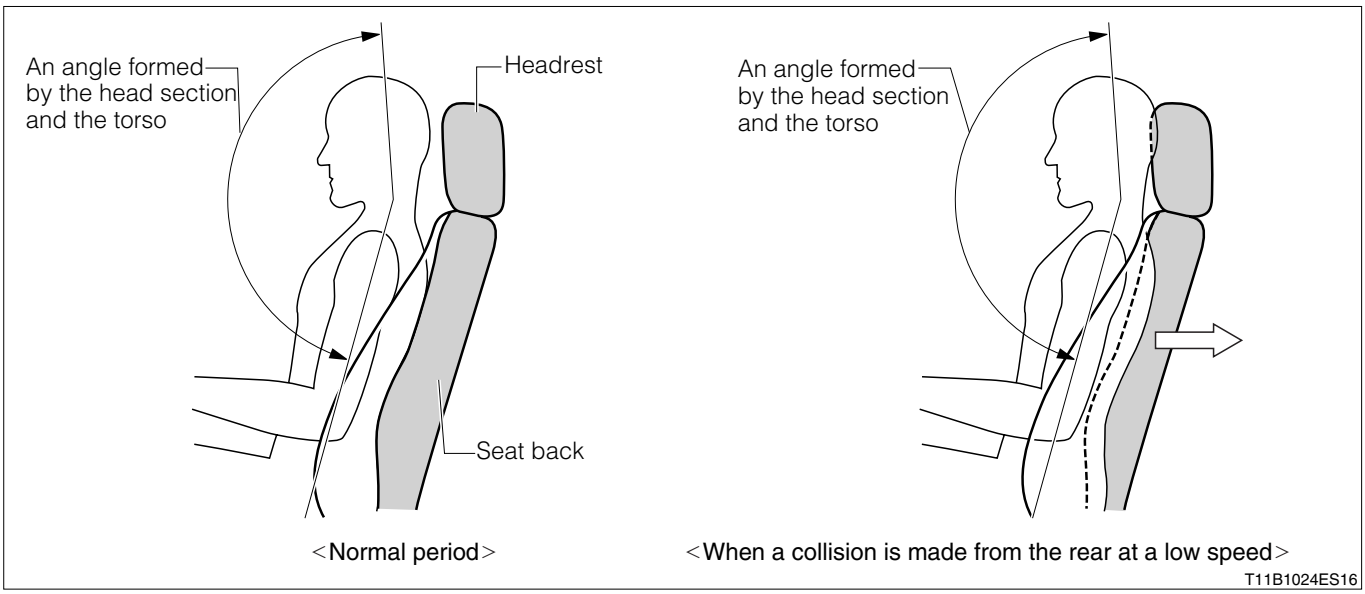
(2) Driver's seat lifter

1. When the seat is to be raised, set the lever on the driver's seat cushion side to the UP side. Thus, in interlocking with this operation, the gear 1 turns in the direction of the arrow A and the gear 2 turns in the direction of the arrow B about the fulcrum a.
2. The gear 2 is provided with the link 1. As a result of the turning of the gear 2 in the direction of the arrow B, the link 1 moves in the direction of C, and the link 2 turns in the direction of the arrow D about the fulcrum b.
3. When the link 2 turns in the direction of the arrow D, thus lifting the rear edge of the seat, the link 3 turns in the direction of the arrow E about the fulcrum C. Consequently, the whole seat is lifted up.
4. When the seat is lowered, set the leaver to the DOWN side. Thus, the respective gears and links operate in the reverse order of the UP operation.



(3) WIL (Whiplash Injury Lessening) concept seat

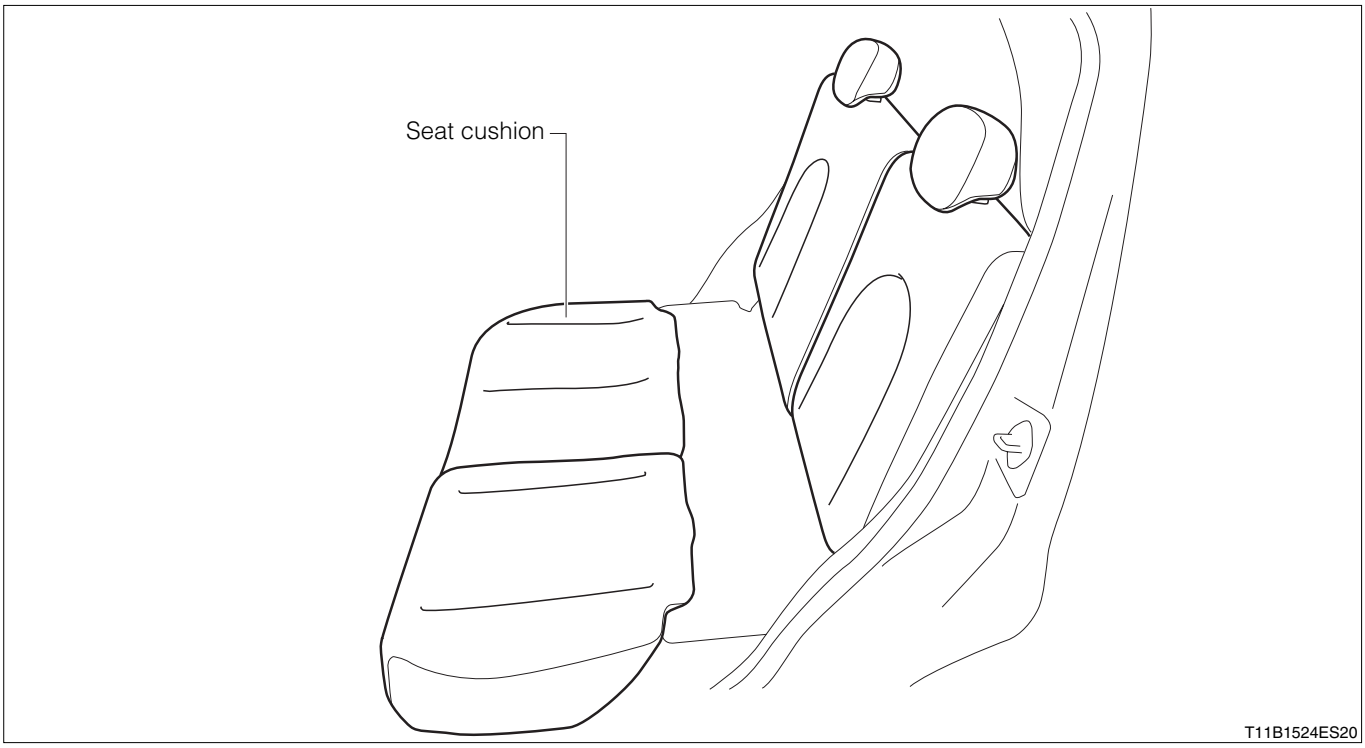
A WIL concept seat supports and holds the angle of the head and body of an occupant so that the relative movement of the body and head is prevented as much as possible, thus reducing the impact to the neck, during a low speed rear-end collision.



2-3-3 REAR SEAT

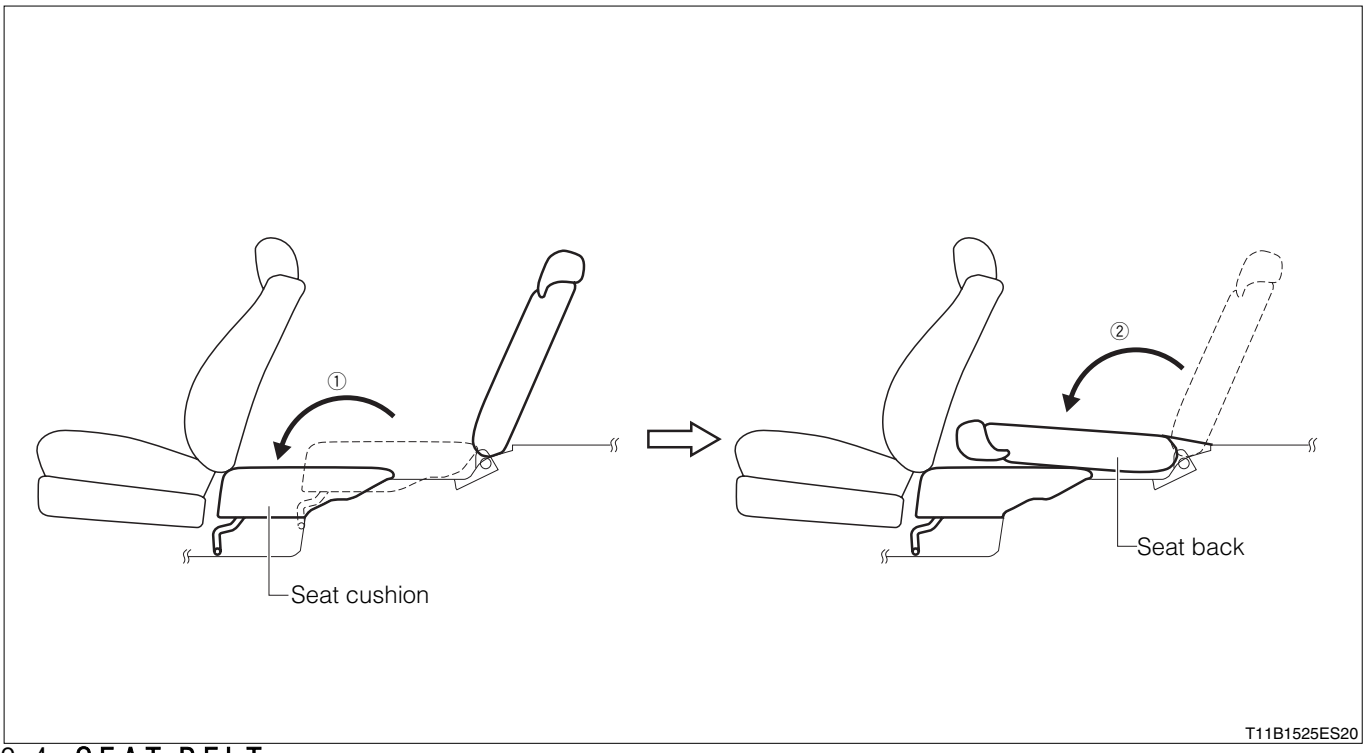
(1) Long cushion mode rear seat

When the rear seat cushions are moved in a front/lower direction, an almost flat space is realized.



(2) Flat luggage mode

When the passenger seat is set to the long cushion mode (Figure ① below) and the seatback of the rear seat is folded forward (Figure ② below), a wide, flat space is realized.



2-4 SEAT BELT

2-4-1 DESCRIPTION

1. The driver's seat and passenger seat are provided with seat belts with pretensioner + force limiter mechanism.
2. The three-point type ELR−VW seat belt is provided on the rear central seat on some specifications.

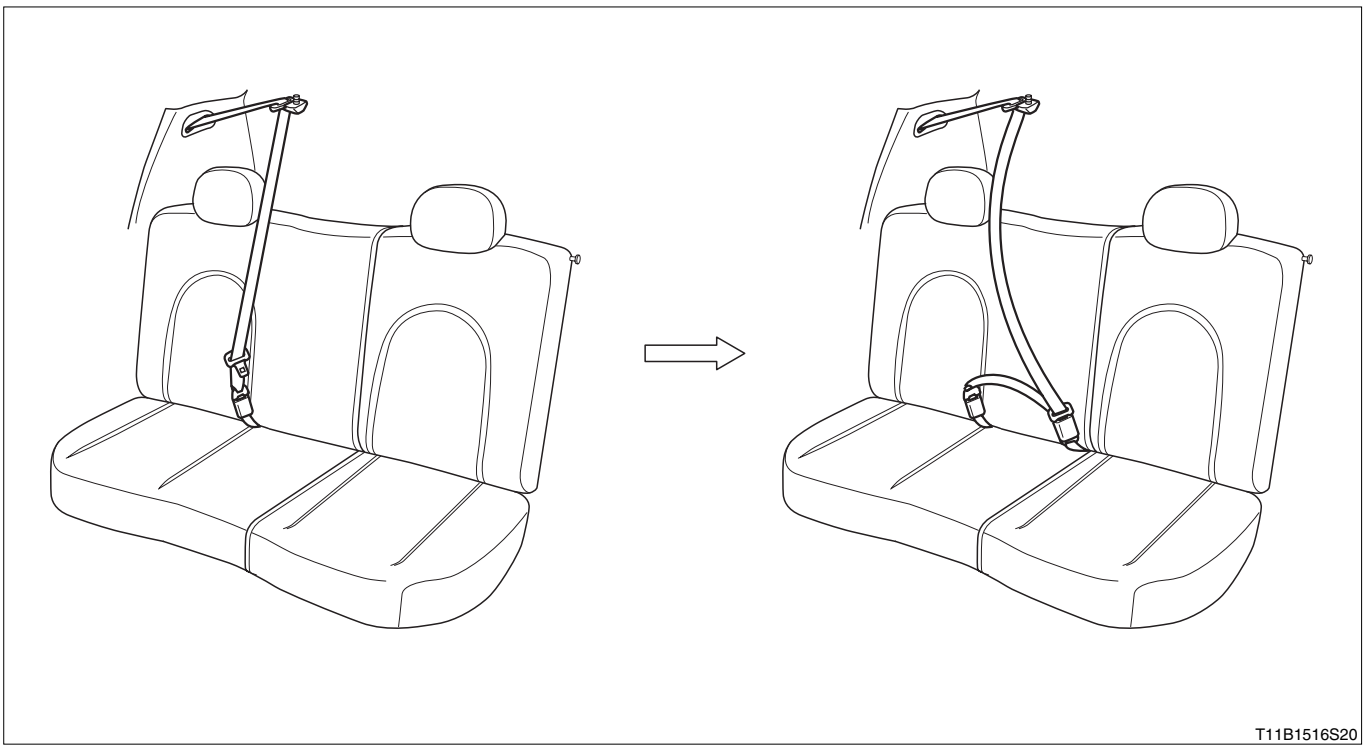
	3-point type ELR−VW	Pretensioner mechanism+ Force limiter mechanism	ELR−ALR
Front seat (Driver's seat, front passenger's seat)	○	○	−
Rear seat(RH, LH)	−	−	○
Rear seat(CTR)	○	−	−

NOTE

- For details of the seat belt with pretensioner mechanism + force limiter mechanism, refer to the section under <H1.SRS airbag>.
- ELR−VW (Emergency Locking Retractor − Vehicle + Webbing)Emergency locking retractor − double sensing type: This type responds to both the vehicle acceleration and belt pulling acceleration.
- ALR (Automatic Locking Retractor): This mechanism is locked at any position automatically by the locking mechanism when the seat belt is extended and fastened.

2-4-2 CENTRAL SEAT BELT ON REAR SEAT

1. The three-point type ELR-VW seat belt is provided on the rear central seat on some specifications.
2. When the seatback of the rear seat is folded forward, insert the key into the right side buckle of the center seat belt of the rear seat so as to remove the plate.



T11B1516S20

I3 WINDSHIELD WINDOWGLASS/MIRROR

1 CONSTRUCTION AND OPERATION

1-1 GLASS

1-1-1 OUTLINE

UV cut glass which reduces the ultraviolet transmission is employed for the windshield glass and front door glass.

1-1-2 GLASS SPECIFICATIONS

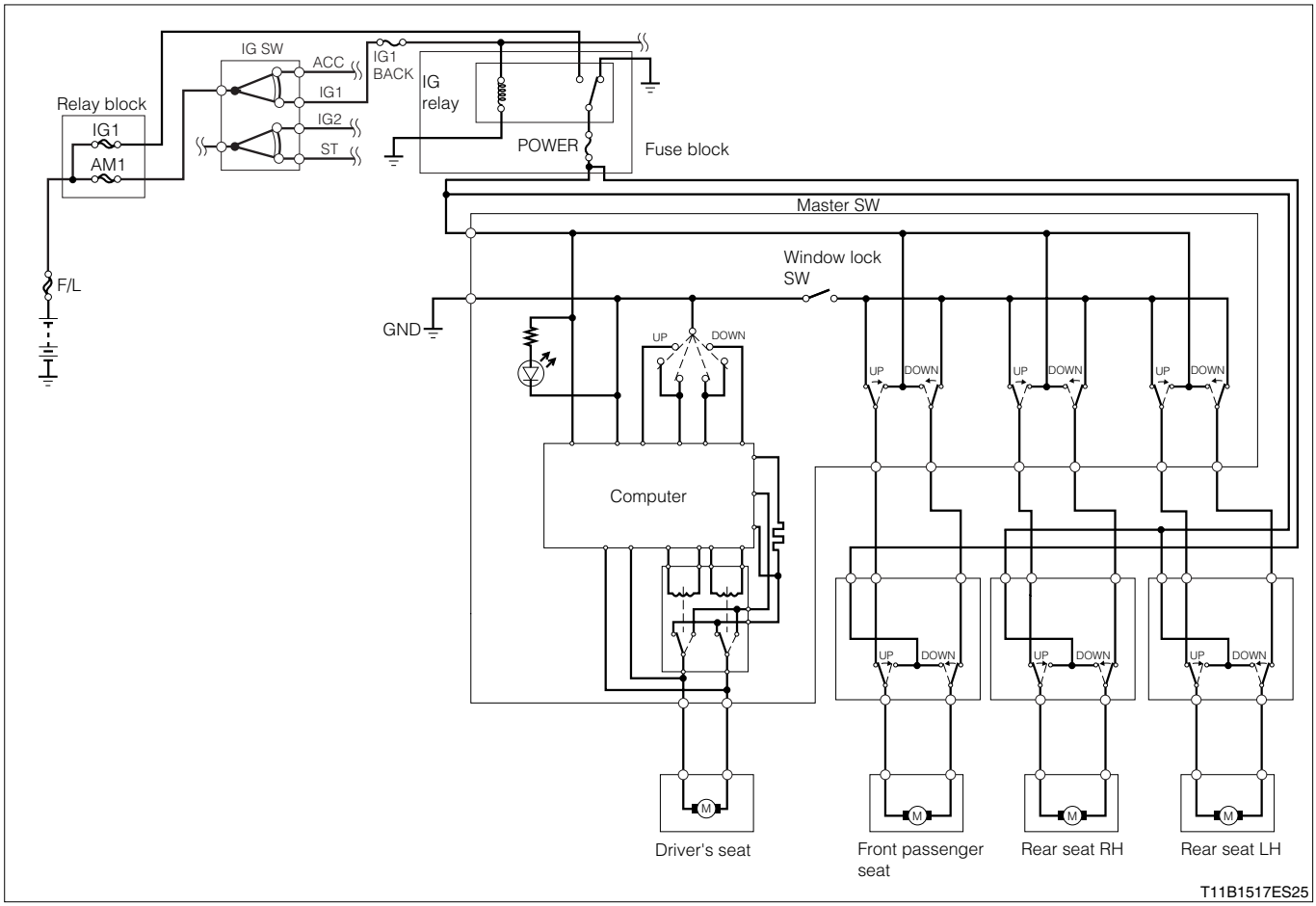
Measuring point	Installation method	Type	Sheet thickness (mm)	Visible light transmission rate (%)	Ultraviolet light transmission rate Reference value(%)
Windshield glass	Adhesion	Heat absorbing laminated glass (Green + UV-filtering)	4.7	78.3	Approx. 0
Front door glass	—	Heat absorbing toughened glass (Green + UV-filtering)	3.1	75.4	Approx. 10
Rear door glass	—	Heat absorbing toughened glass (Green)	3.1	82.2	Approx. 40
Rear door quarter glass	—	Heat absorbing toughened glass (Green)	3.1	82.2	Approx. 40
back door glass	Adhesion	Heat absorbing toughened glass (Green)	3.1	82.0	Approx. 30

1-2 POWER WINDOW

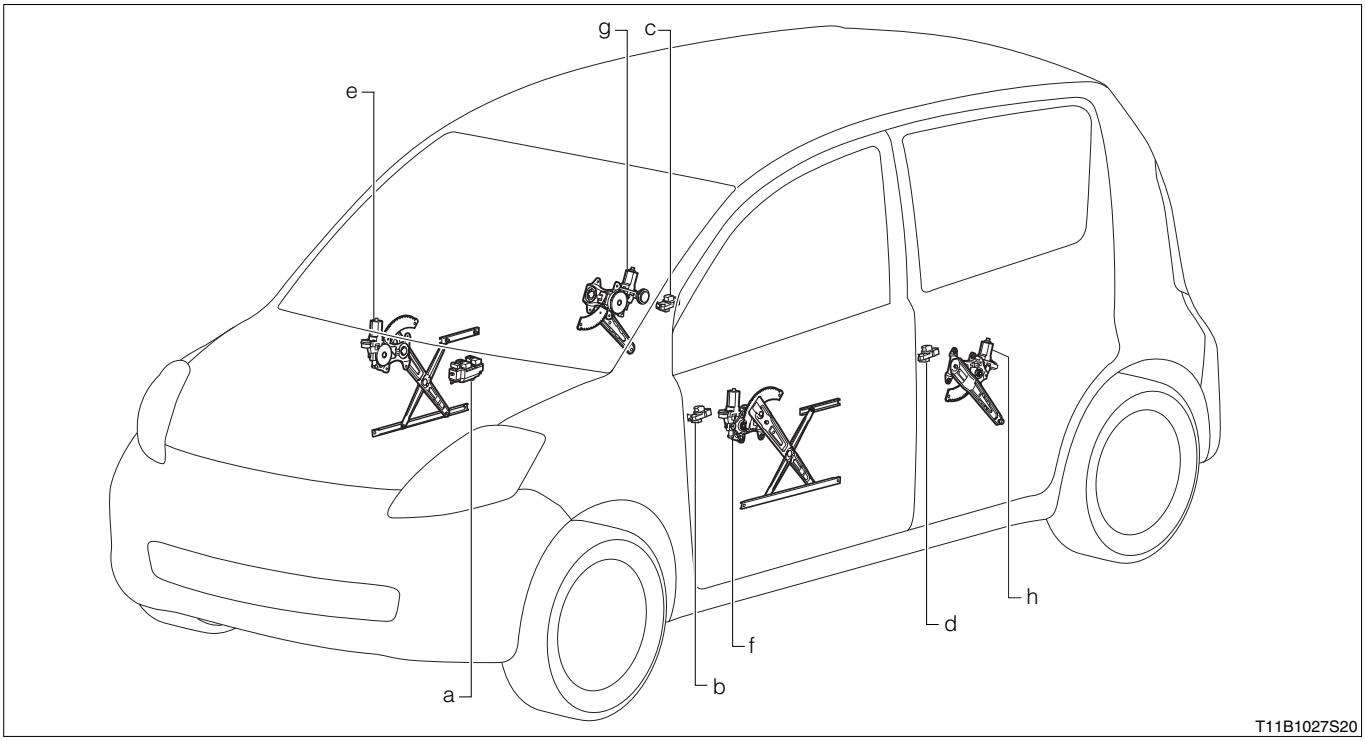
1-2-1 OUTLINE

1. The power window is provided on all the models.
2. The auto down function is provided on the power window of the driver's seat door.
3. Lighting has been added to the driver's seat door power window switch to improve convenience.

1-2-2 SYSTEM WIRING DIAGRAM



1-2-3 LOCATION OF COMPONENTS



The illustration represents the RHD vehicle.

a	Power window master switch
b	Front door power window switch
c	Rear door power window switch RH
d	Rear door power window switch LH
e	Front door regulator motor RH
f	Front door regulator motor LH
g	Rear door regulator motor RH
h	Rear door regulator motor LH

1-2-4 SWITCH ILLUMINATION FUNCTION

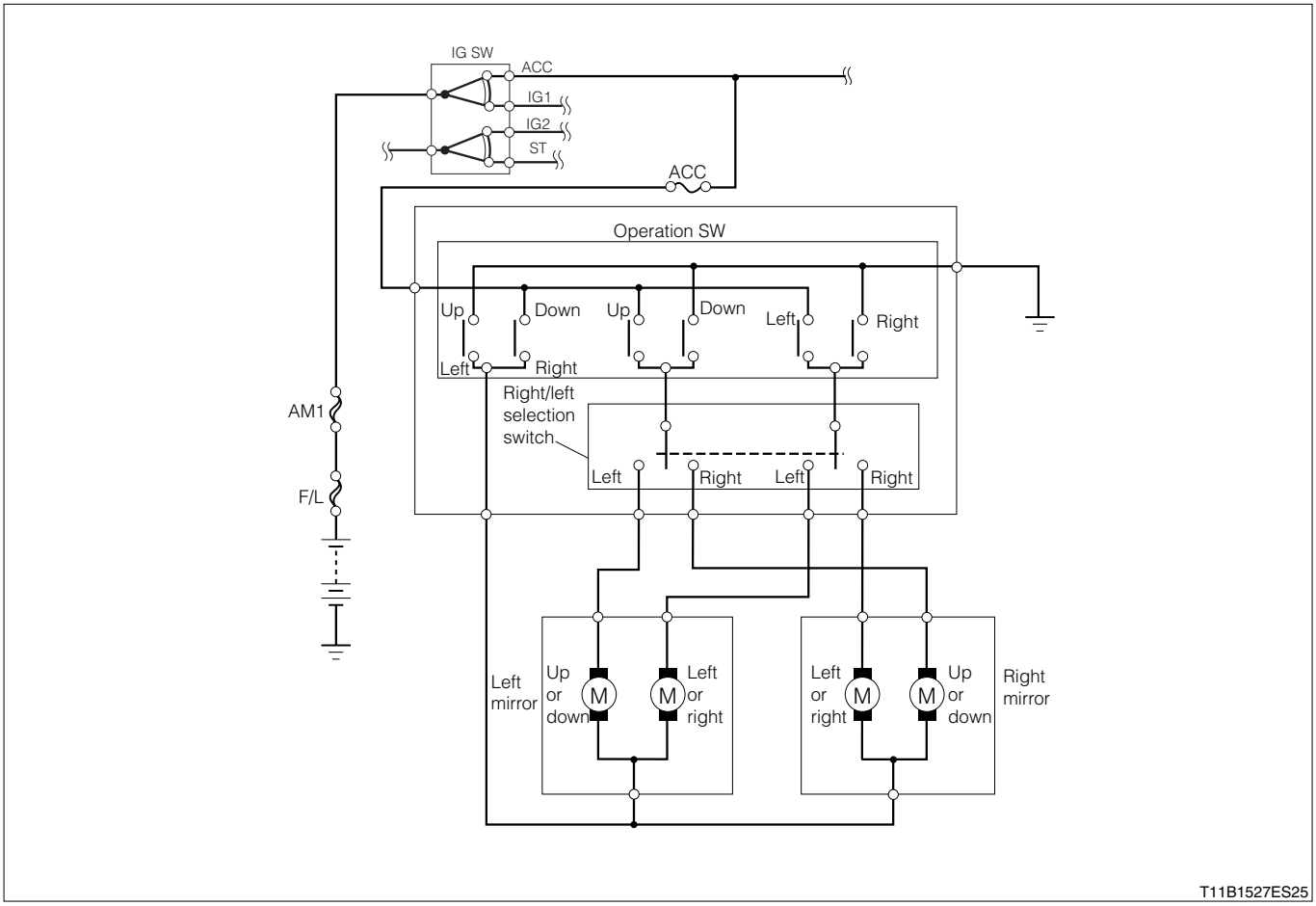
With the ignition switch turned "ON", turn on the driver's seat door power window switch.

1-3 OUTER REARVIEW MIRROR

1-3-1 OUTLINE

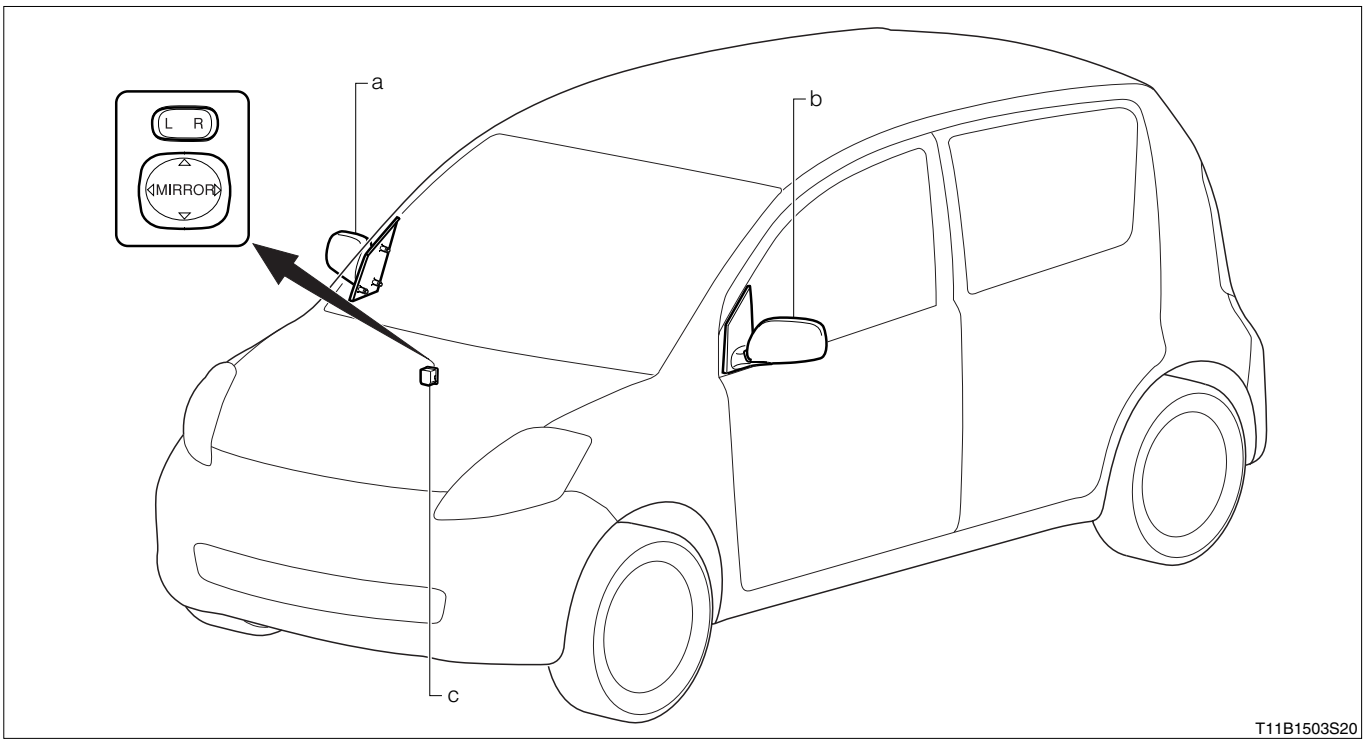
The mirror surface movable type outer rear view mirror is provided on some specifications. Since the mirror surface section and cover can be removed, they can be replaced individually.

1-3-2 SYSTEM WIRING DIAGRAM



T11B1527ES25

1-3-3 LOCATION OF COMPONENTS

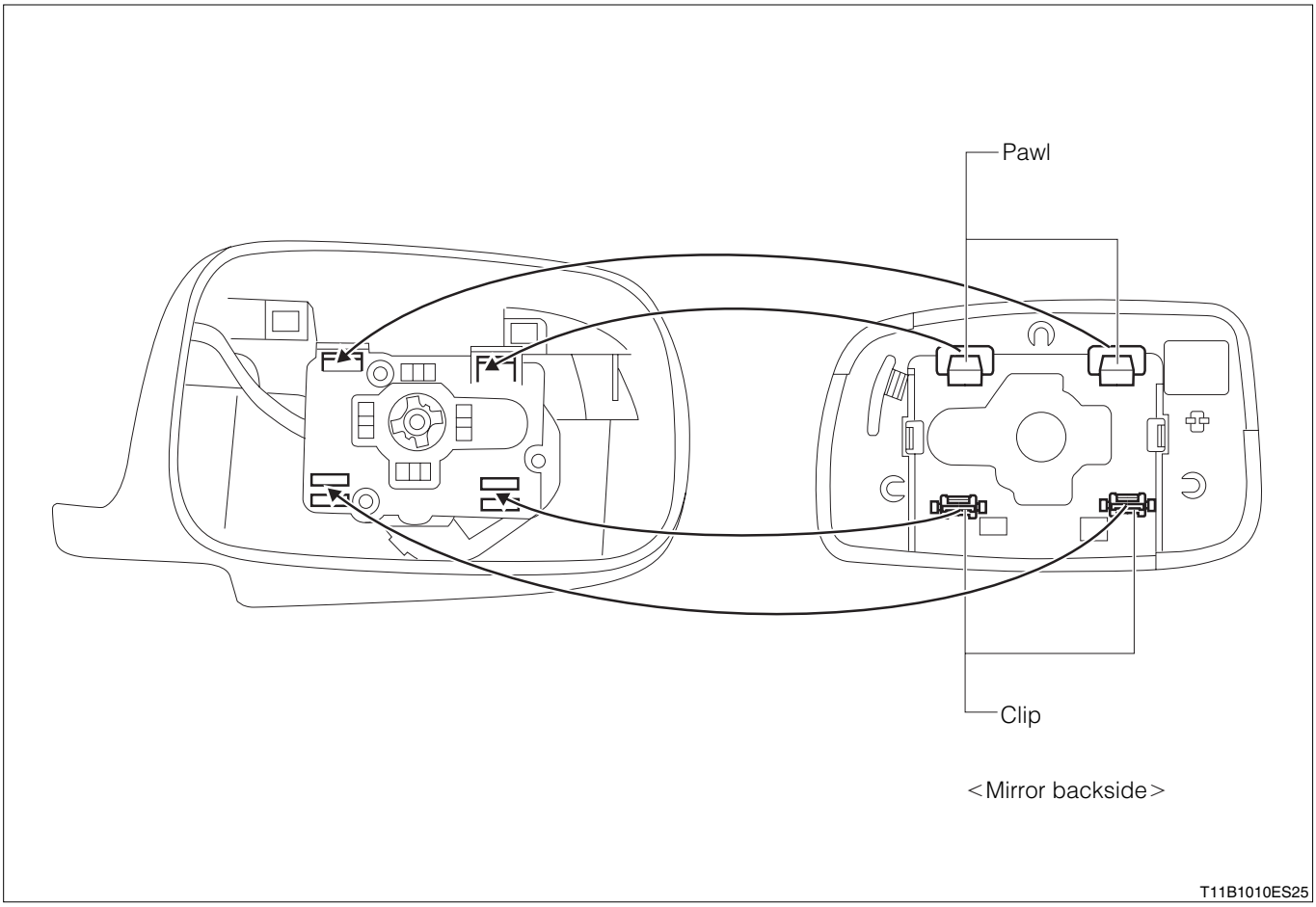


T11B1503S20

The illustration represents the RHD vehicle.

1-3-4 MIRROR SURFACE REMOVABLE CONSTRUCTION

Since mirror surface can be removed, the mirror part can be replaced individually.



I4 DOOR LOCK & THEFT DETERRENT

■ DOOR LOCK SYSTEM

1 OUTLINE

1. The power door lock is provided on all the models.

2. The LIN communication system is employed in a part of the door lock system circuit.
3. The body integrated controller (ITC) is directly attached to the fuse block.
4. The radio wave type keyless entry system is provided on all the models. The "LOCK" and "UNLOCK" operations for the front doors, rear doors and back door can be performed by the remote control operation.
Refer to Page I4-10.

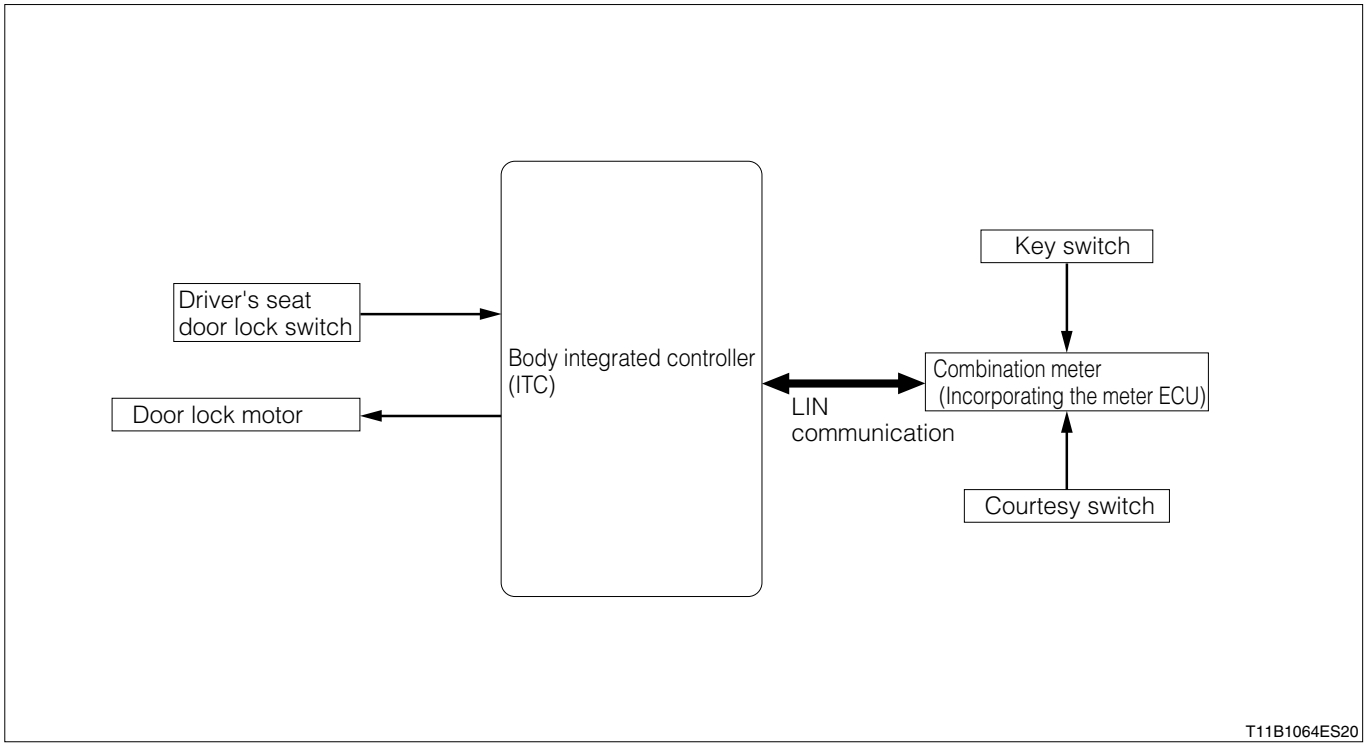
■ POWER DOOR LOCK SYSTEM

1 OUTLINE

1-1 DESCRIPTION

1. The power door lock is fitted to all vehicles as standard. The front passenger seat door, right and left rear doors and back door can be locked and unlocked interlocking with the lock lever at the driver's seat door or the key cylinder operation.
2. The LIN communication system is employed in a part of the system circuit.

1-2 SYSTEM DRAWING



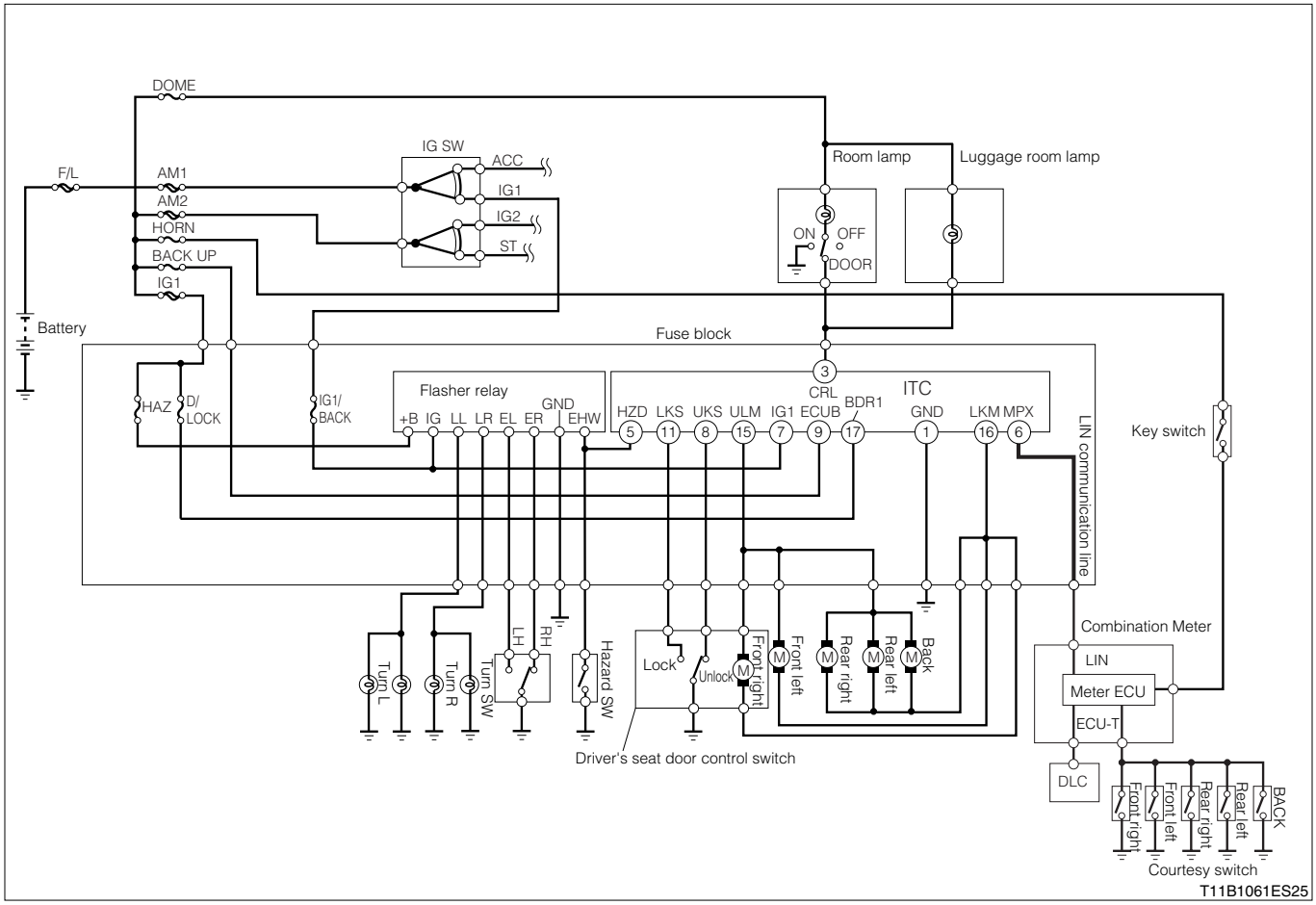
Contents of multiplex communication control

Sending	Receiving	Nomenclature of signals	Contents of control
Meter ECU	ITC	Signal of terminal ECU-T	ECU-T terminal check control
ITC	Meter ECU	Sleep non-permission signal	Sleep (low current mode) transfer prohibition *1

*1

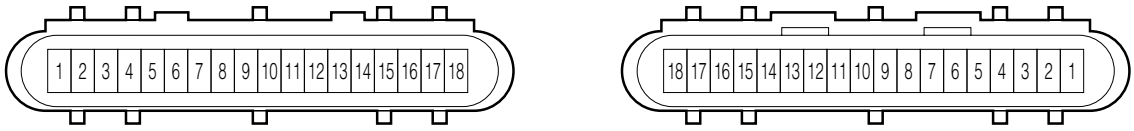
Refer to Page I4-16.

1-3 SYSTEM WIRING DIAGRAM



T11B1061ES25

Computer connector terminal arrangement diagram



ITC

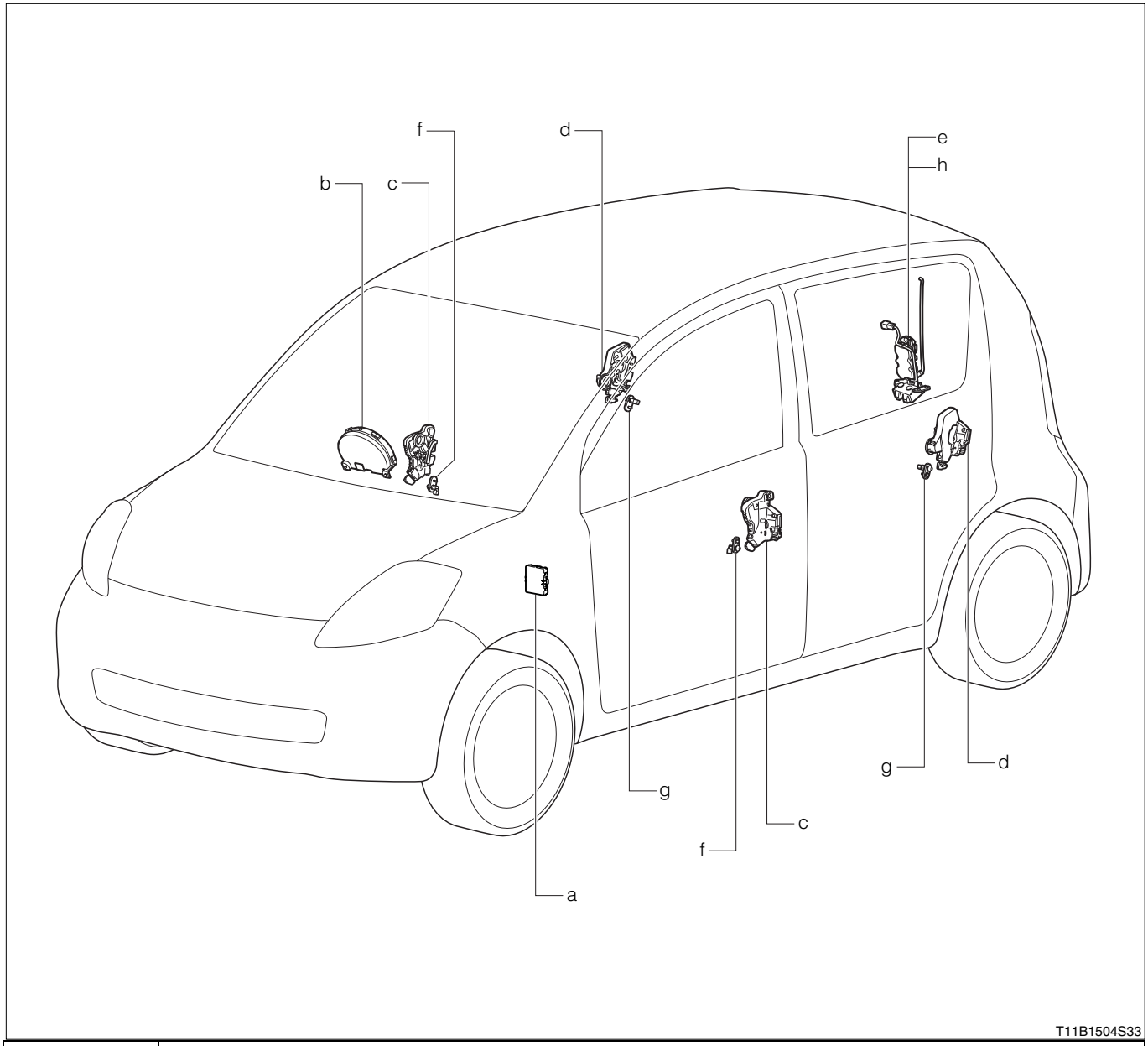
ITC (fuse block side)

M21B5015ES10

Body integrated controller (ITC) terminal name

Terminal No.	Terminal code	Terminal name
1	GND	Earth
2	—	—
3	CRL	Room lamp driving output
4	—	—
5	HZD	Hazard lamp driving output
6	MPX	LIN communication input/output
7	IG1	ECU power supply
8	UKS	Door control unlock side switch input
9	ECU B	ECU power supply
10	—	—
11	LKS	Door control lock side switch input
12	—	—
13	—	—
14	—	—
15	ULM	Door lock motor unlock side output
16	LKM	Door lock motor lock side output
17	BDR1	Power supply
18	—	—

1-4 LOCATION OF COMPONENTS



T11B1504S33

a	Body integrated controller (ITC)
b	Meter ECU
c	Front door lock motor
d	Rear door lock motor
e	Back door lock motor
f	Front door courtesy switch
g	Rear door courtesy switch
h	Back door courtesy switch

2 CONTROL

2-1 KEY LOCKING PREVENTION SYSTEM

1. When all of the following conditions are met, after the door locking procedure has been completed, the door locks are immediately unlocked, thus preventing the key from being locked in.
   (1) The key is inserted into the ignition key cylinder. (Key switch is "ON".)
   (2) Any of the doors are open. (Courtesy switch is "ON".)
   (3) When the driver's seat door lock knob is switched from "UNLOCK" to "LOCK". (Driver's seat door control switch is switched from "UNLOCK" to "LOCK".)

2. When all of the following conditions are met and 1 second has elapsed, the door locks are unlocked thus preventing the key from being locked in.
   (1) The key is inserted into the ignition key cylinder. (Key switch is "ON".)
   (2) The ignition switch is set to "ACC" or "LOCK".
   (3) The driver's seat door lock knob is at the "LOCK". (Driver's seat door control switch is set to "LOCK".)
   (4) Any door is open. →All doors are closed. (Courtesy switch is switched from "ON" to "OFF".)

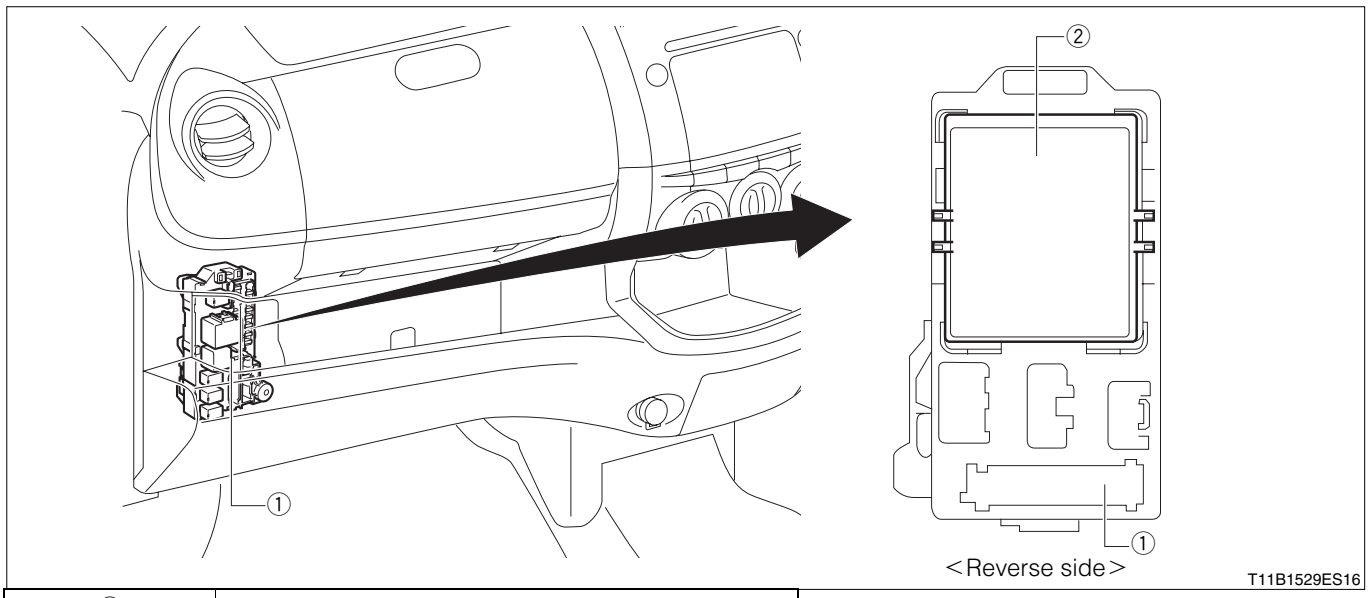
2-2 WAKE-UP/SLEEP FUNCTION

The body integrated controller has a wake-up/sleep function in order to reduce the current used when the ignition is switched to "ACC" or "LOCK".

3 COMPONENTS

3-1 BODY INTEGRATED CONTROLLER (ITC)

1. It is attached to the reverse side of the fuse block on the lower left hand side of the instrument panel.
2. The ITC receives a signal from the driver's seat door lock switch and controls the power door lock motor.



①	Fuse block
②	Body integrated controller (ITC)

3-2 COMBINATION METER

Signals, such as the ECU-T terminal signal, are sent over the LIN communication line to the ITC from the meter ECU in the combination meter.

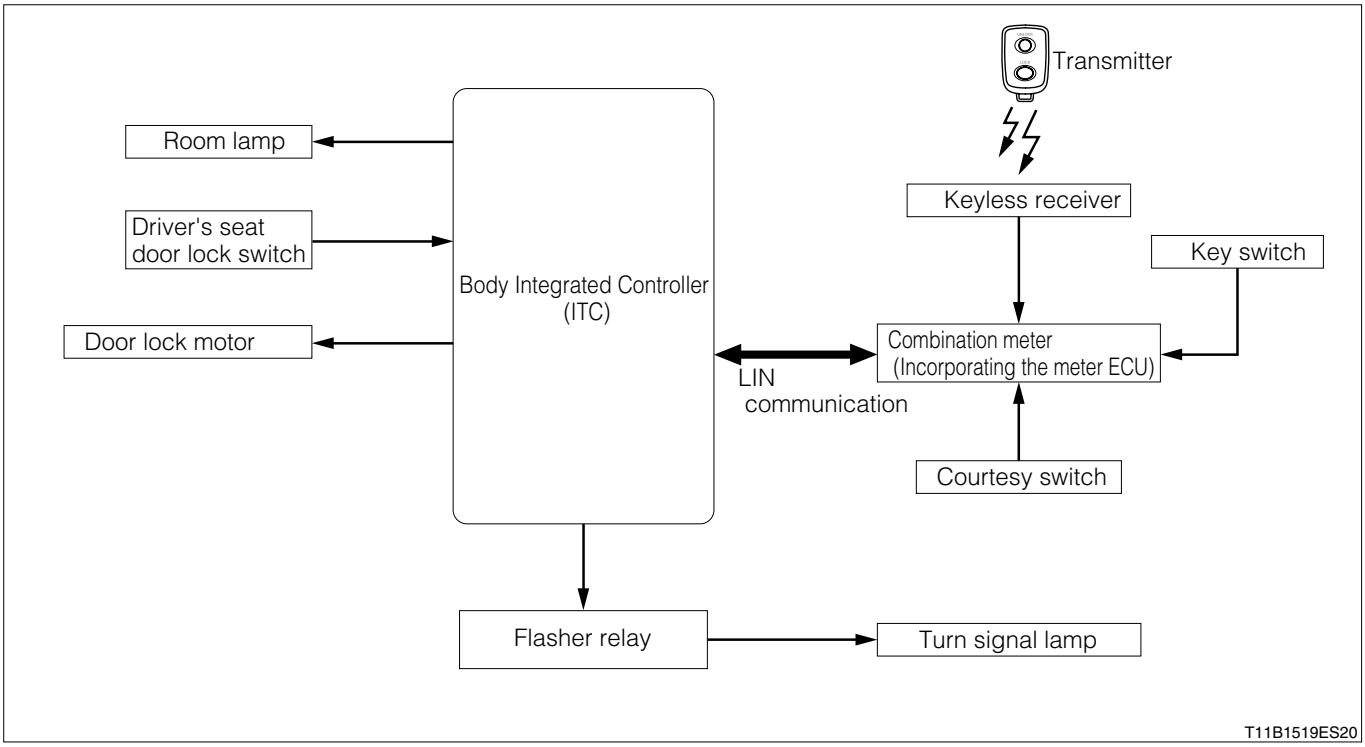
■ KEY-LESS ENTRY SYSTEM

1 OUTLINE

1-1 DESCRIPTION

1. The radio wave type keyless entry system is provided on all the models. The "LOCK" and "UNLOCK" operations for the front doors, rear doors and back door can be performed by the remote control operation.
2. The remote control of locking all the doors is possible by pushing the switch of the transmitter which is apart from the key, thus sending weak waves.
3. The operation range of remote control is approx. 3 meters in radius from the center of the vehicle. However, the range might be reduced or the function could be disabled due to the battery drain, strong radio wave or noise. Also the operation range might be affected by the shape of the vehicle.
4. The LIN communication system is employed in a part of the system circuit.

1-2 SYSTEM DRAWING



Contents of LIN communication control

Sending	Receiving	Signal Nomenclature	Contents of control
Meter ECU	ITC	Keyless door lock signal	Door lock, answer back control
		Keyless door unlock signal	Door unlock, answer back control
		Key switch signal	Key locked in prevention control
		Door courtesy switch signal	Room lamp control *1
ITC	Meter ECU	Sleep non-permission signal	Sleep (low current mode) transfer prohibition *2

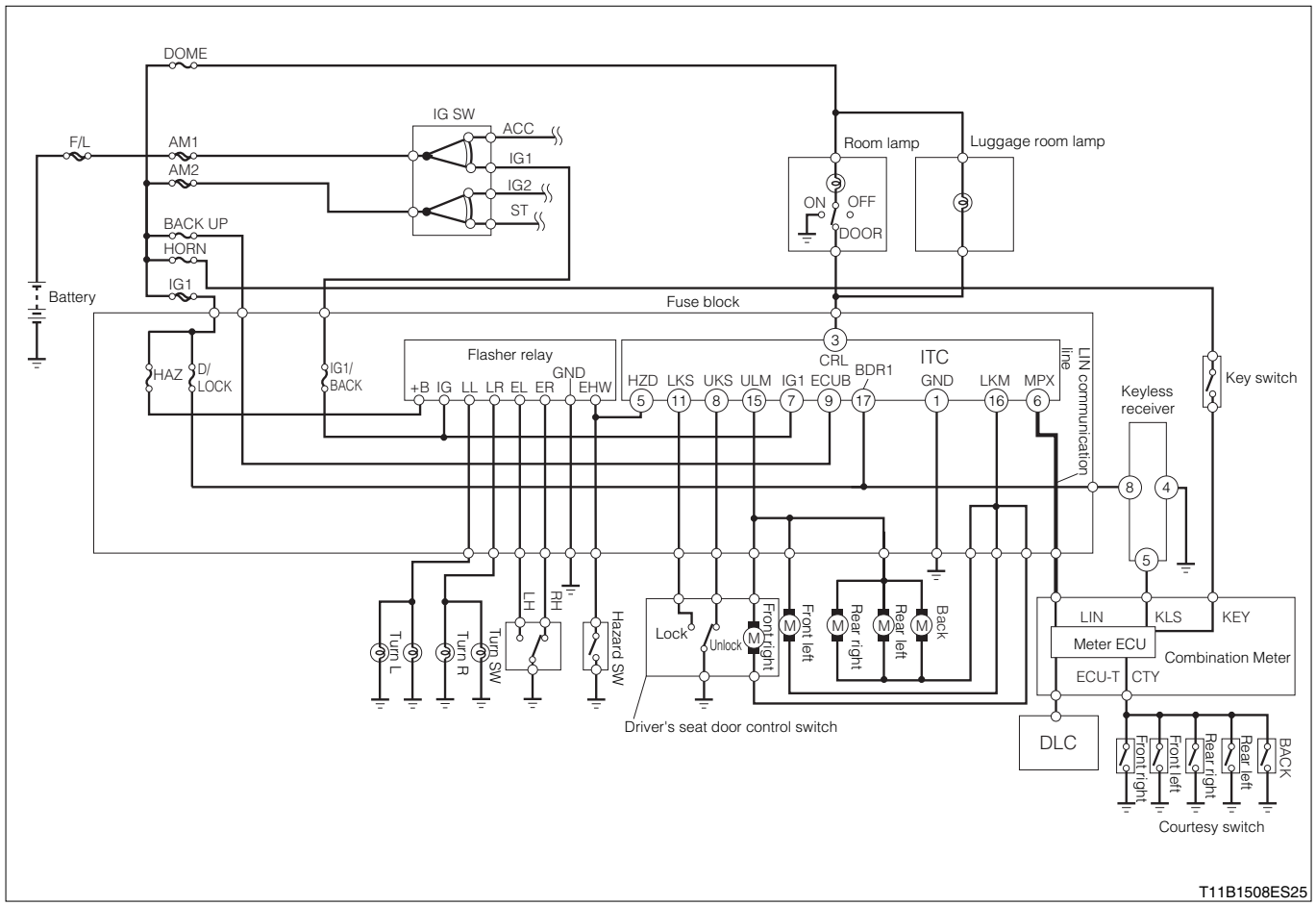
*1

Refer to Page J1-9.

*2

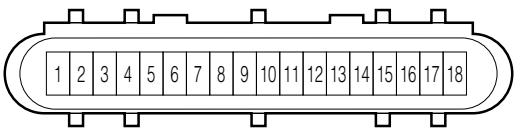
Refer to Page I4-16.

1-3 SYSTEM WIRING DIAGRAM

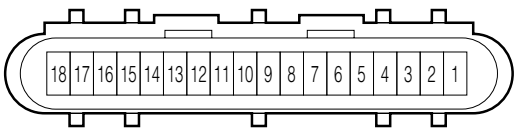


T11B1508ES25

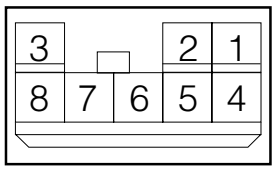
Computer connector terminal arrangement diagram



ITC



ITC fuse block side



Keyless reciever

T11B8511ES16

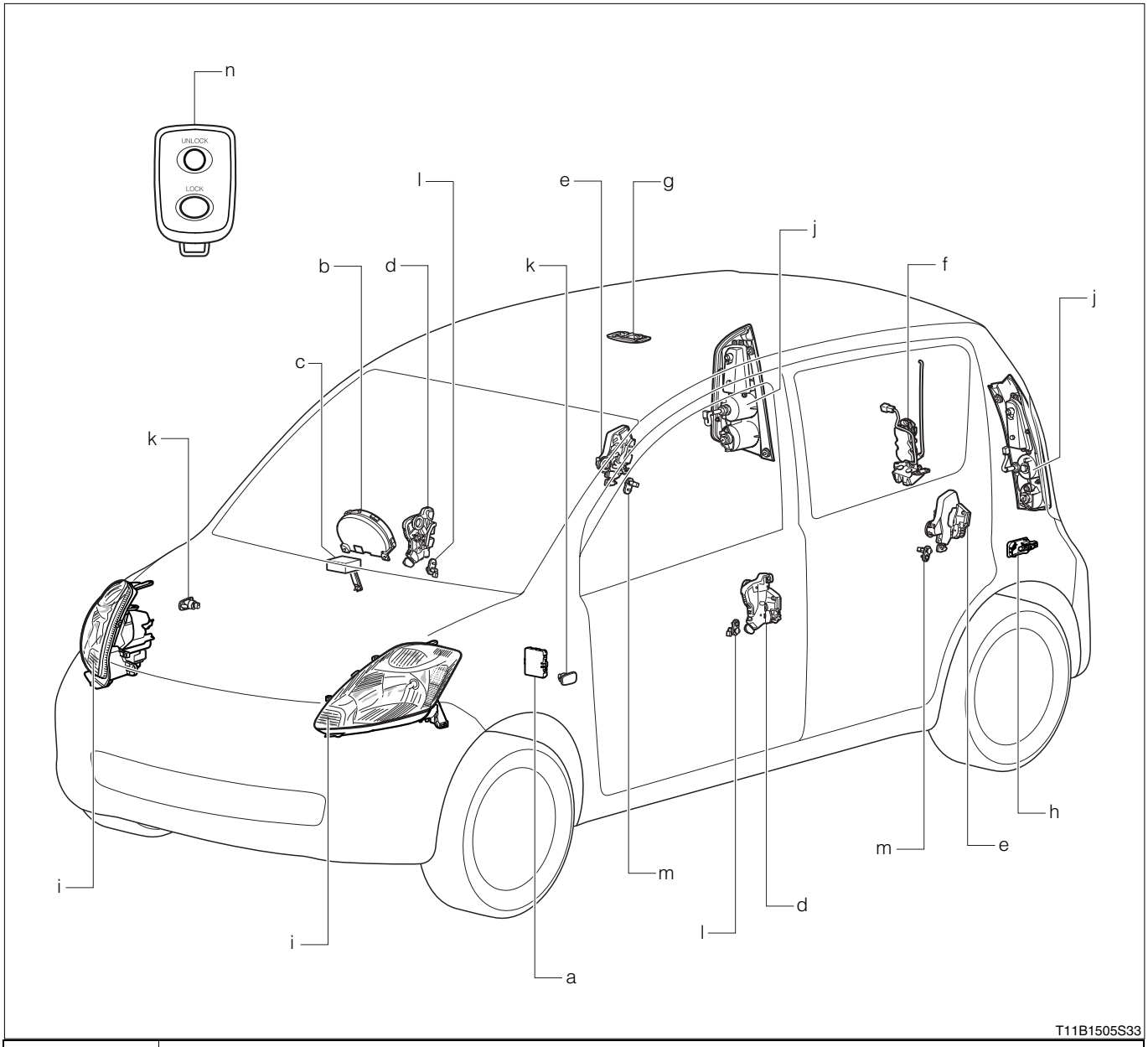
Body integrated controller (ITC) terminal name

Terminal No.	Terminal code	Terminal name
1	GND	Earth
2	—	—
3	CRL	Room lamp driving output
4	—	—
5	HZD	Hazard lamp driving output
6	MPX	LIN communication input / output
7	IG1	ECU power supply
8	UKS	Door control unlock side switch input
9	ECU B	ECU power supply
10	—	—
11	LKS	Door control lock side switch input
12	—	—
13	—	—
14	—	—
15	ULM	Door lock motor unlock side output
16	LKM	Door lock motor lock side output
17	BDR1	Power supply
18	—	—

Receiver connector terminal name

Terminal No.	Terminal code	Terminal name
1	—	—
2	—	—
3	—	—
4	GND	Earth
5	SIG	Keyless signal output
6	—	—
7	—	—
8	+B	Receiver power supply

1-4 LOCATION OF COMPONENTS



T11B1505S33

a	Body integrated controller (ITC)
b	Meter ECU
c	Keyless receiver
d	Front door lock motor
e	Rear door lock motor
f	Back door lock motor
g	Room lamp
h	Luggage room lamp
i	Front turn signal lamp
j	Rear turn signal lamp
k	Side turn signal lamp
l	Front door courtesy switch
m	Rear door courtesy switch
n	Transmitter

2 CONTROL

2-1 BASIC FUNCTION

1. When the electric wave sent from the transmitter is received, all the doors either unlock or lock.
   (1) The receiver picks up the identity code (faint electrical wave) sent from the transmitter.
   (2) The receiver checks the incoming identity code against the registered identity code and if they are in agreement it sends an "LOCK" or "UNLOCK" activation request signal.
   (3) The activation request signal from the receiver is sent from the meter ECU over the LIN communication line to the ITC.
   (4) The ITC receives an activation request from the meter ECU and controls the door locks, hazard lamps and the room lamp.

2-2 AUTOMATIC LOCKING FUNCTION

If all the doors have been unlocked by the remote control by the transmitter, but none of them are physically opened within 30 seconds, all the doors will automatically lock.

2-3 AJAR DOOR PREVENTING FUNCTION

Remote control is disabled if any of the doors is open or ajar. (when courtesy switch is "ON".)

2-4 KEY REMAINING REMINDER FUNCTION

If the key is in the ignition key cylinder, the remote control will not have any effect.

2-5 ANSWER BACK FUNCTION

When door locks are remotely operated by the transmitter, the hazard lamps and room lamp answer back. The room lamp answers back only when the switch is set to the door interlocking position.

Answer back function

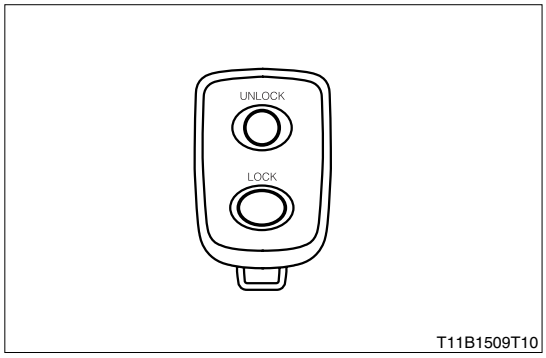
Operating conditions	Section	Answer back
At time of locking	Room lamp	Illuminates after about 3 seconds of dimming
	Luggage room lamp	
	Hazard lamp	Flashing one time
At time of unlocking	Room lamp	Illuminates for approx. 15 seconds
	Luggage room lamp	
	Hazard lamp	Flashing twice

2-6 WAKE-UP/SLEEP FUNCTION

The body integrated controller has a wake-up/sleep function in order to reduce the current used when the ignition is switched to "ACC" or "LOCK".

3 COMPONENTS

3-1 TRANSMITTER



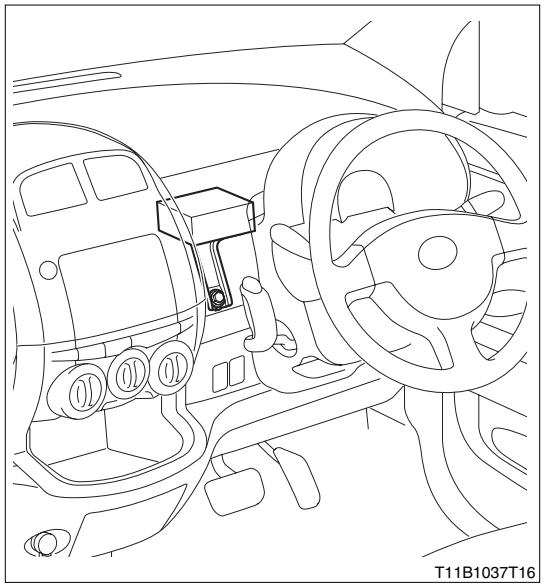
1. The transmitter is a key holder type with a "LOCK" switch and an "UNLOCK" switch.
2. When the signal sending switch is operated, the identifying code by weak radio waves is sent. There are 2^{40} kinds of identifying codes, which differ from transmitter to transmitter.
3. Expected life of the imbedded button battery should be 2 years when used ten times a day (one time refers to one unlock and one lock operations).The button battery can be replaced.

NOTE

- Button battery type: CR1616 3V

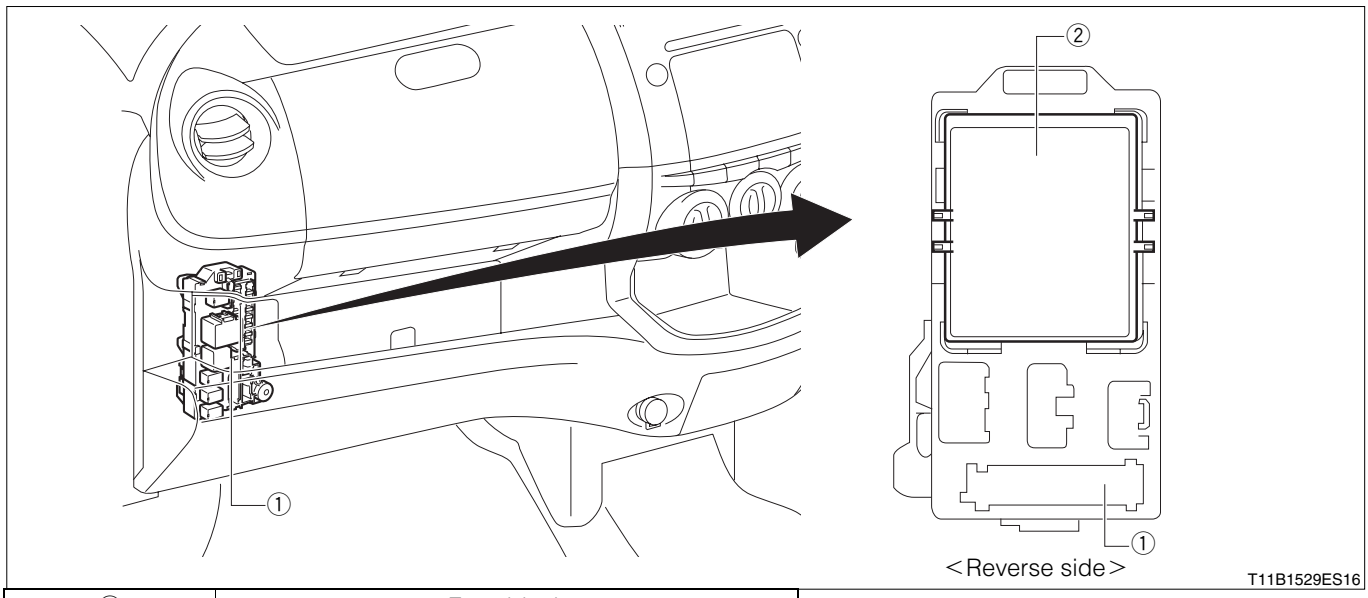
3-2 KEYLESS RECEIVER

1. When the incoming identity code (faint electrical wave) from the transmitter is received, if it is in agreement with the registered identity code in the receiver, an "LOCK" or "UNLOCK" activation request signal is sent to the meter ECU.
2. Up to two identification codes can be stored, which means two transmitters can be used.
3. When the new transmitter is registered, any previously registered identification codes stored in the receiver will be completely cleared, therefore the codes need to be re-registered.
4. Even if the battery is removed, stored identification codes are not cleared.


T11B1037T16

3-3 BODY INTEGRATED CONTROLLER(ITC)

1. It is fitted to the reverse-side of the fuse block which is located on the lower left-hand side of the instrument panel.
2. Upon receiving the "LOCK"/"UNLOCK" activation request signals from the meter ECU over the LIN communication line, all the doors are locked or unlocked and other functions are performed.



T11B1529ES16

①	Fuse block
②	Body integrated controller (ITC)

3-4 COMBINATION METER

The meter ECU is built-in and it communicates with the ITC over the LIN communication line.

3-5 COURTESY SWITCH

The open/close status signal of each door is sent via the meter ECU to the ITC.

3-6 ROOM LAMP

Refer to Page J1-9.

3-7 TURN SIGNAL LAMP

Refer to Page J1-5.

■ IMMOBILIZER SYSTEM

1 OUTLINE

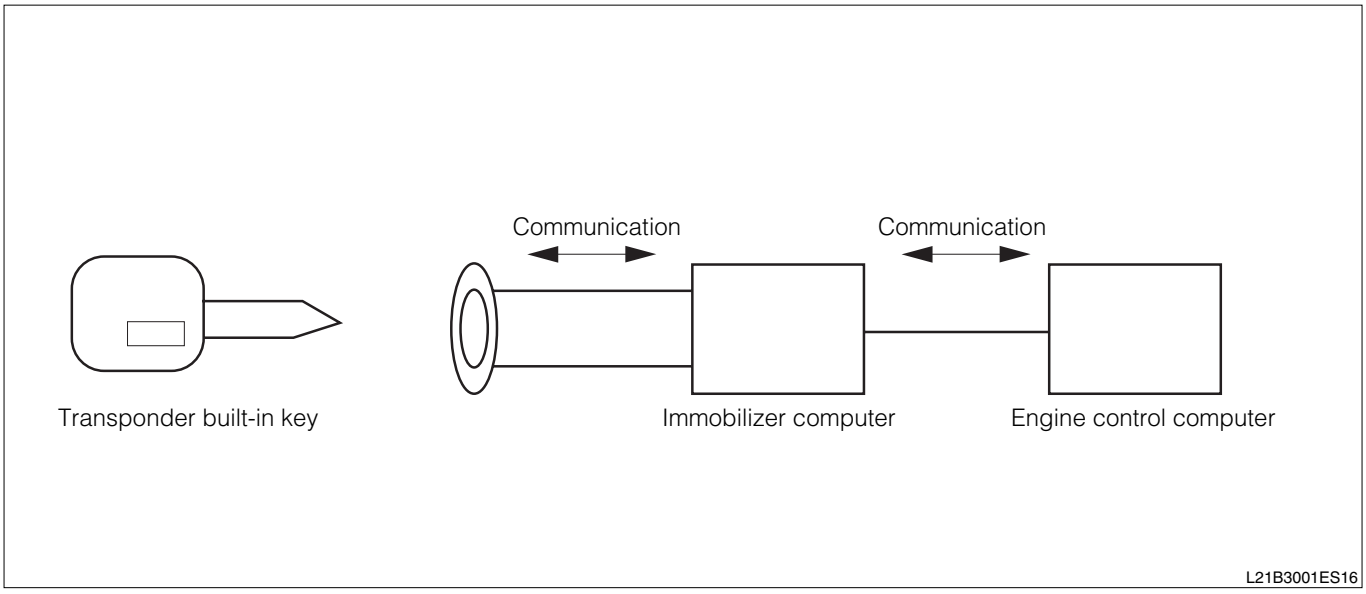
1-1 DESCRIPTION

1. The immobilizer system prohibits the unauthorized start of the engine, thus enhancing the security.
2. It becomes possible to start the engine when the ID code registered in the immobilizer ECU is matched with the ID code memorized in the key.
3. When the immobilizer system is in the operating condition, the indicator in the combination meter flashes.

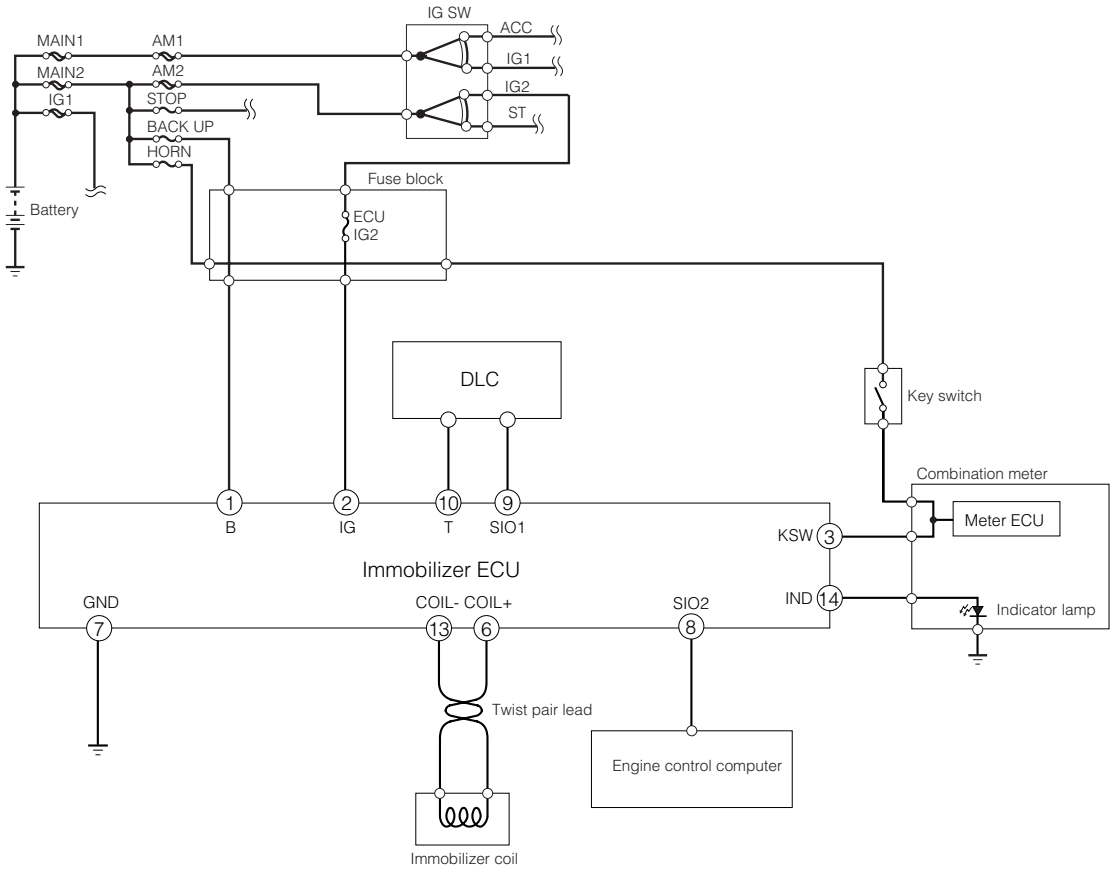
1-2 NOTES ON IMMOBILIZER SYSTEM

1. In the case of the ignition key for the immobilizer equipped vehicles, there are cases where correct communication with the immobilizer ECU is impossible, thus not allowing the engine to start.
   (1) When the grip section of the key is in contact with a metal object.
   (2) When the key is close to or in contact with the key (Which incorporates a signal transmitter) for the immobilizer system of another vehicle.
2. Do not put the ignition key in ultrasonic cleaners, etc.

1-3 SYSTEM DRAWING

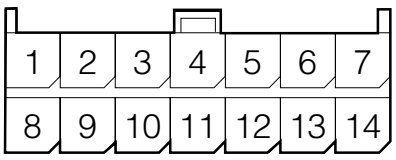


1-4 SYSTEM WIRING DIAGRAM

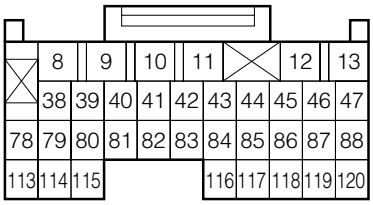


T11B1510ES25

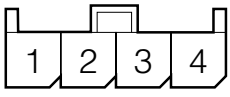
Computer connector terminal arrangement diagram



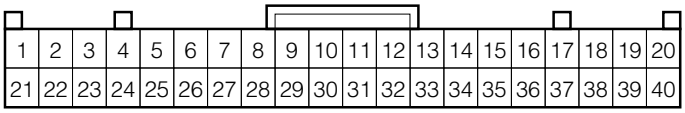
Immobilizer ECU



Engine control computer



Immobilizer coil
key switch



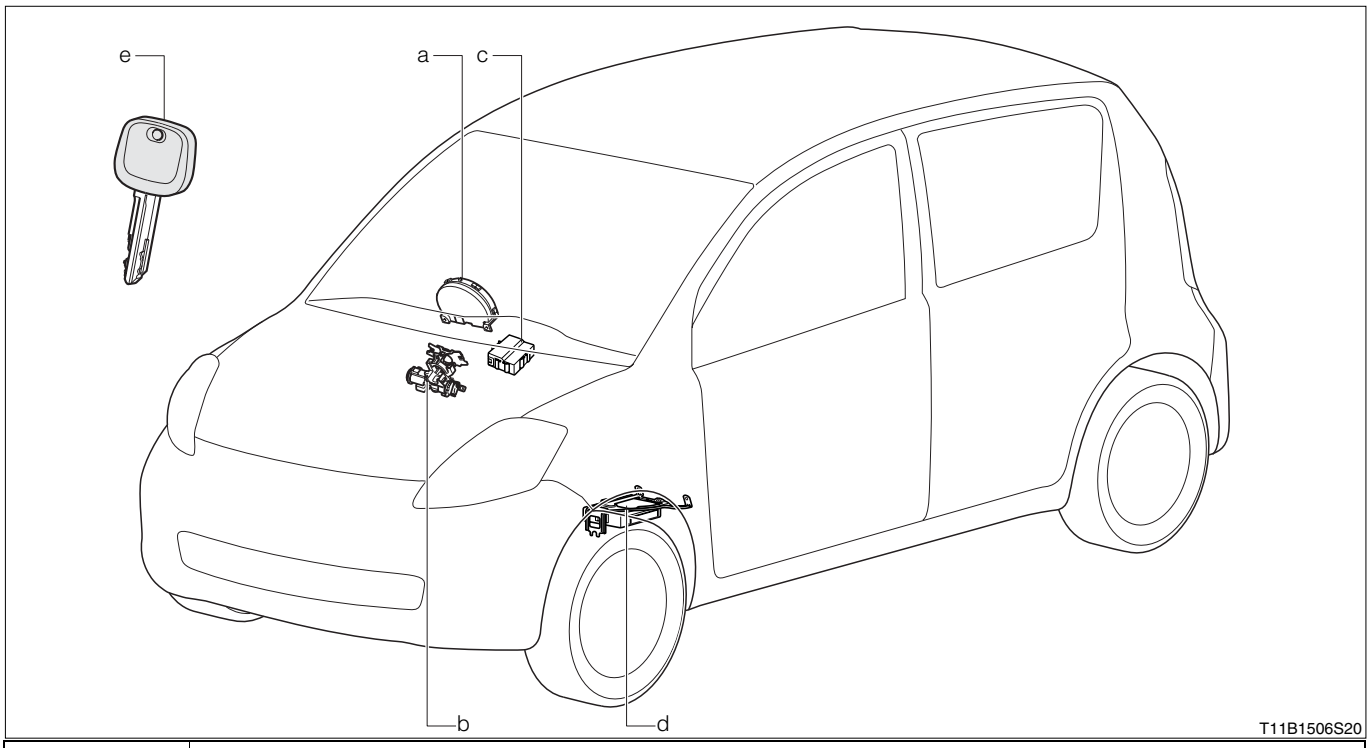
Combination meter

T11B8503ES20

Immobilizer ECU terminal name

Terminal No.	Terminal code	Terminal name
1	+B	ECU power supply
2	IG	Ignition switch power supply
3	KSW	Key switch
4	—	—
5	—	—
6	COIL+	Transponder communication
7	GND	Earth
8	SIO2	Immobilizer communication
9	SIO1	Diagnostic tester communication
10	T	Diagnostic tester communication
11	—	—
12	—	—
13	COIL—	Transponder communication
14	IND	Security indicator

1-5 LOCATION OF COMPONENTS

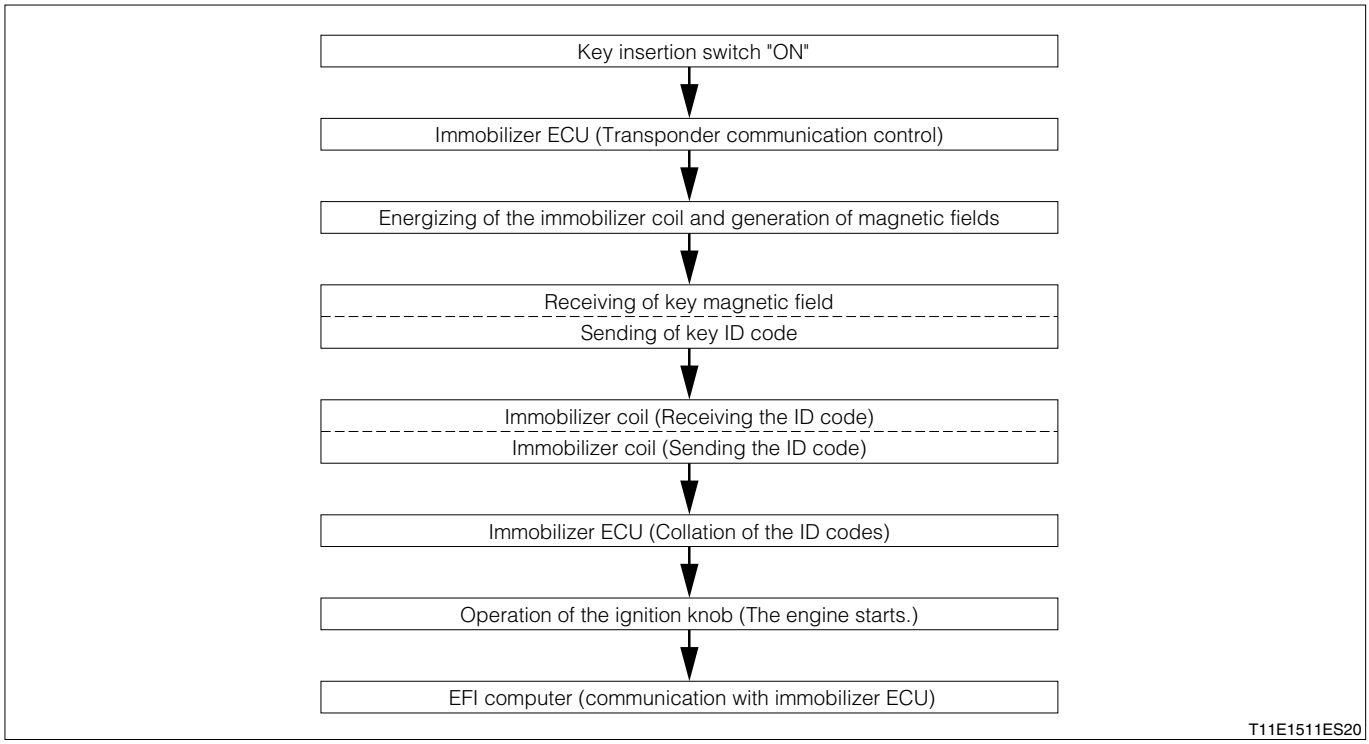


a	Combination meter
b	Steering column upper W/switch bracket
c	Immobilizer ECU
d	EFI ECU
e	Transponder

2 CONTROL

2-1 BRIEF DESCRIPTION OF OPERATION

1. The key switch is turned "ON", when the key is inserted into the ignition cylinder.
2. The immobilizer ECU energizes the immobilizer coil. As a result, a magnetic field is generated in the coil.
3. When the transponder (chip) incorporated in the key receives the magnetic field of the coil, the ID code memorized in the chip is transmitted.
4. The ID code is received by the immobilizer coil and sent to the immobilizer ECU.
5. The immobilizer ECU performs the collation of the transmitted ID code and the registered ID code. When the codes are matched, the communication with the EFI ECU is permitted. ("UNSET" condition.) (In cases where the collation of the codes is not performed correctly, the communication with the EFI ECU remains prohibited. ("SET" condition.) (Therefore, even if the ignition switch is turned "ON", the communication with the EFI ECU will not be started.)
6. When the ignition switch is turned "ON" by turning the ignition knob, the collation of the code with the EFI ECU is carried out.
7. If the collation of the codes is correct, the engine is started by turning the ignition knob to the "START" position.



2-2 IMMOBILIZER SYSTEM CONTROL

2-2-1 IMMOBILIZER SYSTEM OPERATING CONDITION

When the following conditions are satisfied, the immobilizer system is set to the operating condition (communication with the EFI ECU prohibited).

(1) The key switch is "OFF" as well as the ignition switch is at "LOCK" or "ACC" position.
(2) Thirty seconds have passed after the key switch is "ON", and the ignition switch is changed from "ON"→"LOCK" or "ACC" position.

2-2-2 IMMOBILIZER SYSTEM RELEASED CONDITION

When the following conditions are satisfied, the immobilizer system is set to the released condition (communication with the EFI ECU allowed).

(1) When the ID code stored in the key and the ID code stored in the immobilizer ECU match.

2-3 TRANSPONDER COMMUNICATION CONTROL

2-3-1 TRANSPONDER COMMUNICATION STARTING CONDITION

If any of the following conditions is met, the transponder communication (Check of the ID code of the key) starts.

(1) In the immobilizer system "SET" condition, the key switch is "OFF"→"ON".
(2) In the immobilizer system "SET" condition, the ignition switch is changed from "LOCK" or "ACC" position→"ON".
(3) In the immobilizer system "SET" condition, the key switch is "ON" and the ignition switch is changed from "ON"→"LOCK" or "ACC" position.
(4) In the immobilizer system "SET" condition, the key switch is turned "ON" or the ignition switch is turned "ON" after the ECU power "ON" reset is released.

2-3-2 TRANSPONDER COMMUNICATION FINISHING CONDITION

When any of the following conditions is satisfied, the transponder communication (key ID code verification) is finished.

(1) The key switch is "OFF" as well as the ignition switch is at "LOCK" or "ACC" position.
(2) Three seconds has passed after the key switch is turned from "OFF"→"ON"
(3) Three seconds has passed after the ignition switch is turned from "OFF"→"ON"
(4) Three seconds has passed after the key switch is turned "ON" and the ignition switch is turned from "OFF"→"ON"
(5) The ID code registered in the immobilizer ECU matches the ID code memorized in the key.
(6) After an ID code not registered in the immobilizer ECU has been received three times and the key ID has been read properly

2-4 EFI ECU COMMUNICATION CONTROL

2-4-1 EFI ECU COMMUNICATION STARTING CONDITION

When the immobilizer system has been released and the ignition switch is set to "LOCK", or set from "ACC"→"ON", the immobilizer ECU communicates with the EFI ECU.

2-4-2 EFI ECU COMMUNICATION FINISHING CONDITION

If any of the following conditions is met, the immobilizer ECU will inhibit communication with the EFI ECU.

(1) During communicating with the EFI ECU, the ignition switch is changed from "ON"→"LOCK" or "ACC" position.
(2) Immobilizer system "SET" status
(3) Communication with the EFI ECU is complete.

2-5 DIAGNOSIS

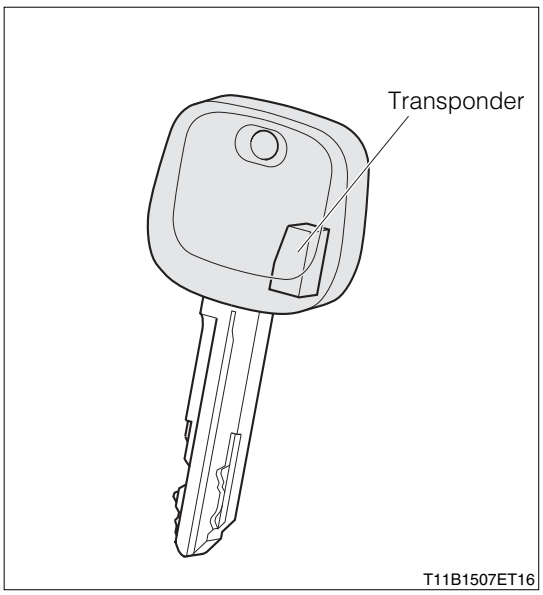
2-5-1 DESCRIPTION

The diagnosis means "Trouble diagnosis". In cases where an abnormality exists in the input/output system, the computer inside the sensor unit informs the check operator of the abnormal items.
For the details of the diagnosis, refer to the repair manual.

3 COMPONENTS

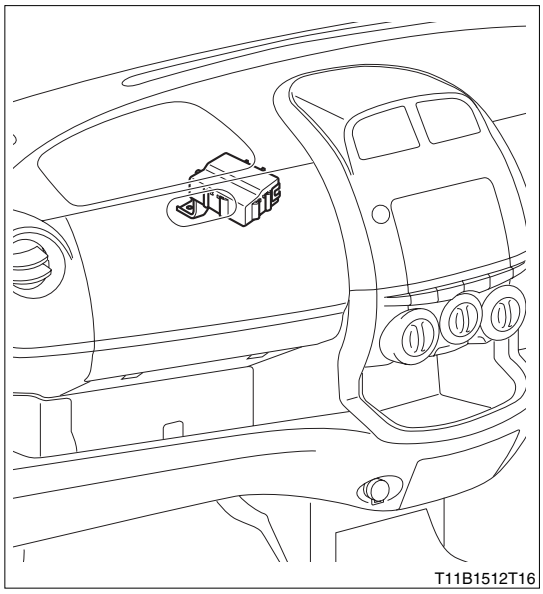
3-1 IGNITION KEY

A transponder (Chip) is incorporated in the grip section of the ignition key. Upon receiving the magnetic field generated by the immobilizer coil, this chip sends the ID code. Moreover, the ID code differs, depending on the ignition key.



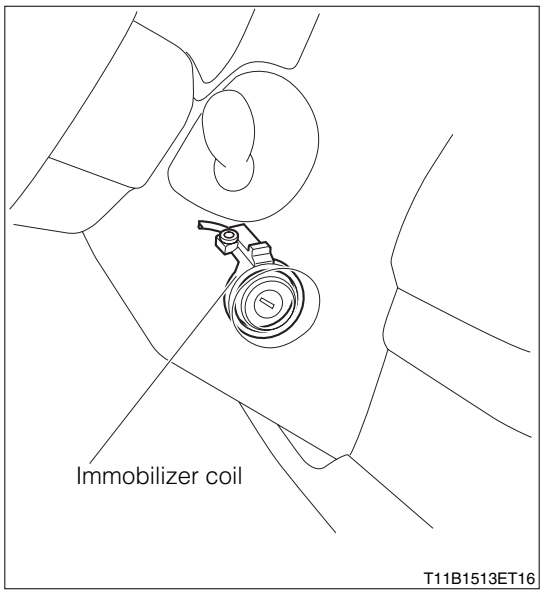
3-2 IMMOBILIZER ECU

1. The immobilizer coil is energized and the transponder communication is performed. Furthermore, the collation of ID codes is carried out with the EFI ECU.
2. It is possible to register up to four keys. Even when the battery is disconnected, the memory of ID codes of the registered key will not be lost



3-3 IMMOBILIZER COIL

When electric current flows into the immobilizer coil due to the immobilizer ECU control, a magnetic field is generated and the ID code is received from the key.

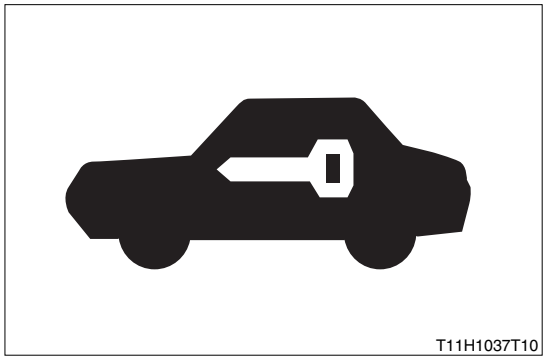


3-4 EFI ECU

The ID code is collated by the signal from the immobilizer ECU, thus controlling the injection of fuel.

3-5 COMBINATION METER

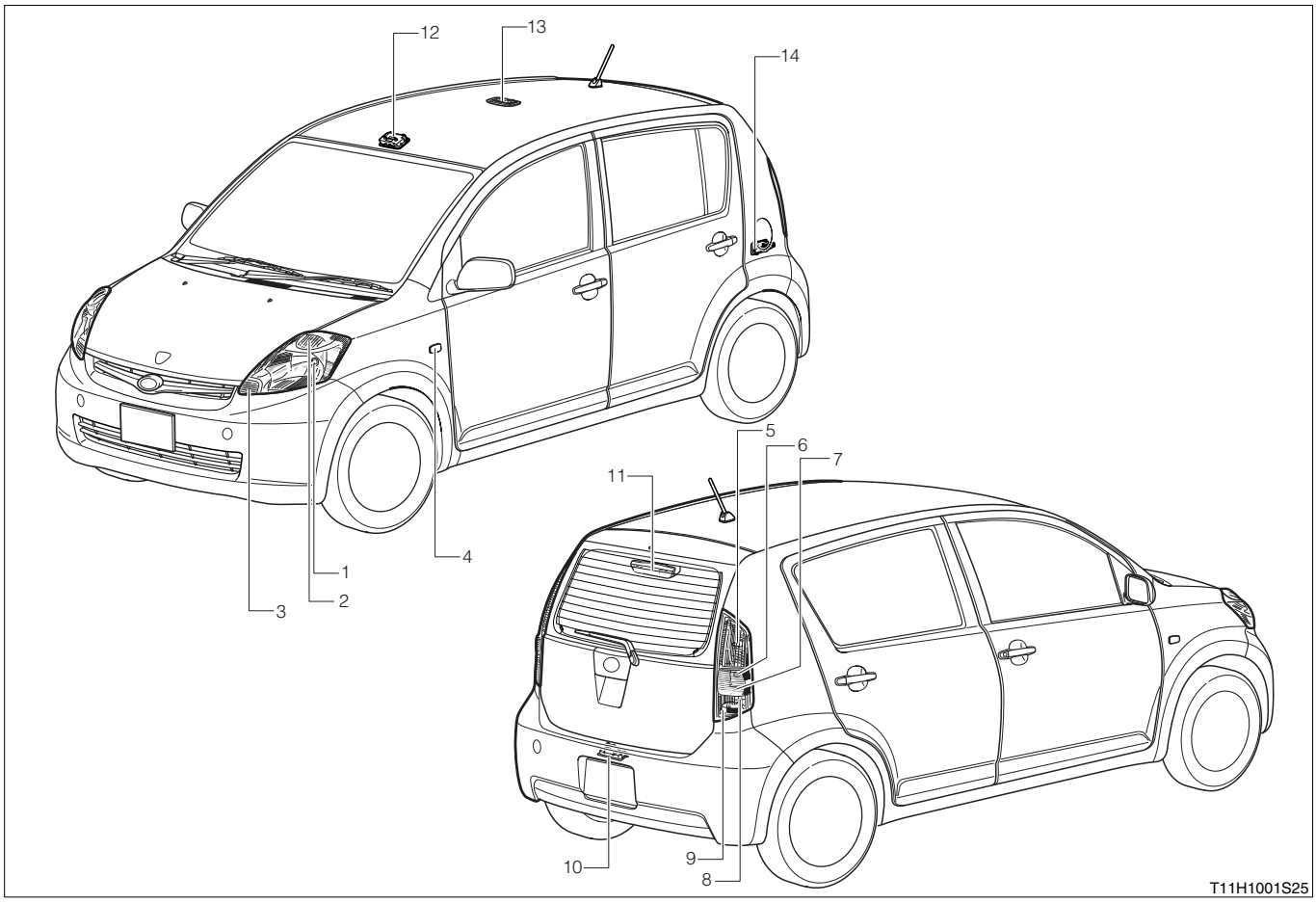
When the immobilizer system is in the operating condition, the indicator in the combination meter flashes.


T11H1037T10

J1 LIGHTING

1 OUTLINE

1. Two-headlamp type halogen headlamps have been selected.
2. For the headlamps, unconventional multi-reflector type that has enhanced the photometric performance has been employed.
3. The manual headlamp leveling mechanism is provided on some specifications on.
4. An excellent appearance has been achieved by employing clear lenses for outer lenses of the front, side and rear turn signal lamps. In addition to the employment of the clear lens, amber bulbs have been employed for the front, and rear turn signal lamps and amber caps for the interior of the side turn signal lamps.
5. High-mount stop lamps equipped on the back door have been set in all specifications.
6. An excellent appearance has been achieved by employing clear lenses for the outer lenses of the rear combination lamp.
7. The rear fog lamp has been set in all specifications and is provided in the driver seat side rear combination lamp.



Specification table

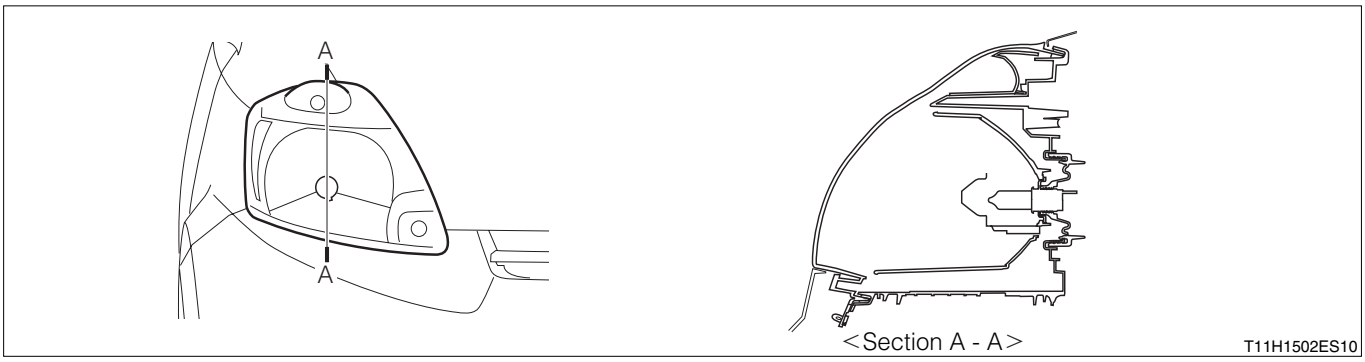
No.	Nomenclature	Category	Capacity (W)
1	Headlamp	H4	60/55
2	Clearance lamp	T10	5
3	Front turn signal lamp	S25 (Amber)	21
4	Side turn signal lamp	T10	5
5	Tail and stop lamp	T20	21/5
6	Rear turn signal lamp	T20 (Amber)	21
7	Backup lamp	T16	16
8	Rear fog lamp	T20	21
9	Reflex reflector	—	—
10	License plate lamp	T10	5
11	High-mount stop lamp	T16	16
12	Front map lamp	—	8
13	Room lamp	—	8
14	Luggage room lamp	—	5

2 CONSTRUCTION AND OPERATION

2-1 HEADLAMP

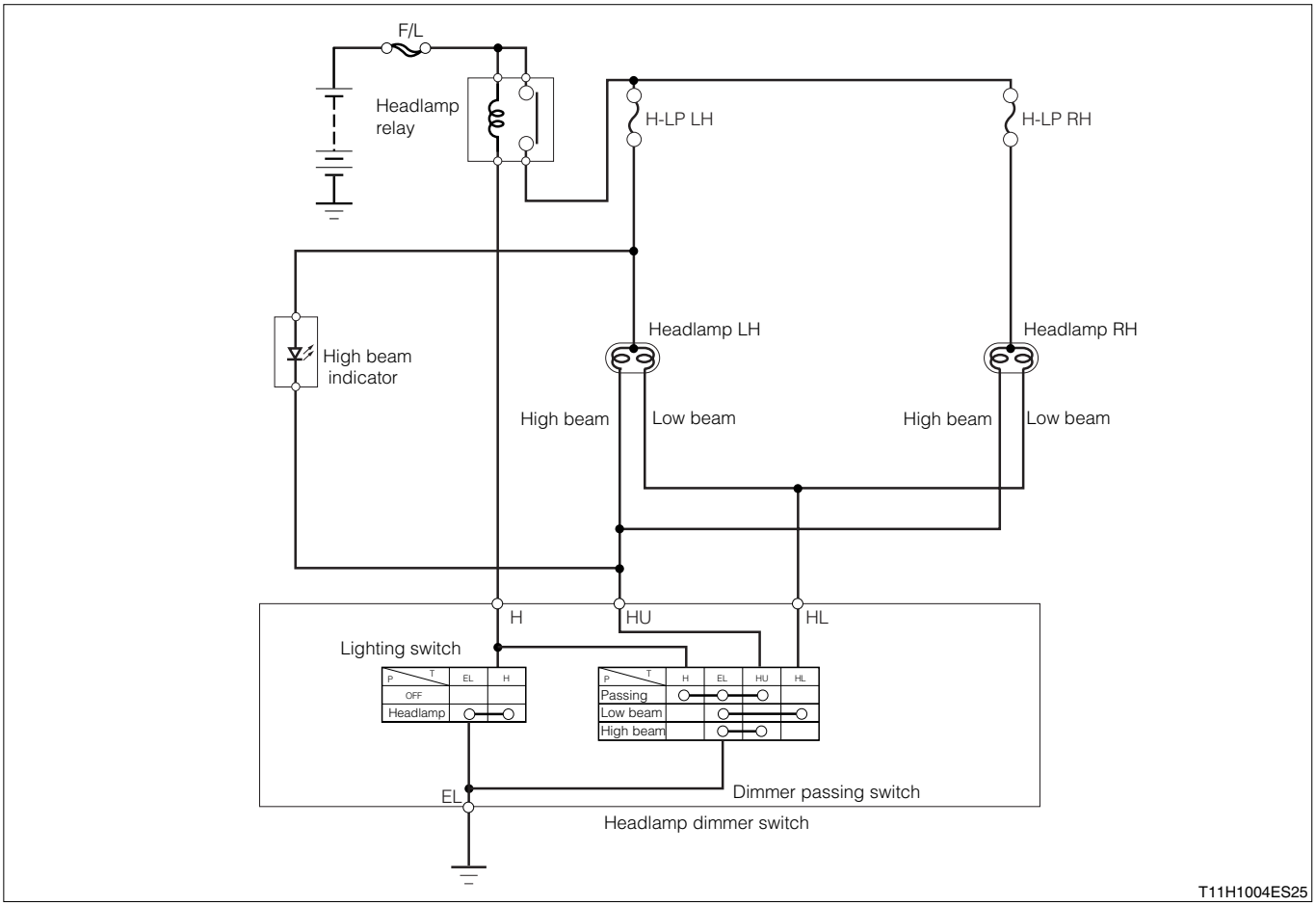
2-1-1 DESCRIPTION

1. Two-headlamp type halogen headlamps have been selected.
2. The multi-reflector type that has enhanced the photometric performance has been employed.
3. A combination lamp that has integrated the front turn signal lamp and the clearance lamp has been employed.
4. The manual headlamp leveling mechanism is provided on.

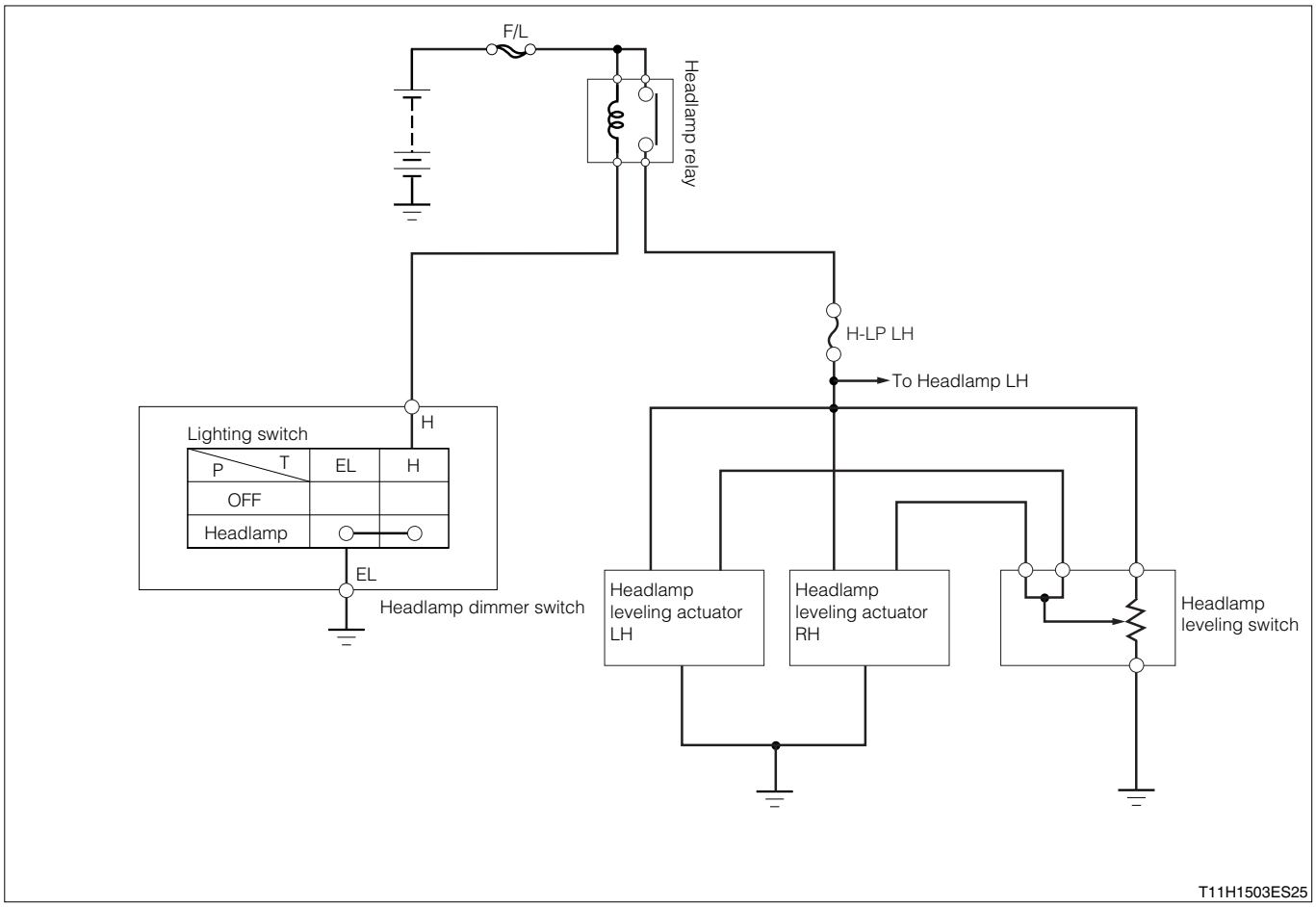


2-1-2 SYSTEM WIRING DIAGRAM

(1) Headlamp

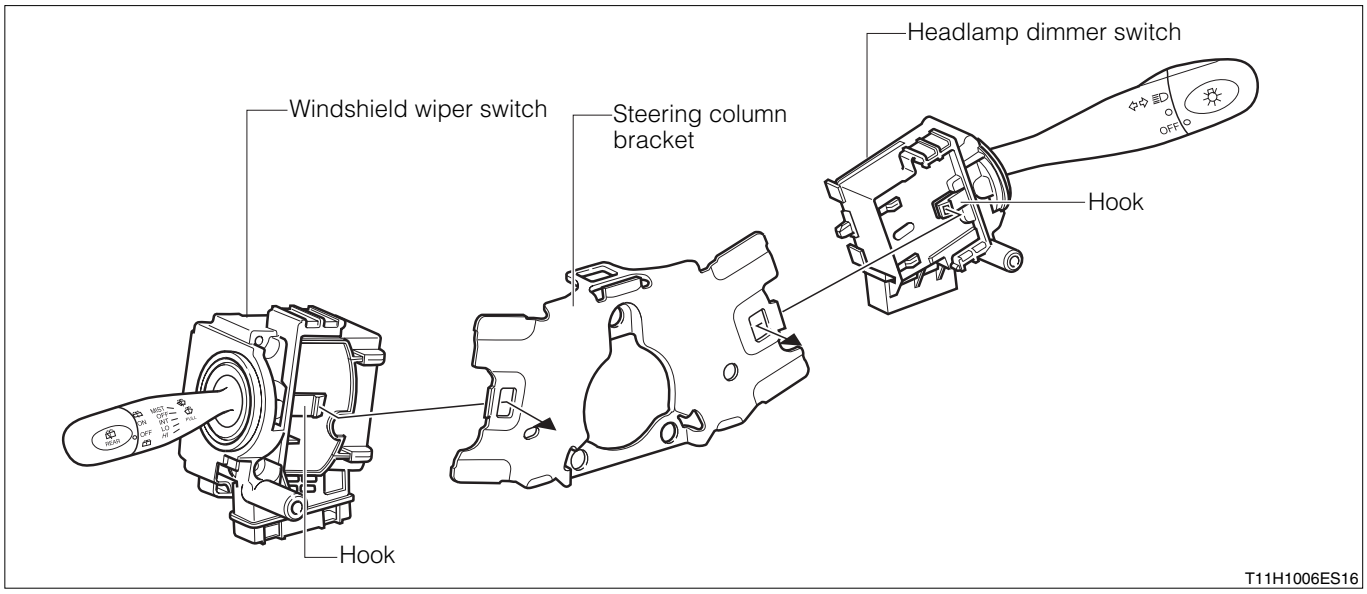


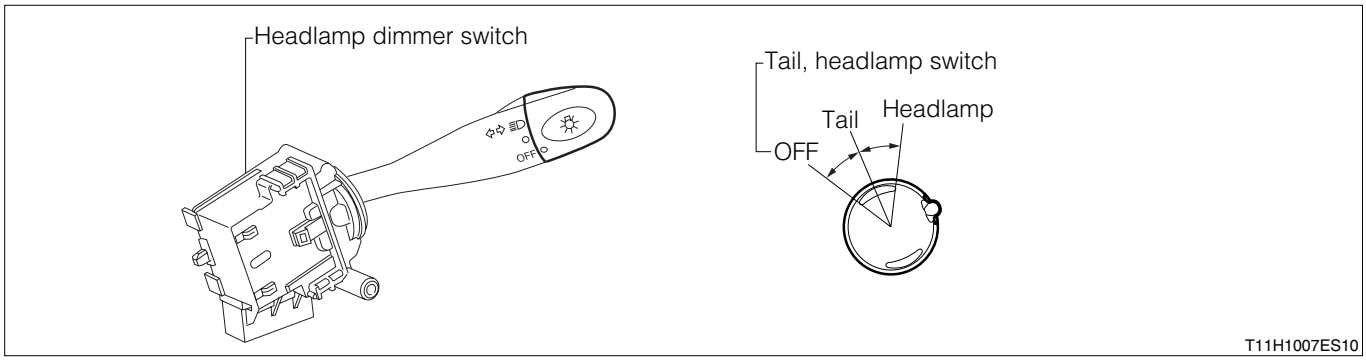
(2) Manual headlamp leveling mechanism



2-1-3 HEADLAMP DIMMER SW

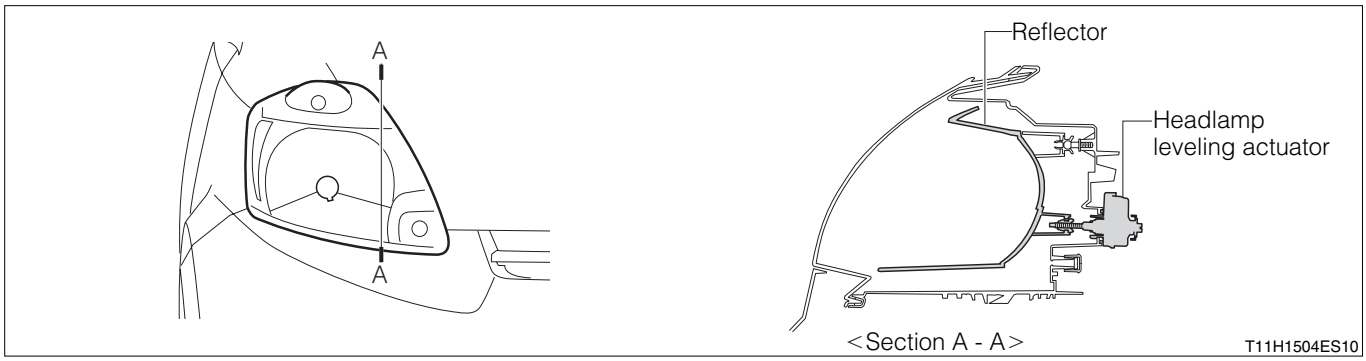
1. Replacement of the headlamp dimmer switch has been made possible without removing the steering wheel by positioning the headlamp dimmer switch and the windshield wiper switch independently.
2. A mechanism in which the headlamp dimmer switch is directly fixed to the steering column bracket with a hook has been employed. This has enhanced serviceability.
3. A turn canceling mechanism has been built in the headlamp dimmer switch.





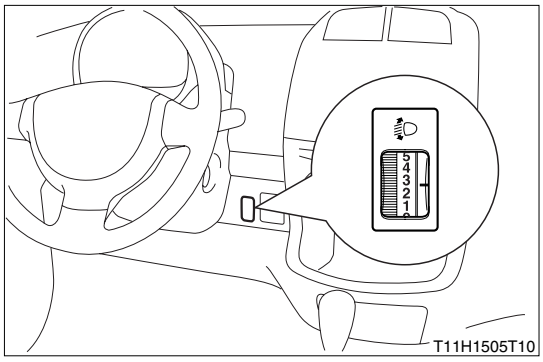
2-1-4 MANUAL HEADLAMP LEVELING MECHANISM

1. All specifications employ the manual headlamp leveling mechanism whereby the vertical direction of the photometric axis can be adjusted from the vehicle interior as the vehicle posture changes due to a loaded state. This mechanism can help avoiding dazzling the coming vehicles and vehicles running ahead.
2. Depending upon the state signal of the headlamp leveling switch in the vehicle interior (the highest direction in the level 0, the lowest direction in the level 5), the headlamp leveling actuator is driven. Thus, the reflector direction is changed vertically so as to adjust the photometric axis.
3. The headlamp leveling actuator is provided at the rear of the headlamp.



2-1-5 HEADLAMP LEVELING SWITCH

It is installed at the side of the steering column.

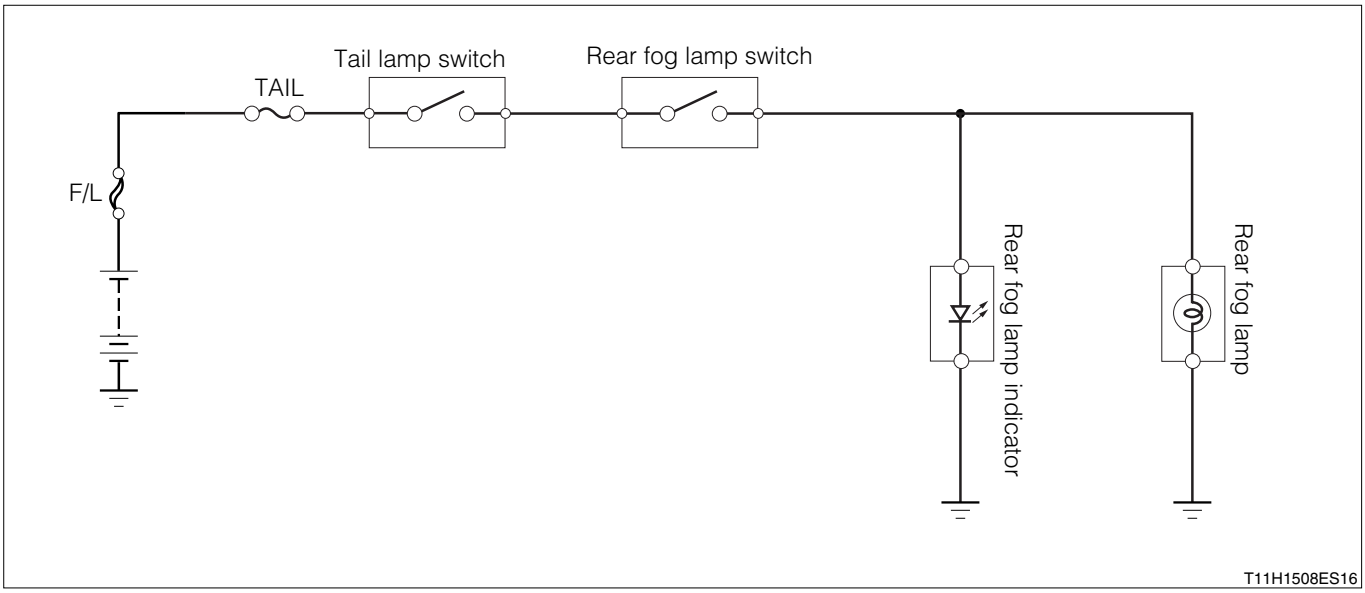


2-2 REAR FOG LAMP

2-2-1 DESCRIPTION

The rear fog lamp has been set in all the models and is built in the driver seat side rear combination lamp.

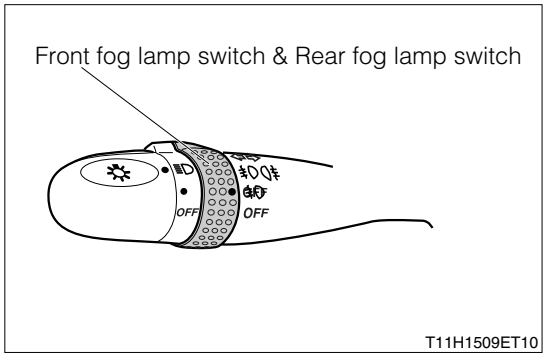
2-2-2 SYSTEM WIRING DIAGRAM



The rear fog lamp switch can be turned ON only when the headlamp or front fog lamp is illuminated.

2-2-3 REAR FOG LAMP SWITCH

For easy operation, this switch has been integrated with the headlamp dimmer switch.



2-3 TURN SIGNAL AND HAZARD LAMP

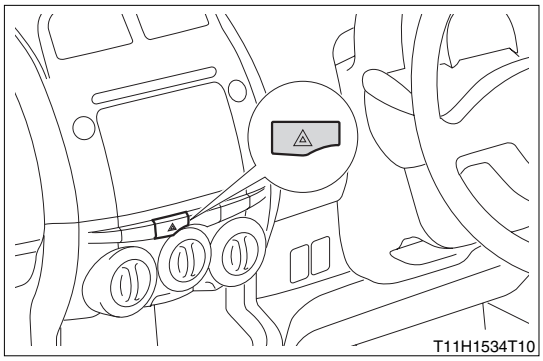
2-3-1 DESCRIPTION

1. The front turn signal lamp has been built in the combination headlamp.
2. Other than its primary usage, the hazard lamp serves as an answer back function for the keyless entry system*.

Refer to Page I4-10.

2-3-2 HAZARD SWITCH

1. The switch has employed a push type that incorporates night illumination.
2. For easier operation, it is provided at the central section of the heater control panel.

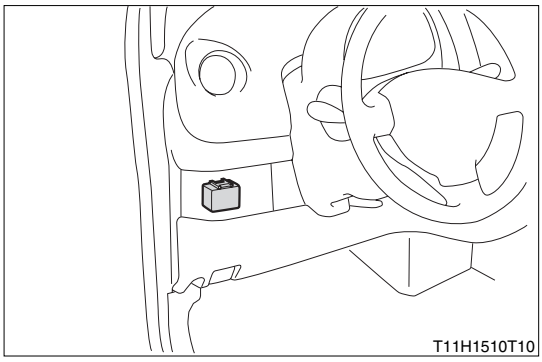


2-3-3 FLASHER RELAY

This is of an insertion type into the fuse block.

Specification table

Number of flashing during normal operation	85±10 (times/minute)
Number of flashing when one lamp is burnt out	140 - 250 (times/minute)



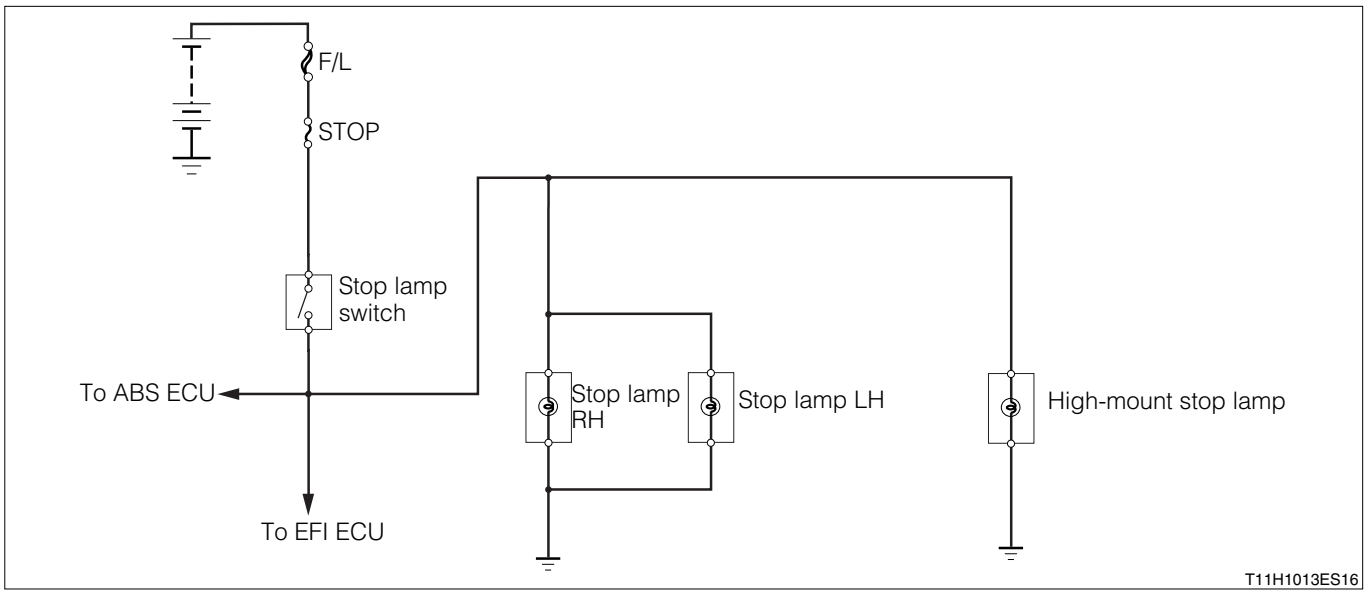
2-4 STOP LAMP

2-4-1

2-4-2 DESCRIPTION

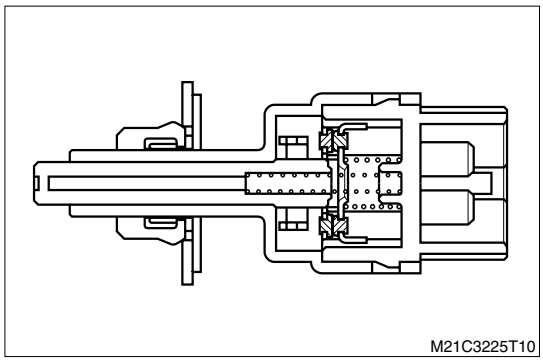
A high-mount stop lamp equipped on the back door has been set in some specifications.

2-4-3 SYSTEM WIRING DIAGRAM



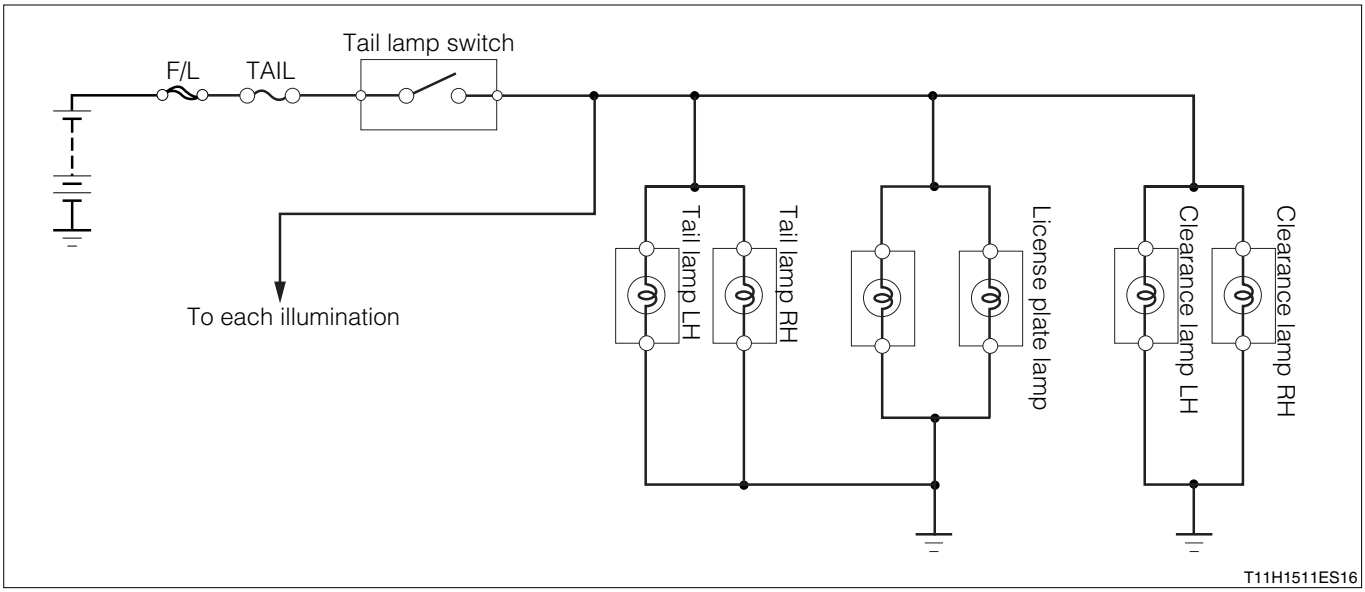
2-4-4 STOP LAMP SWITCH

1. The stop lamp switch is installed in the upper part of the brake pedal and it detects that the brake pedal is depressed.
2. It becomes "ON" when the brake pedal is depressed.



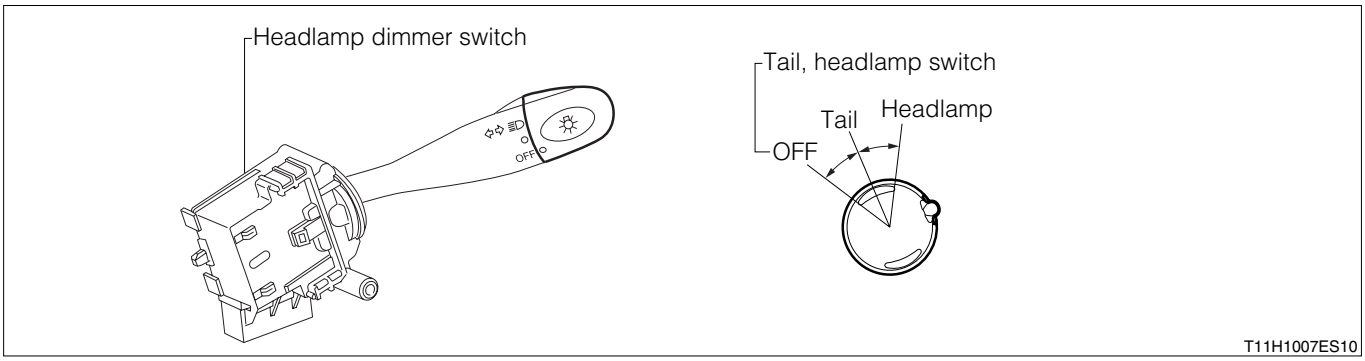
2-5 TAIL LAMP & ILLUMINATION

2-5-1 SYSTEM WIRING DIAGRAM



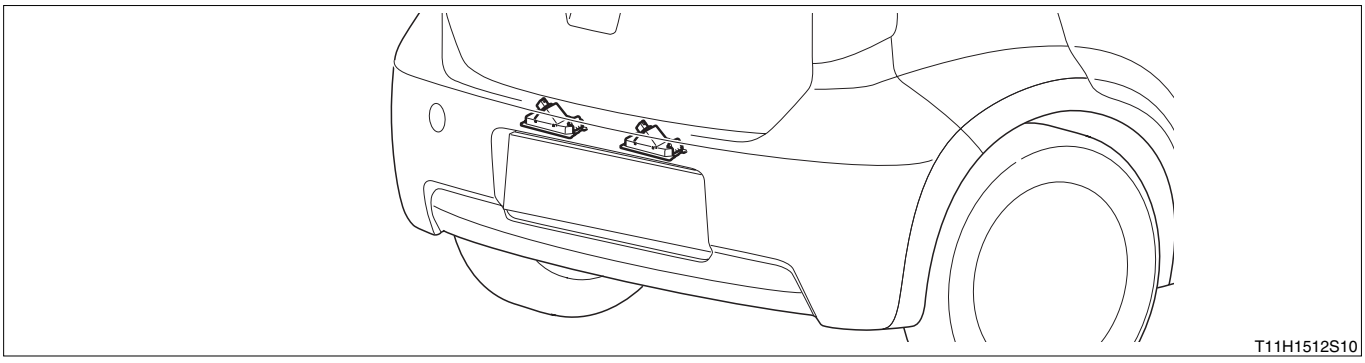
2-5-2 TAIL LAMP SWITCH

It is positioned in the headlamp dimmer switch.



2-5-3 LICENSE PLATE LAMP

1. The installation position of the license plate lamp is at the back door and the downward illumination type has been employed.
2. A two-lamp type has been employed for the lamps.

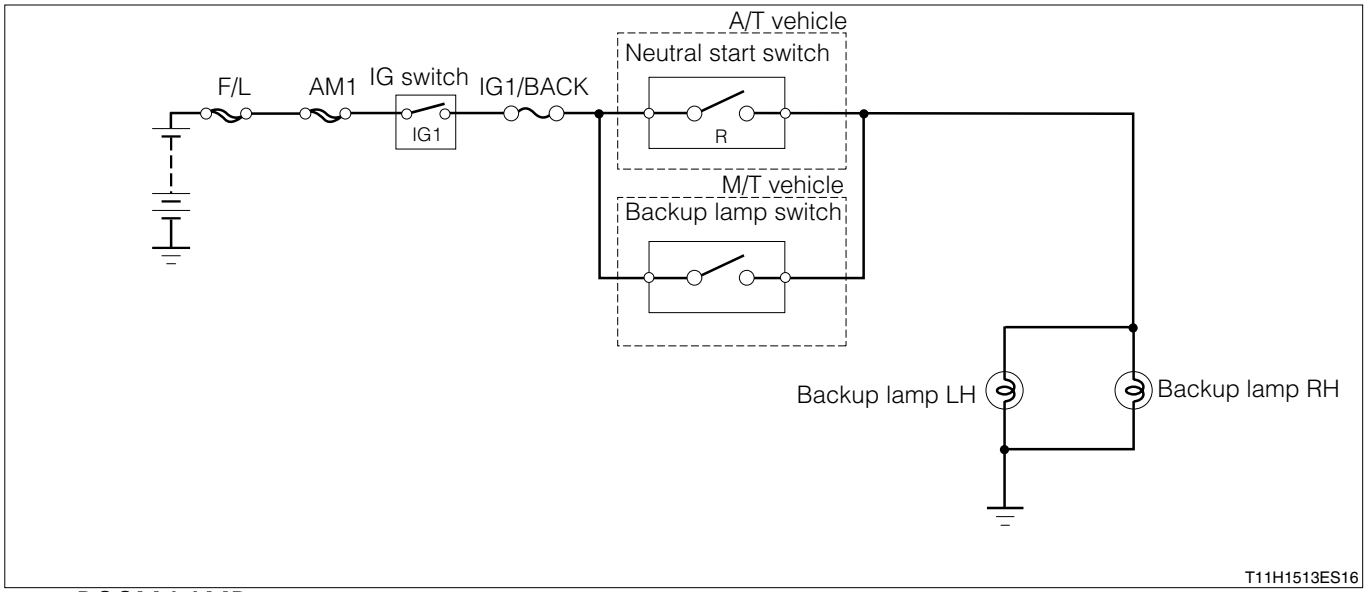


2-5-4 MULTI-TRAY ILLUMINATION

Refer to Page I2-3.

2-6 BACKUP LAMP

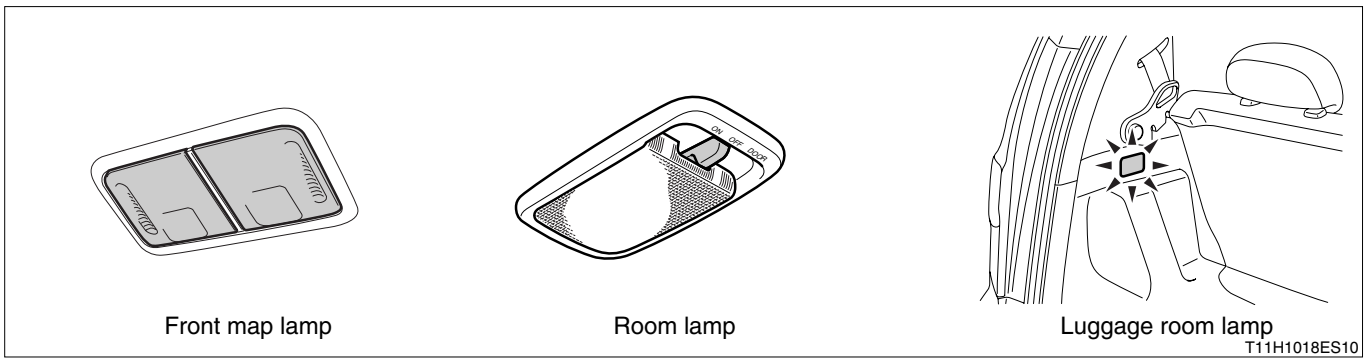
2-6-1 SYSTEM WIRING DIAGRAM



2-7 ROOM LAMP

2-7-1 DESCRIPTION

1. As for the interior lighting, the front map lamp, room lamp and luggage room lamp have been employed for all models.
2. The convenience has been enhanced by employing a room lamp timer function for the room lamp and luggage room lamp.
3. Other than its primary usage, the room lamp and the luggage room lamp serve as an answer back function for the keyless entry system*.

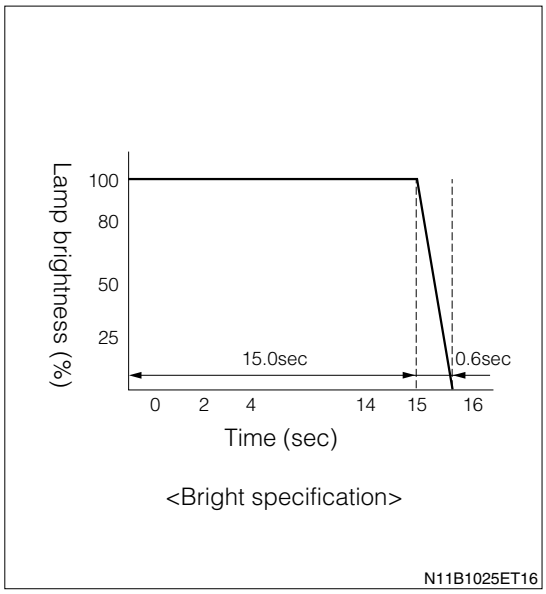


*

Refer to Page I4-10.

2-7-2 ROOM LAMP TIMER FUNCTION

1. When the following conditions are met, the room lamp and the luggage room lamp are lighted for 15 seconds and then fade away.
   (1) Either of the door opened→all doors closed



2. When all of the following conditions are met, the room lamp and the luggage room lamp are lighted for 15 seconds and then fade away.
   (1) IG switch "OFF"
   (2) All doors closed (courtesy switch "OFF")
   (3) Driver seat door lock (door control switch) "LOCK"→"UNLOCK"
3. If the driver seat door lock (door control switch) is changed to "LOCK" while the lamp is lighted under the room lamp timer control, the light is dimmed to 50% of when it is lighted and then is faded away three seconds later.
4. When the IG switch becomes "ON" during the room lamp timer control, it is faded away immediately.

2-7-3 BATTERY OVER-DISCHARGE PREVENTIVE FUNCTION

1. When all of the following conditions are met continuously for 10 minutes, the room lamp and the luggage room lamp are turned off.
   (1) IG switch "OFF"
   (2) Either of the door opened (courtesy switch "ON")
2. When either of the following conditions are met, the battery over-discharge preventive function is released.
   (1) IG switch "ON"
   (2) All doors closed (courtesy switch "OFF")

2-7-4 ROOM LAMP LIGHTING FUNCTION AT TIME OF KEY REMOVAL

1. When all of the following conditions are met, the room lamp and the luggage room lamp are lighted for 15 seconds.
   (1) All doors closed (courtesy switch "OFF")
   (2) Elapse of 200ms or more since the recovery from sleep mode (low current mode) of ITC
   (3) Key switch "ON" (inserted)→"OFF" (not inserted)
2. When the IG switch becomes "ON", it fades away immediately.

NOTE

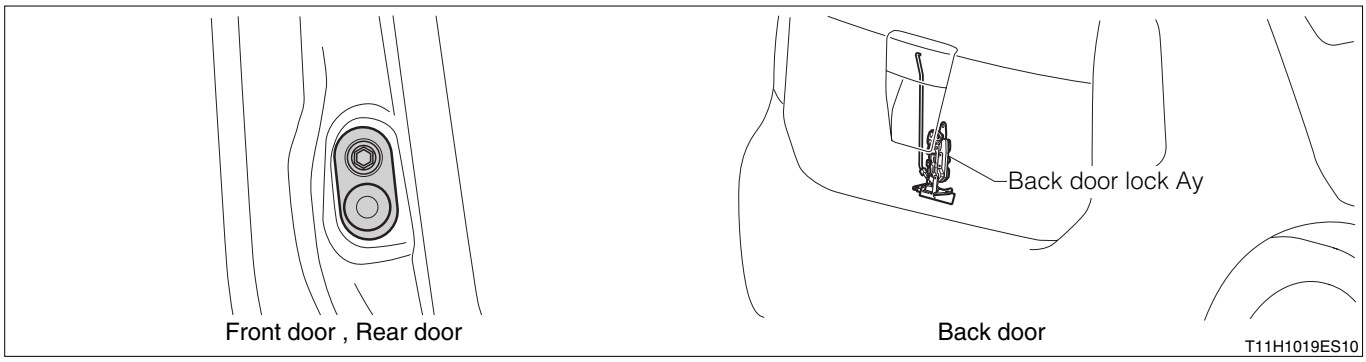
- After 10 minutes or more have passed since the IG switch has been "OFF", if the key switch changes from "ON" (inserted)→"OFF" (not inserted), the room lamp lighting mechanism at time of key removal does not take control.

CAUTION

- When other room lamp control conditions are met while the room lamp lighting control at time of key removal is in operation, it makes transition to the other control.

2-7-5 COURTESY SWITCH

For the courtesy switches on the front door and the rear door, a shape that has the main body switch section and the cushion section integrated has been employed with the aim of enhancing the water-proofing property. This switch directly connects the main body and the connector.
Additionally, as for the back door, the back door lock Ay serves for the courtesy switch function.

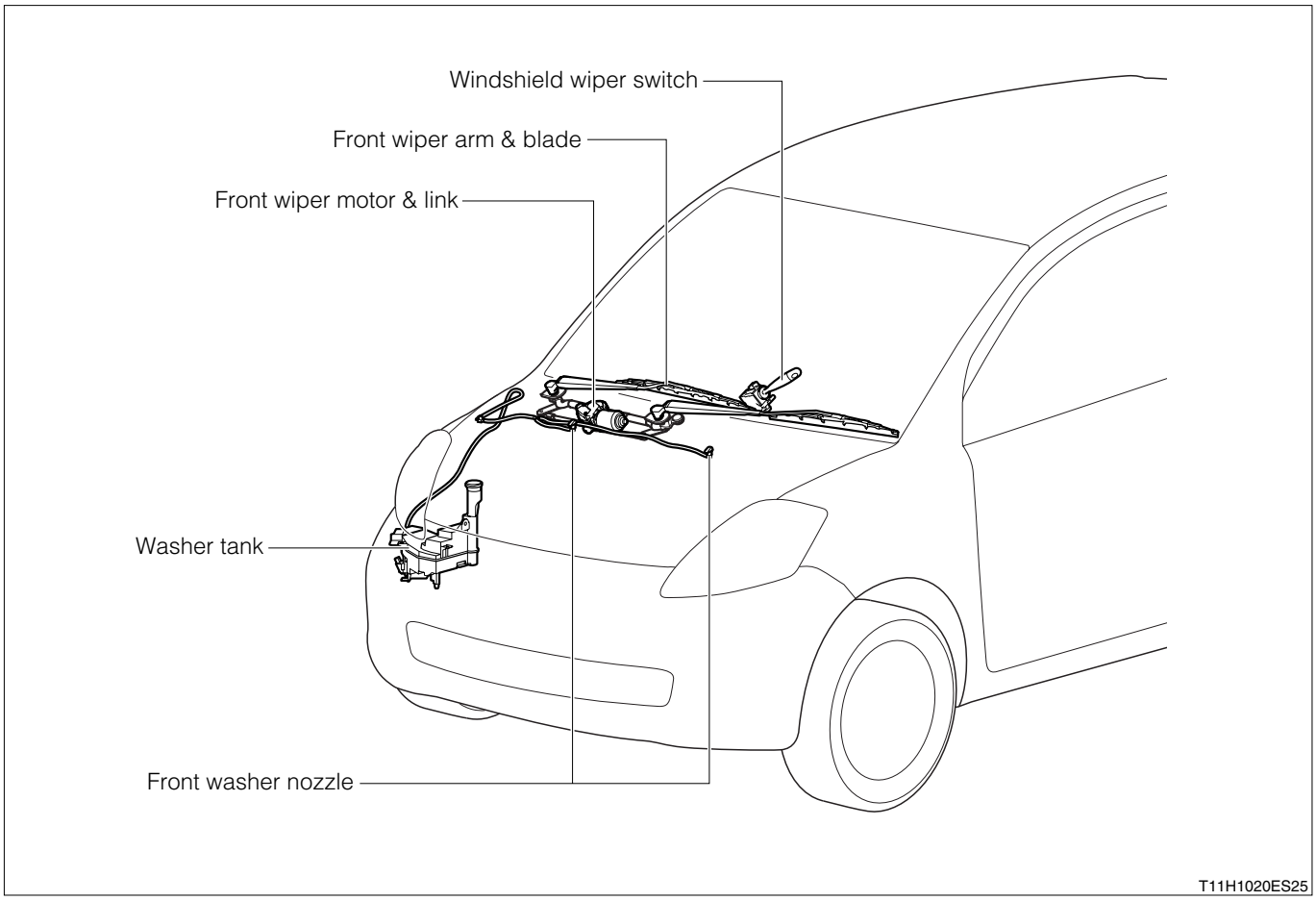


J2 WIPER & WASHER

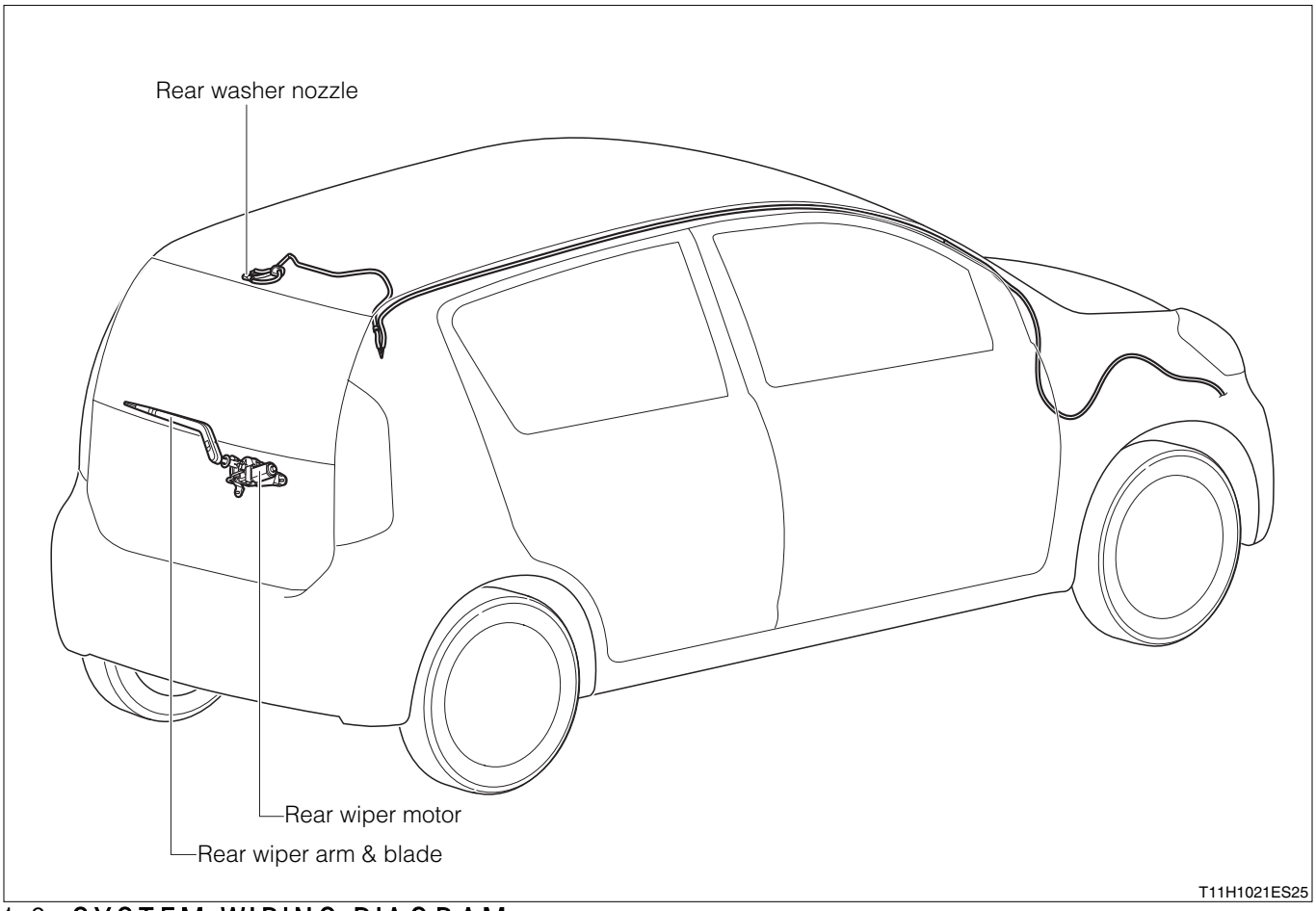
1 OUTLINE

1-1 DESCRIPTION

1. Improvements have been made in the downward field of view and the interior appearance of the arm by positioning the front wiper system lower than the previous model.
2. The appearance and the workability when replacing the blade has been improved by employing the U-hook type for the tightening of the front wiper arm and the front wiper blade.
3. The frame integrated module type has been employed for the installation structure of the front wiper motor and the front wiper link. As a result, the system rigidity has been enhanced, thus reducing the wiper operation sound as well as the variation of the wiper sweep angle.
4. Careful consideration has been made for the protection of pedestrians by employing a pivot section breaking structure for the front passenger seat side wiper.
5. The rear wiper which has a plastic arm and blade has been provided on some specifications.
6. Two 1-hole type washer nozzles have been set in the front and one 1-hole type washer nozzle has been set in the rear side.

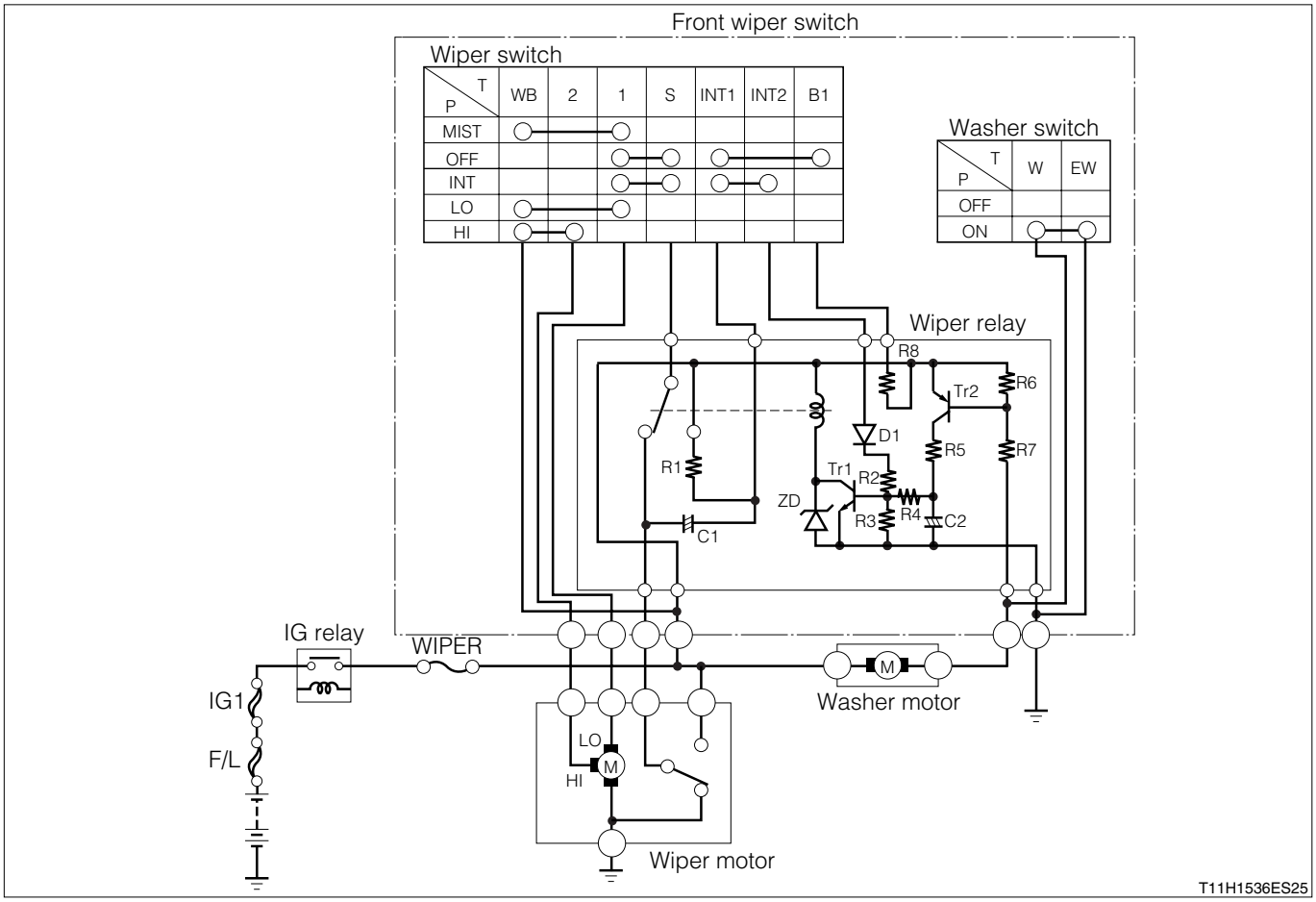


The illustration represents the RHD vehicle.

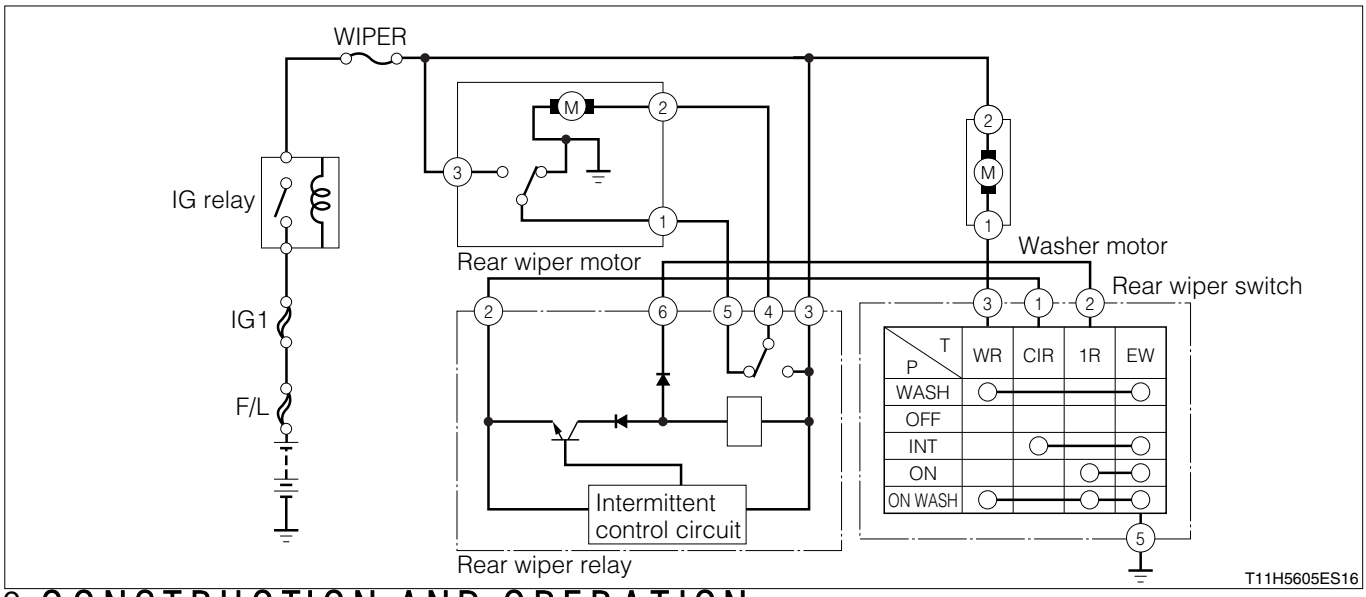


1-2 SYSTEM WIRING DIAGRAM

1-2-1 FRONT WIPER & WASHER



1-2-2 REAR WIPER & WASHER (VEHICLES WITH INTERMITTENT FUNCTION)



2 CONSTRUCTION AND OPERATION

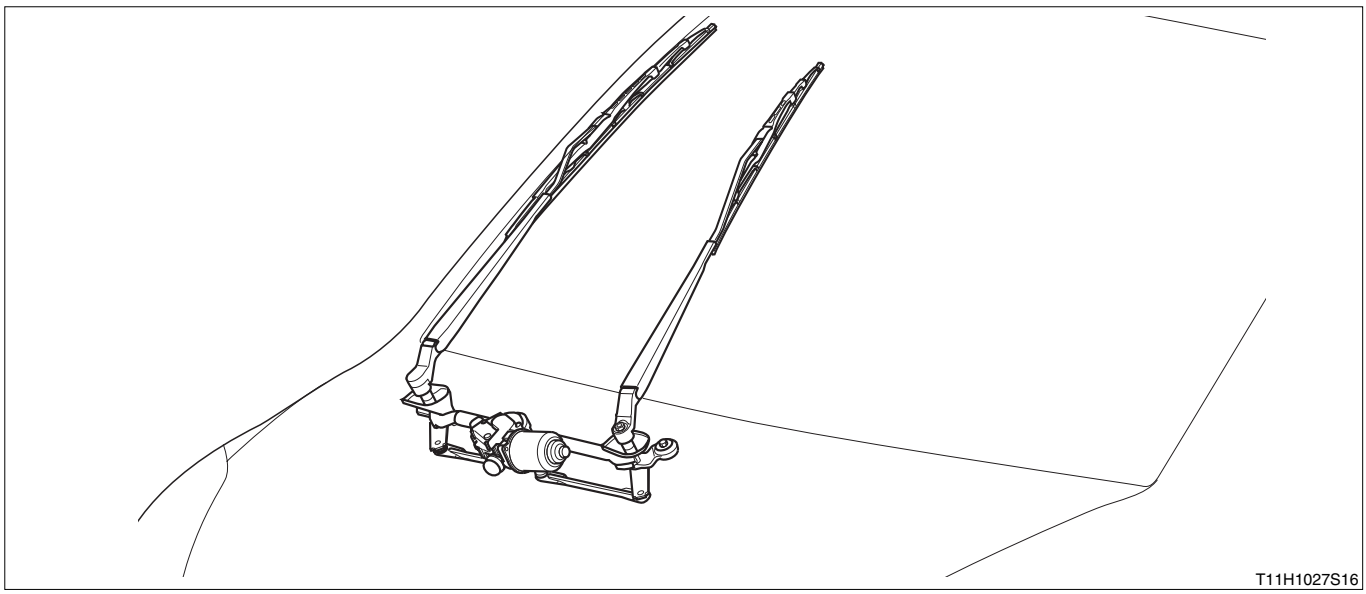
2-1 FRONT WIPER

2-1-1 DESCRIPTION

1. The module type wiper motor & link has been employed for the front wiper.
2. Careful consideration has been made for the protection of pedestrians by employing a breaking structure for the front passenger seat side pivot section.

2-1-2 FRONT WIPER MOTOR AND LINK

The frame integrated module type has been employed for the installation structure of the front wiper motor and the front wiper link. As a result, the system rigidity has been enhanced, thus reducing the wiper operation sound as well as the variation of the wiper sweep angle.



2-1-3 FRONT WIPER MOTOR

For the front wiper motor, a motor with rated voltage of 12V and rated torque of 18N·m has been employed for all models.

Specification table

Rated voltage (V)	12
Rated torque (N·m)	18

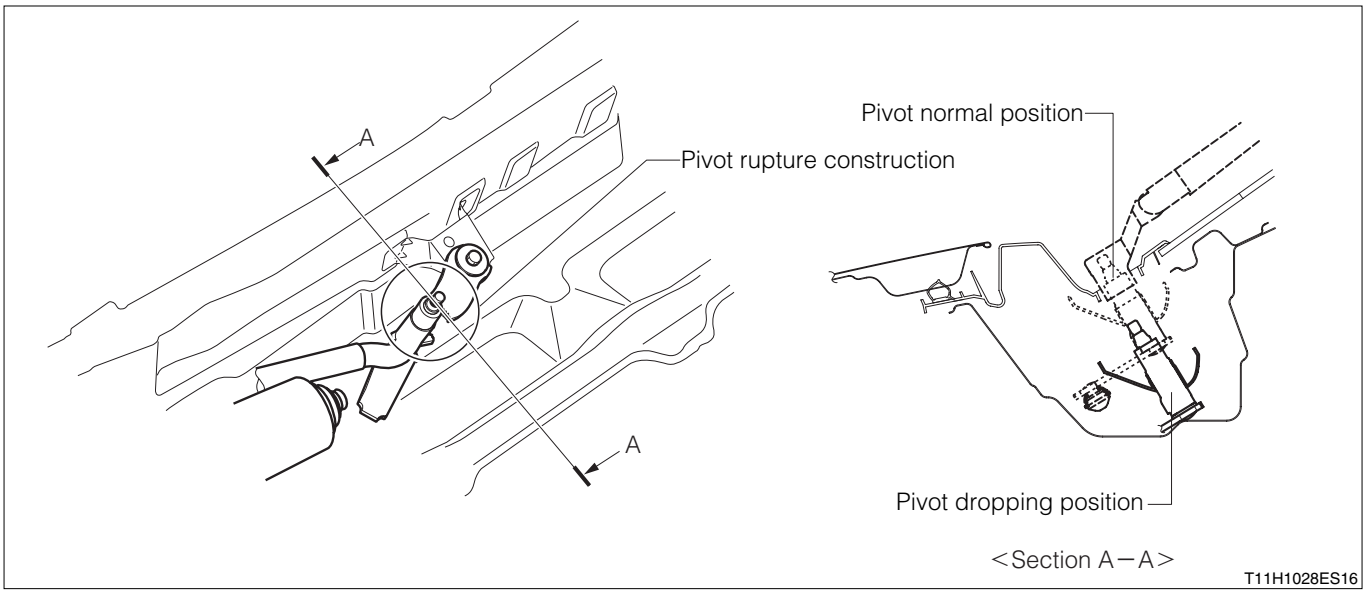
2-1-4 FRONT WIPER ARM & BLADE

Specification table

Driver seat side front wiper blade length (mm)	500
Front passenger seat side front wiper blade length (mm)	400

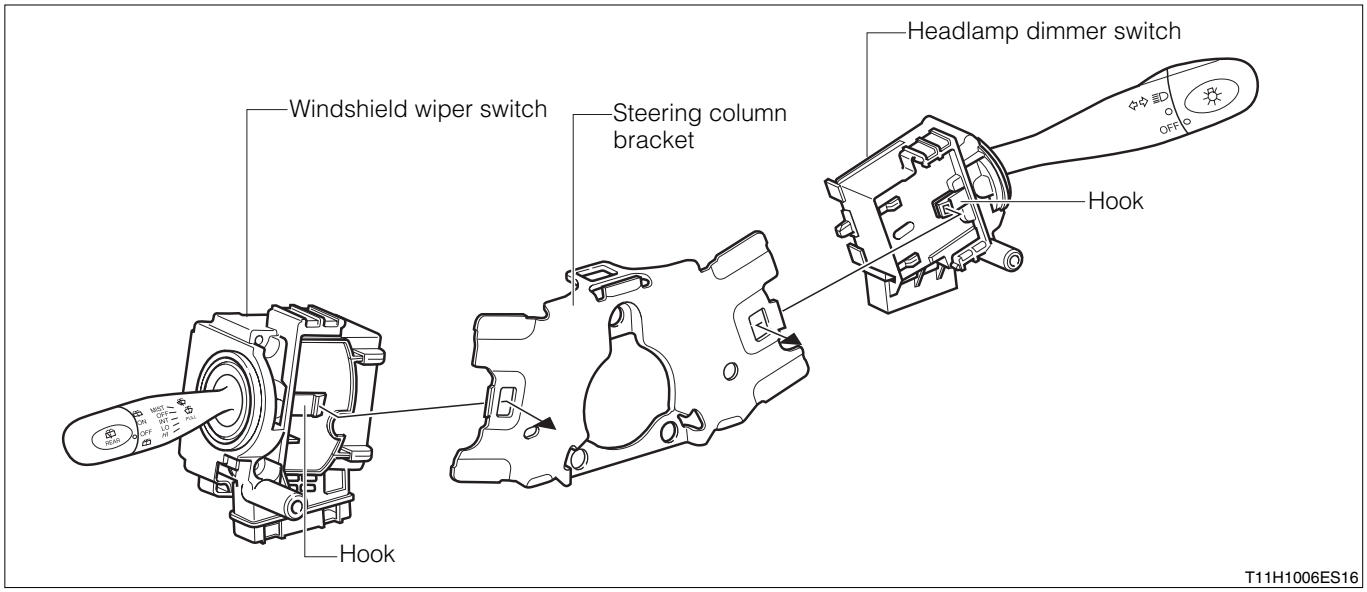
2-1-5 FRONT WIPER LINK

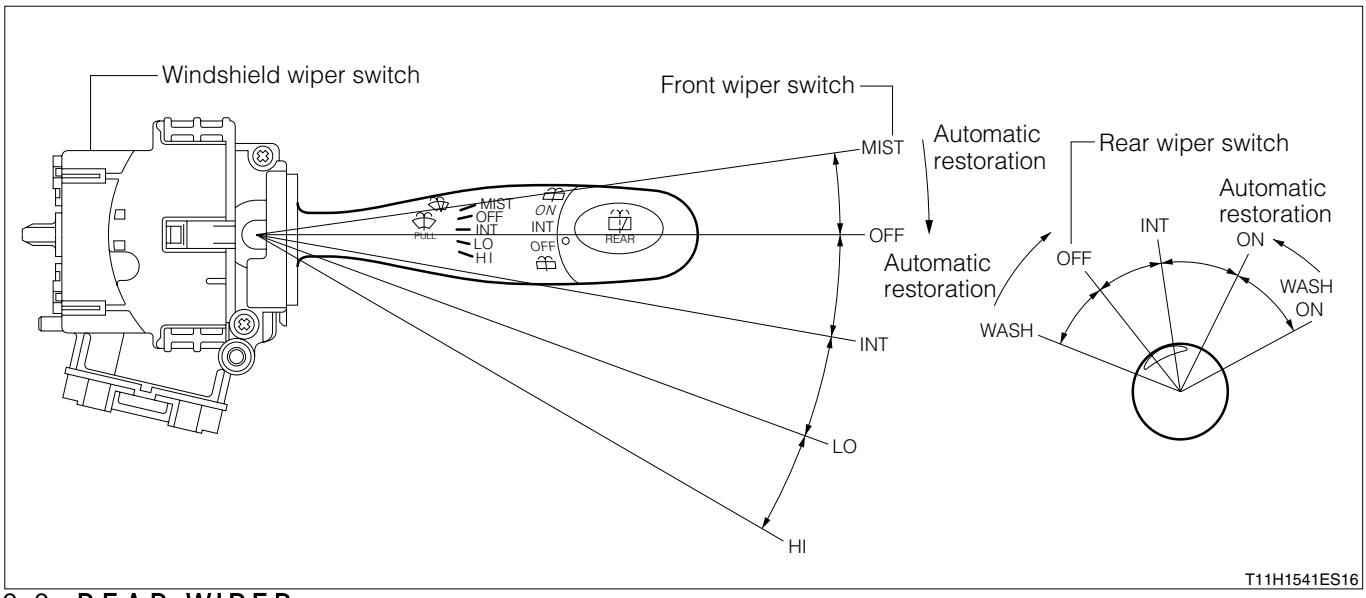
1. Careful consideration has been made for the protection of pedestrians by employing the pivot section breaking structure for the front passenger seat side wiper.
2. A structure in which it is difficult for the head of the pedestrian to hit the base of the wiper directly has been employed by positioning the hood higher than the base of the wiper.
3. Even in the event that the vehicle and the pedestrian collide and the pedestrian hit the base of the wiper, the pivot shaft falls off downward and reduces the impact by the breaking of the pivot section due to the impact.



2-1-6 WINDSHIELD WIPER SWITCH

By positioning the headlamp dimmer switch and the windshield wiper switch independently, replacement of the windshield wiper switch has been made possible without removing the steering wheel. In this way, the serviceability has been enhanced.





2-2 REAR WIPER

2-2-1 DESCRIPTION

Individual replacement of the rear wiper blade has been made possible by letting the rear wiper arm and the blade have separate body structure made of resin.

2-2-2 REAR WIPER MOTOR

The rear wiper motor is common for all models.

Specification table

Rated voltage (V)	12
Rated torque (N·m)	7

2-2-3 REAR WIPER ARM & BLADE

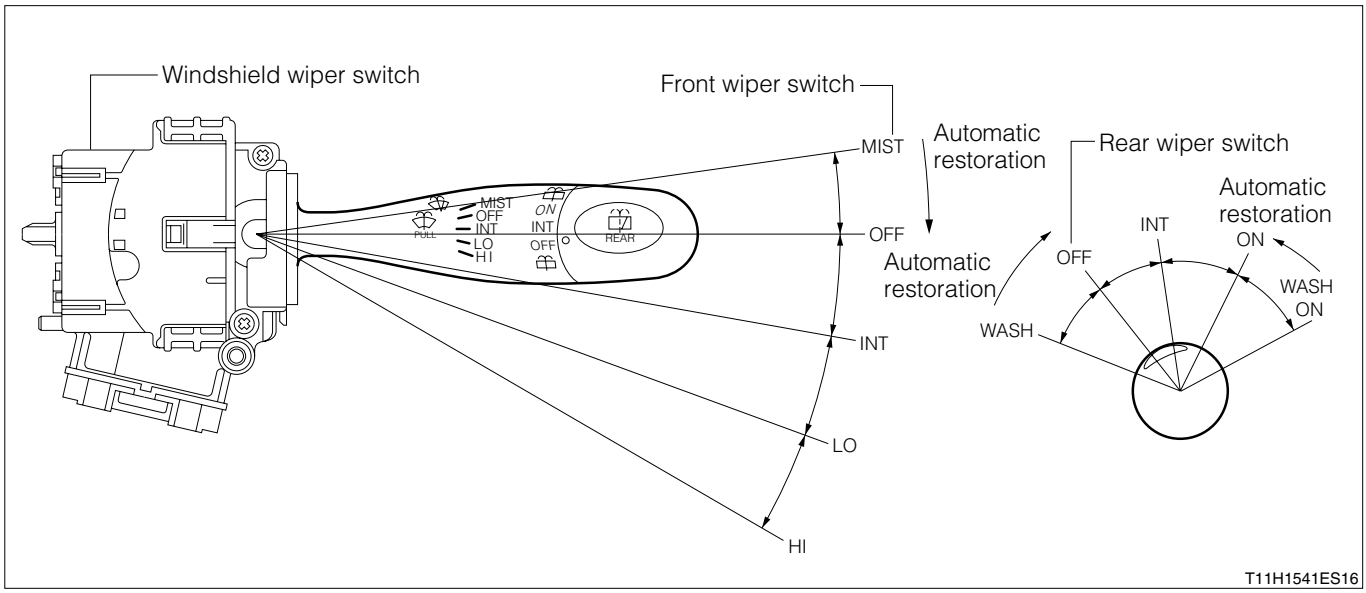
1. Individual replacement of the rear wiper blade has been made possible by letting the rear wiper arm and the rear wiper blade have separate body structure made of resin.
2. The rear wiper arm and the rear wiper blade have the specification common for all models.

Specification table

Rear wiper blade length (mm)	350

2-2-4 REAR WIPER SWITCH

For easier operation, the rear wiper switch has been integrated with the front wiper switch.



2-3 WASHER

2-3-1 WASHER TANK & PUMP

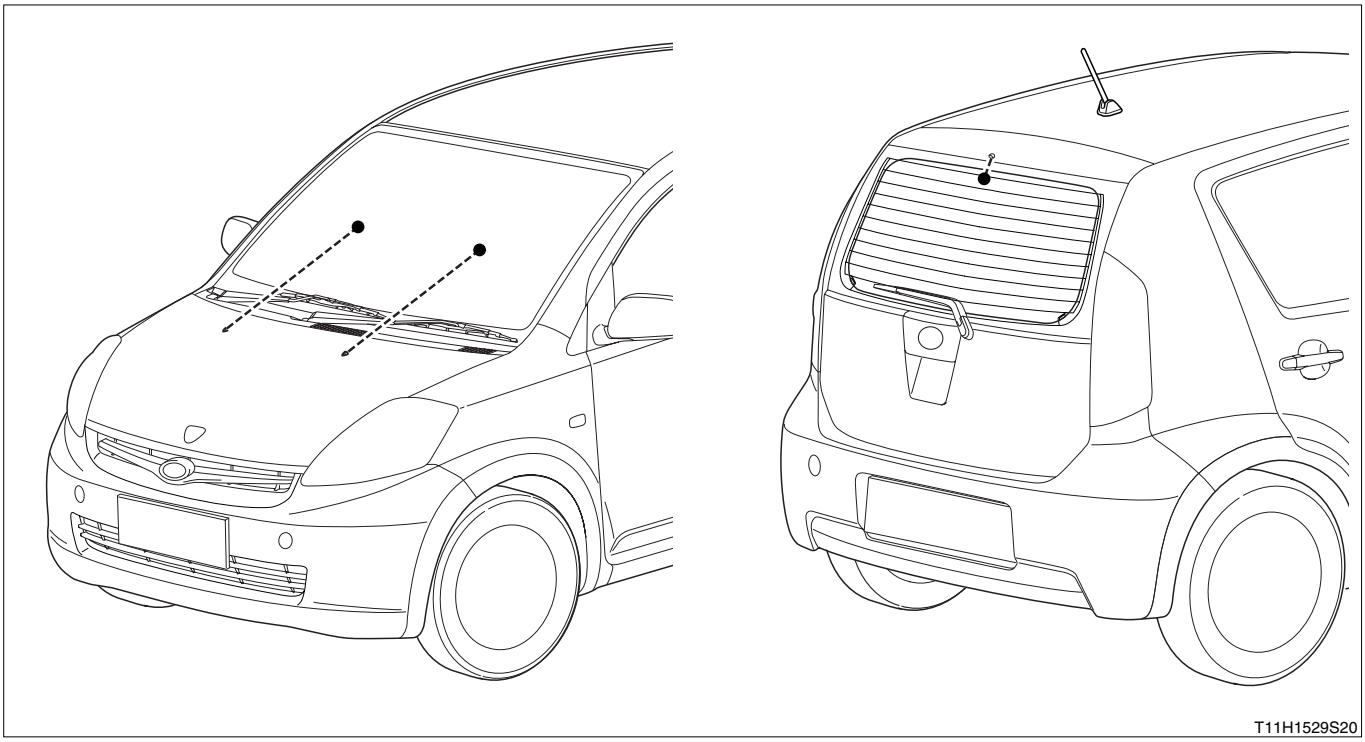
1. The washer tank has been positioned below the right headlamp.
2. A wash tank of 2.0ℓ and pump have been employed for all models.

Specification table

Tank capacity (ℓ)	2.0
Rated voltage (V)	12
Current when in use (A)	Not to exceed 2.0
Pump injection pressure (kPa)	150±30
Injection flow rate (ℓ/minute)	1.1 or more

2-3-2 WASHER NOZZLE

1. Two 1-hole type washer nozzle has been set in the front and one 1-hole type washer nozzle has been set in the rear side.
2. A stable cleaning performance during high speed driving has been achieved by setting two washer nozzles in the front.



T11H1529S20

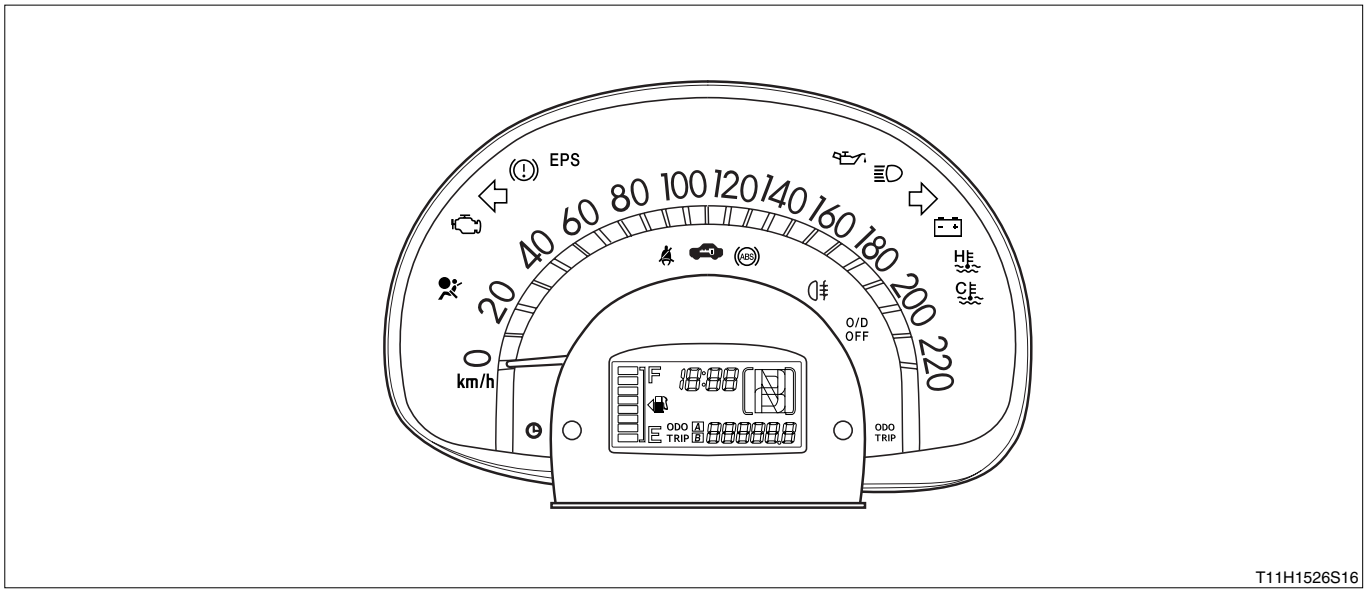
J3 METER

1 OUTLINE

1-1 DESCRIPTION

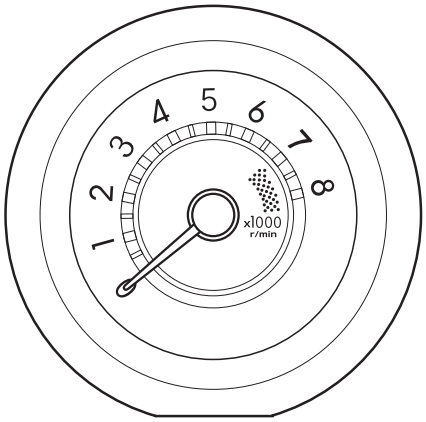
1. The designing and legibility have been enhanced by positioning the meter on the upper part of the steering column.
2. Legibility and visibility have been enhanced by employing the letter size which provides comprehensibility and easy reading.
3. As for the odometer · trip meter, electric type odometer · trip meter equipped with a twin trip meter has been employed.
4. A tachometer is available on. The tachometer is separate from the combination meter and is positioned on the upper part of the instrument panel.
5. For some of the communications of the meter and other ECU, multiplex communication of CAN (Controller Area Network) and LIN (Local Interconnect Network) has been employed.
6. A clock is set within the meter.
7. An excellent visibility is achieved by indicating fuel gauge, odometer · trip meter, shift position indicator and clock in LCD (Liquid Crystal Display).
8. A multi-buzzer that makes a buzzer sound while various warnings are given such as when the key is remaining in the key cylinder, or when reversing has been employed and is built in the meter.
9. Fuel level warning function has been employed for all models.
10. Power saving and long lasting features have been promoted by employing LED for all lightings such as the dial plate and the indicator lamps.

Combination meter



The illustration represents a major example.

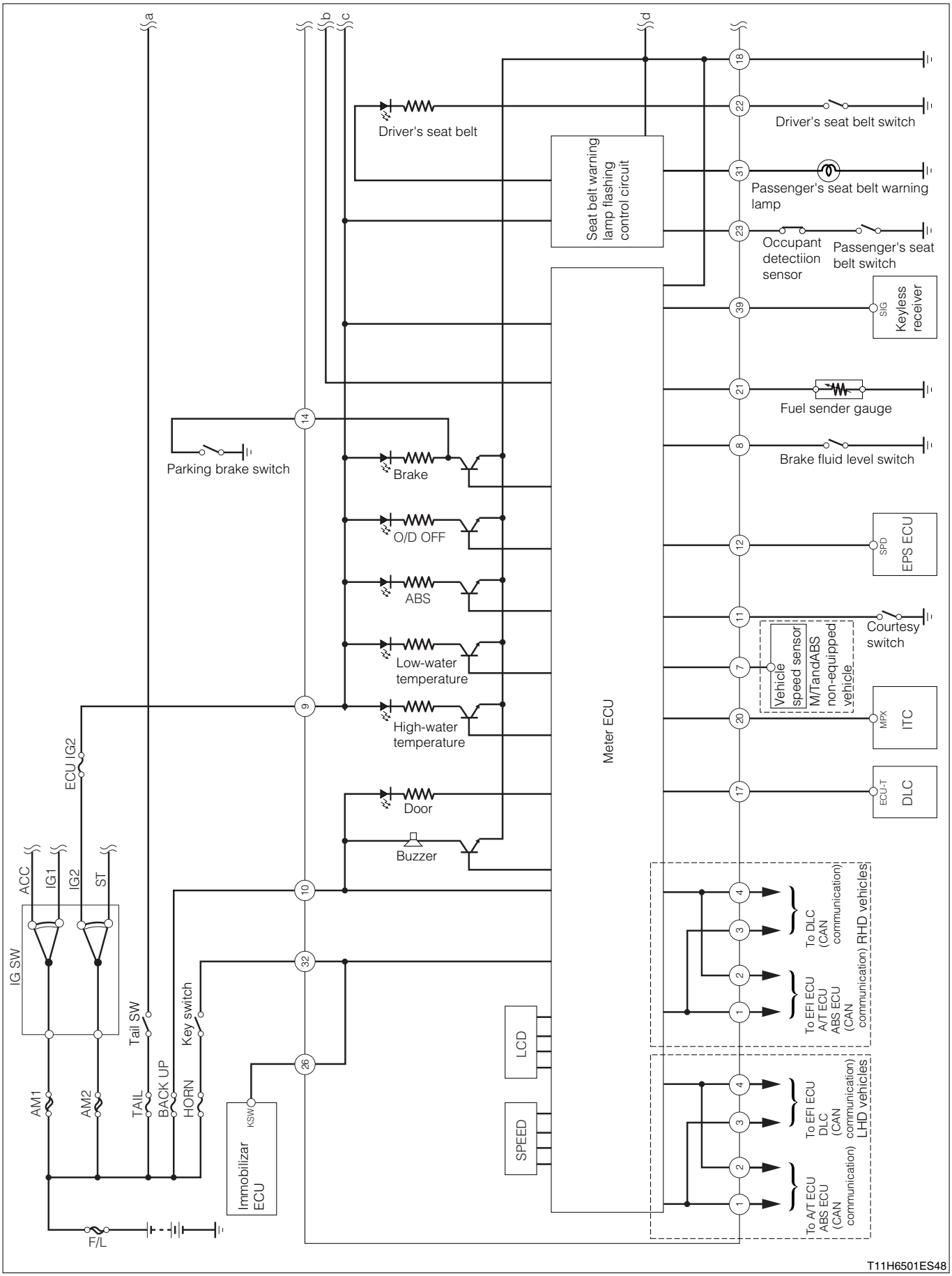
Tachometer



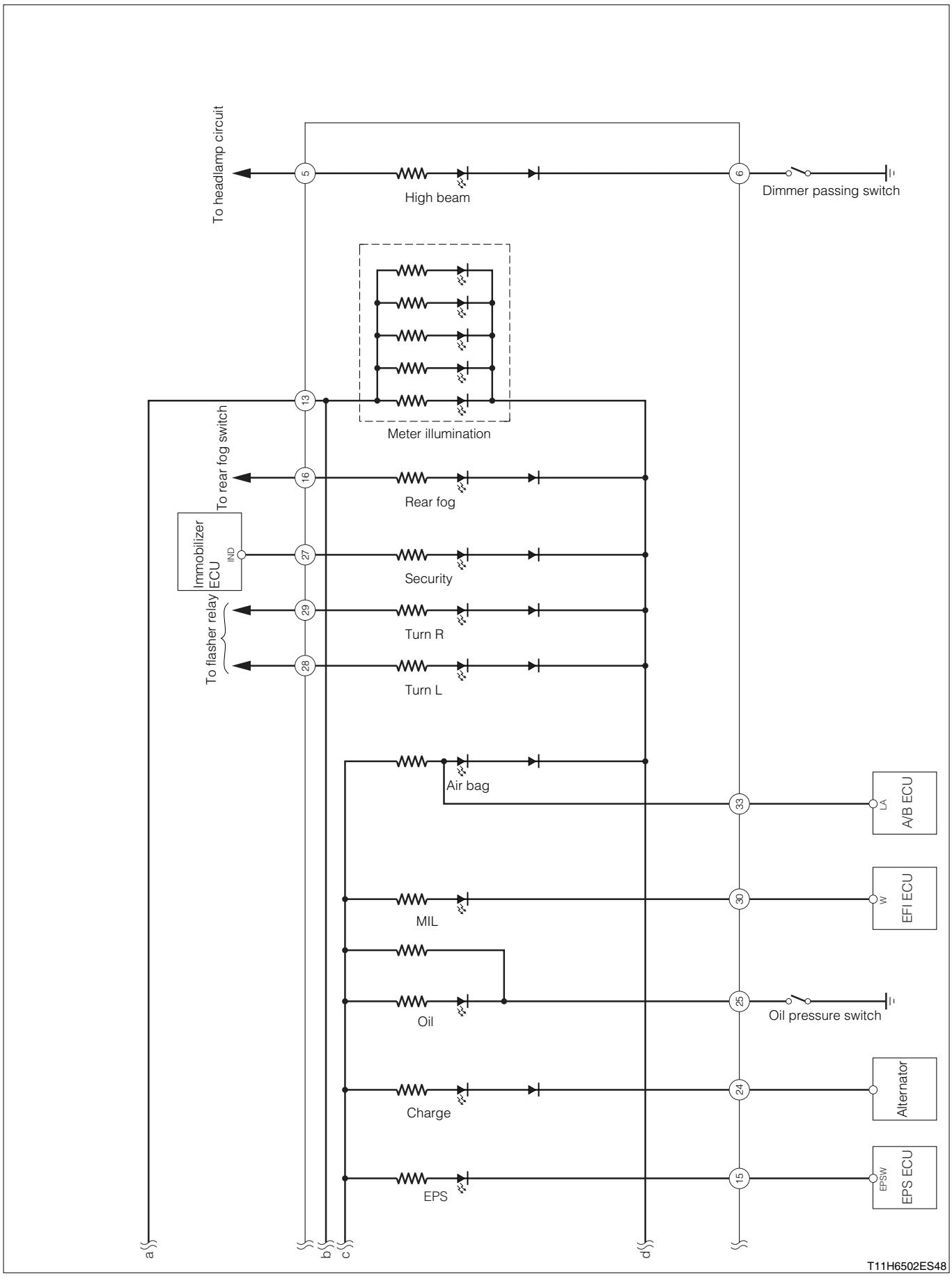
T11H1031S16

1-2 SYSTEM WIRING DIAGRAM

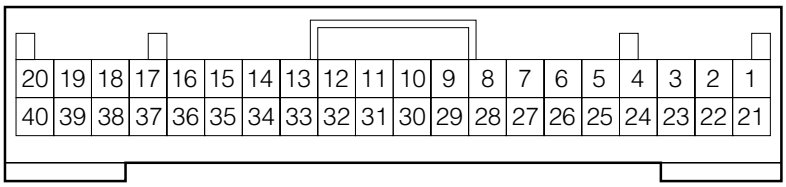
1-2-1 COMBINATION METER



T11H6501ES48


To headlamp circuit
5
High beam
6
Dimmer passing switch
13
Meter illumination
To rear fog switch
16
Rear fog
Immobilizer ECU
IND
27
Security
To flasher relay
29
Turn R
28
Turn L
Air bag
33
LA
A/B ECU
MIL
30
W
EFI ECU
Oil
25
Oil pressure switch
Charge
24
Alternator
EPS
15
EPSW
EPS ECU
a
b
c
d
T11H6502ES48

Arrangement of meter terminal

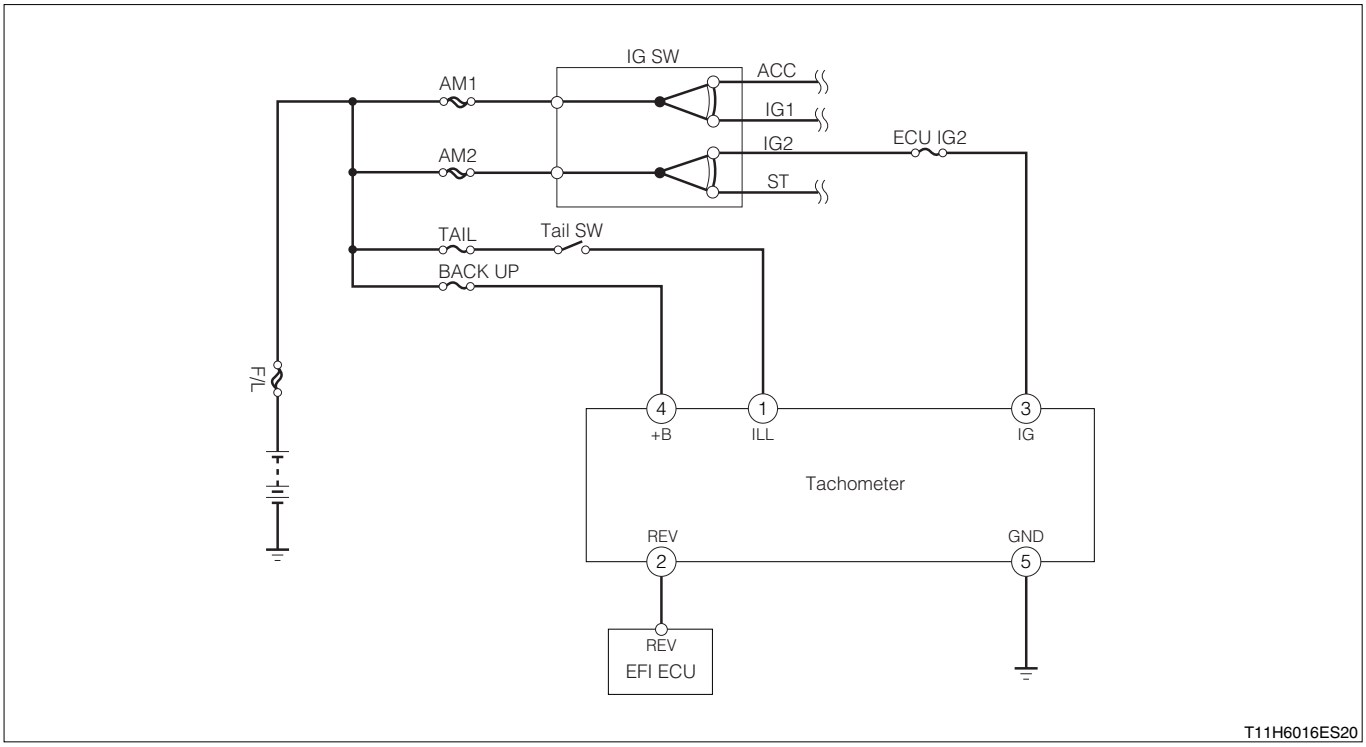


T11H6013S10

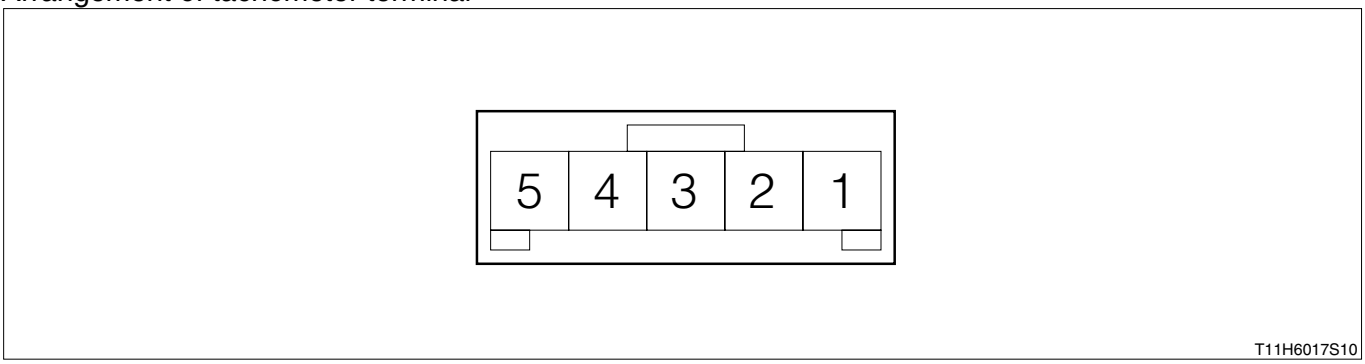
Meter terminal name

Terminal No.	Terminal code	Terminal name
1	CANH	CAN communication HI (1)
2	CANL	CAN communication LO (1)
3	HCAN	CAN communication HI (2)
4	LCAN	CAN communication LO (2)
5	BEAM+	High beam +
6	BEAM−	High beam −
7	SPD	Input of vehicle speed signal
8	BRK	Input of brake fluid signal
9	IG2	IG power supply
10	+B	+B power supply
11	DOOR	Input of courtesy switch signal
12	SPOUT	Output of vehicle speed signal
13	TAIL	Illumination +
14	PKBSW	Parking brake
15	EPS	EPS
16	RR-FOG	Rear fog lamp
17	ECU-T	ECU-T terminal signal input
18	GND	Earth
19	−	−
20	LIN	LIN communication input/output
21	FUEL	Input of fuel signal
22	D-BELT	Seat belt at driver's seat side
23	P-BELT	Front passenger seat side seat belt signal input
24	CHG	Charge
25	OIL	Oil
26	KEY2	Output of key switch signal
27	SEC	Security
28	TURNL	Turn LH
29	TURNR	Turn RH
30	MIL	MIL
31	P-BELOUT	Front passenger seat side seat belt signal output
32	KEY	Input of key switch signal
33	A/B	Airbag
34	−	−
35	−	−
36	−	−
37	−	−
38	−	−
39	KLS	Keyless receiver signal input
40	−	−

1-2-2 **TACHOMETER**



Arrangement of tachometer terminal



Tachometer terminal name

Terminal No.	Terminal code	Terminal name
1	ILL	Illumination
2	REV	Input of engine revolution speed signal
3	IG	IG power supply
4	+B	+B power supply
5	GND	Earth

2 CONSTRUCTION AND OPERATION

2-1 SPEEDOMETER

2-1-1 DESCRIPTION

1. For the speedometers, the electric type has been employed for all models.

2-1-2 SPECIFICATIONS

Indication	Function
Indication range: 0 - 220 km/h 0 - 140 MPH At increments of 10 km/h At increments of 10 MPH	Electric type (pointer: stepper motor type) Vehicle speed signal source: ABS ECU Meter output vehicle speed pulse: 4 pulse/rev (42.47 Hz [at 60 km/h]) 4 pulse/rev (68.33 Hz [at 60 MPH]) The vehicle speed is indicated by inputting the vehicle speed signal from the ABS ECU over the CAN communication and processing the signal at the meter ECU. (ABS-equipped vehicles)

2-2 TACHOMETER

2-2-1 DESCRIPTION

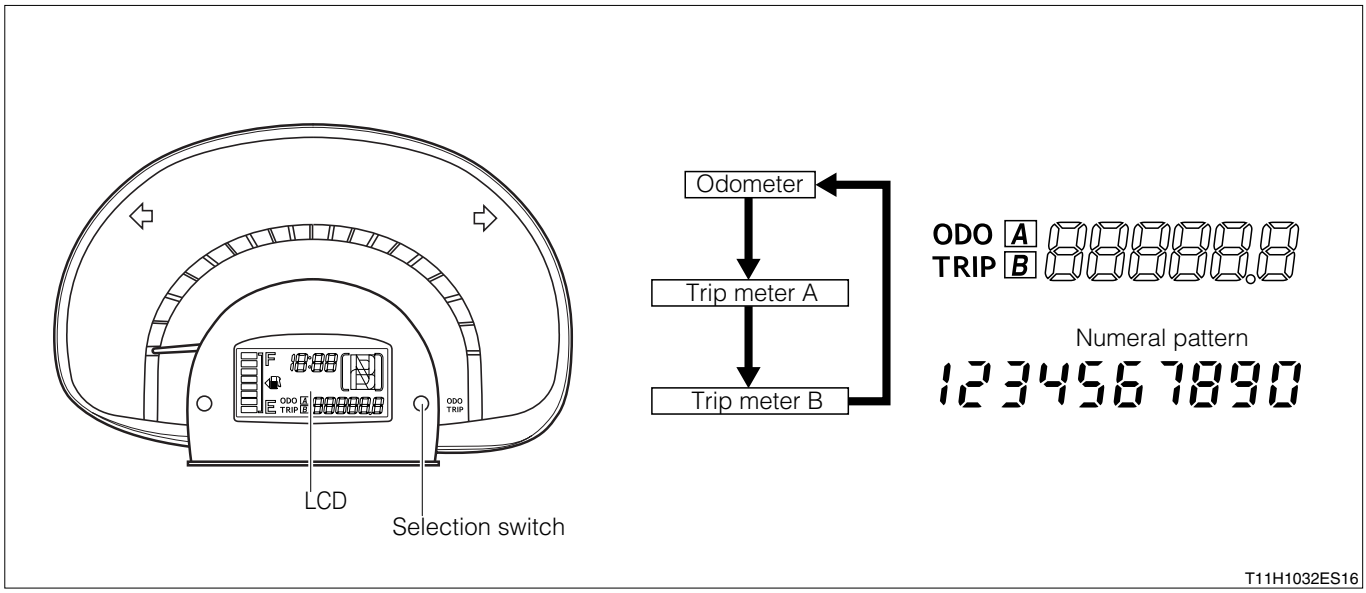
2-2-2 SPECIFICATIONS

Indication	Function
Indication range: 0 - 8400 rpm (Red zone: 6800 - 8400 rpm)	Electric type (pointer: stepper motor type) Revolution signal source: EFI ECU Number of input pulses: 2pulse/rev (100 Hz at 3000 rpm) The pulse signal from the EFI ECU is inputted. Then, the tachometer counts the pulse signals and performs calculation and finally indicates the engine revolution speed.

2-3 ODOMETER · TRIP METER

2-3-1 DESCRIPTION

1. An excellent visibility is achieved by employing an odometer · trip meter with LCD (Liquid Crystal Display) indication.
2. As for the odometer · trip meter, an electric type odometer · trip meter equipped with a twin trip meter has been employed.
3. The changing of each mode is done by pressing the selection switch at the right of the speedometer. Indications are made in the order of odometer→trip meterA→trip meter B→odometer.
4. The figure of the trip meter is reset by pressing the selection switch for more than about one second.



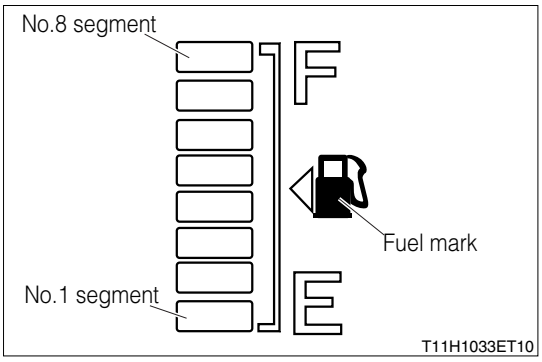
2-3-2 SPECIFICATIONS

Indication	Function
Digital indication by LCD Indication range: Odometer: 0 - 999999 km 0 - 999999 MILE Trip meter A · B: 0 - 9999.9 km 0 - 9999.9 MILE	LCD type Mileage signal source: ABS ECU The running distance is indicated by inputting the running distance signal from the ABS ECU over the CAN communication and processing the signal at the meter ECU. (ABS-equipped vehicles) The backward moving distance is also added. By pressing the selection switch, indications are made in the order of odometer→trip meter A →trip meter B. By pressing the selection switch for more than about one second, the figure of the trip meter is reset.

2-4 FUEL GAUGE

2-4-1 DESCRIPTION

1. An excellent visibility is achieved by indicating fuel gauge in LCD (Liquid Crystal Display).
2. The meter ECU calculates the accurate fuel level by calculating the average data of a certain period of time based on the level signal from the fuel sender gauge.
3. The Fuel gauge indicates the fuel level by turning on/off of the eight segments in the bar graph.



2-4-2 SPECIFICATIONS

Indication	Function
Digital indication by LCD (Liquid Crystal Display) Indicated by 8 segment bar graph. Indication range: E - F	The fuel level is indicated by inputting the fuel sender gauge voltage and calculating at the meter ECU. No.1 segment (bottom position) blinks when No.2 segment is turned off (when fuel level is about 6ℓ).

2-4-3 FUEL LEVEL INDICATION FUNCTION

The meter ECU indicates the corresponding LCD segments by calculating the average data of a certain period of time based on the level signal from the fuel sender gauge.

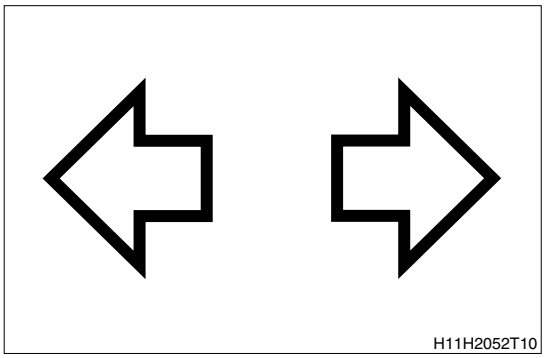
2-4-4 FUEL LEVEL WARNING FUNCTION

The driver is warned by the No.1 segment (bottom position) blinking when No.2 segment is turned off (when the fuel level is about 6ℓ).

2-5 WARNING / INDICATOR

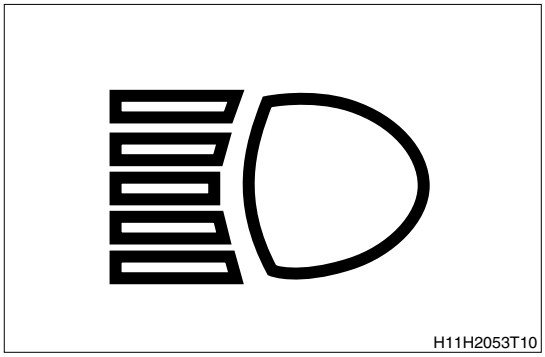
2-5-1 TURN

1. A turn indicator has been set in the meter.
2. It blinks when the turn signal switch and the hazard switch are "ON".



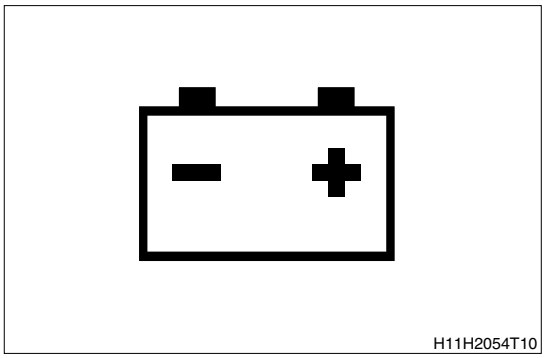
2-5-2 **HIGH-BEAM**

1. A high-beam indicator is set in the meter.
2. It is lighted when the headlamp is set at high-beam or passing.


H11H2053T10

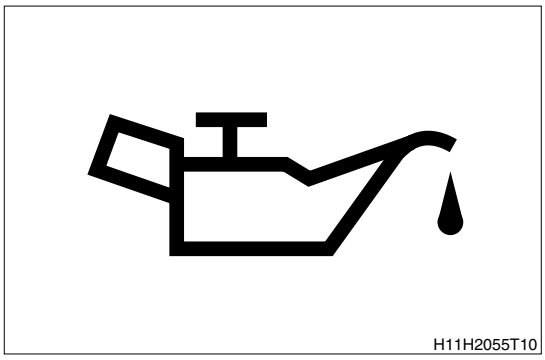
2-5-3 **CHARGE**

1. A charge warning lamp is set in the meter.
2. If the charging system is normal, it is lighted when the IG switch is turned "ON" and is turned off when the engine is started.
3. It is constantly lighted when there is an abnormality in the system.


H11H2054T10

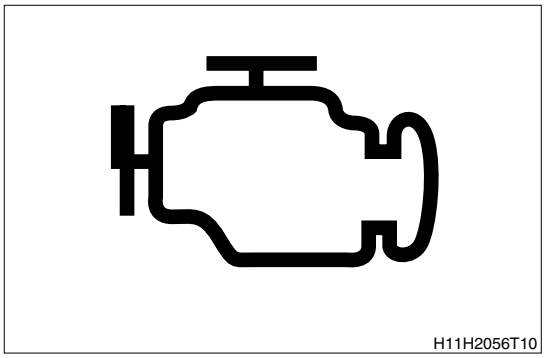
2-5-4 **OIL**

1. An oil warning lamp has been set in the meter.
2. It is lighted when the oil pressure switch is "ON" and is turned off when the engine is started.
3. It is constantly lighted when the oil pressure is low.


H11H2055T10

2-5-5 **MIL**

1. If the engine control system is normal, it is lighted when the IG switch is turned "ON" and is turned off when the engine is started.
2. It is constantly lighted when there is an abnormality in the system.
3. The diagnosis code of the engine control system is outputted.


H11H2056T10

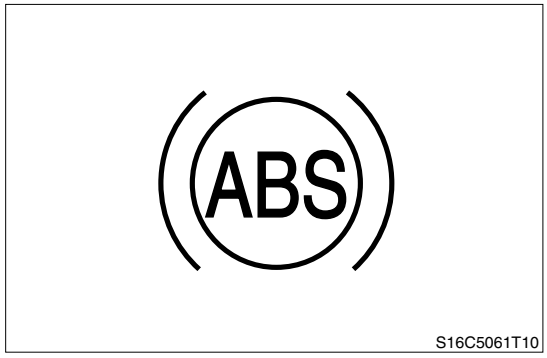
2-5-6 **BRAKE**

1. A brake warning lamp has been set in the meter.
2. If the system is normal, it is lighted when the IG switch is turned "ON" and is turned off three seconds later under the condition in which the parking brake is not operating.
3. It is lighted when the parking brake switch or the brake fluid level switch is "ON".
4. It is constantly lighted when there is an abnormality in the ABS.


W13C6012T10

2-5-7 **ABS**

1. An ABS warning lamp has been set in the meter.
2. If the system is normal, it is lighted when the IG switch is turned "ON" and is turned off about three seconds later.
3. It is constantly lighted when there is an abnormality in the system.
4. The diagnosis code of the ABS is outputted.



S16C5061T10

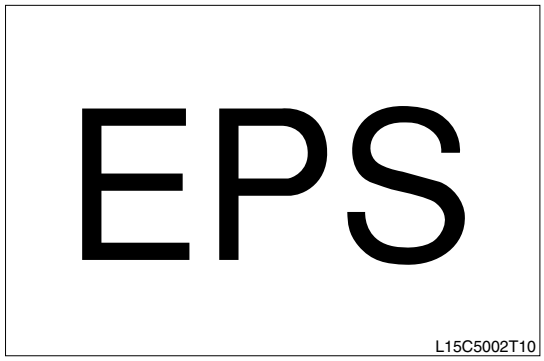
2-5-8 **AIRBAG**

1. An airbag warning lamp has been set in the meter.
2. If the system is normal, it is lighted when the IG switch is turned "ON" and is turned off about six seconds later.
3. It is constantly lighted when there is an abnormality in the system.
4. The diagnosis code of the airbag system is outputted.


L11A5009T10

2-5-9 **EPS**

1. An EPS warning lamp has been set in the meter.
2. If the system is normal, it is lighted when the IG switch is turned "ON" and is turned off two seconds later.
3. It is constantly lighted when there is an abnormality in the system.
4. The diagnosis code of the EPS system is outputted.



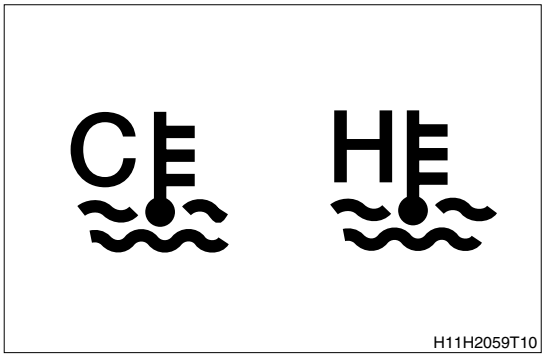
L15C5002T10

2-5-10 **HIGH WATER TEMPERATURE/LOW WATER TEMPERATURE**

1. A high water temperature warning lamp and low water temperature indicator lamp have been set in the meter.
2. If the system is normal, the high temperature warning lamp and low temperature indicator lamp are lighted when the IG switch is turned "ON" and are turned off about three seconds later under the condition in which the water temperature is neither high or low.

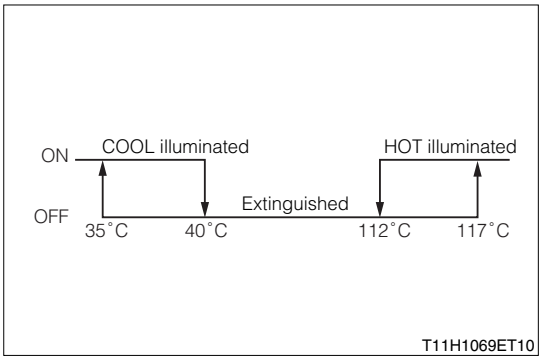
NOTE

- Even if the IG switch is turned "ON" when the engine water temperature is low, the high water temperature warning lamp is lighted for about three seconds for initial check. In that case, the low water temperature indicator lamp is also lighted and will continue to be lighted after three seconds until the engine water temperature becomes high.



H11H2059T10

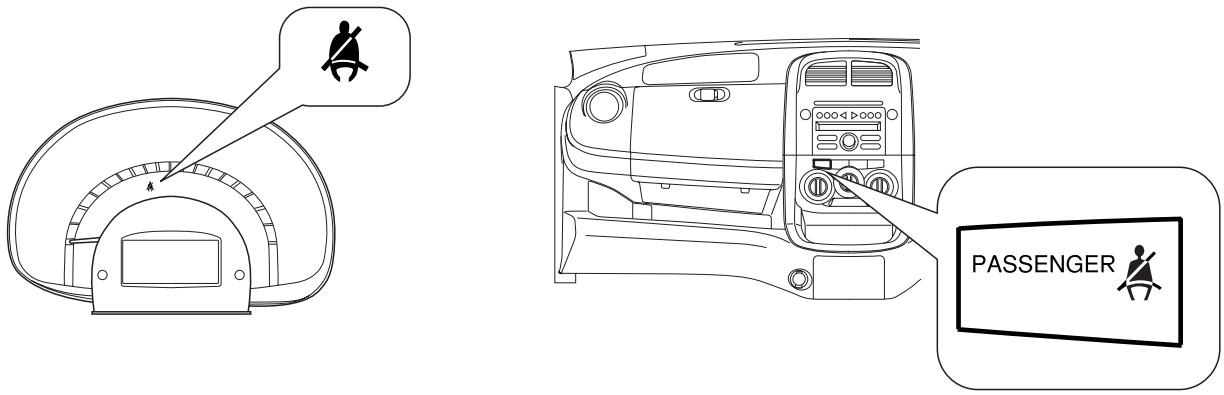
3. The high water temperature warning lamp blinks when the water temperature is about 117℃ or above and is turned off when it is about 112℃ or below.
4. The low water temperature indicator lamp is lighted when the water temperature is about 35℃ or below and is turned off when it is about 40℃ or above.



2-5-11 **SEAT BELT**

(1) **Description**

1. A blinking type seat belt warning lamps have been set to the driver seat and the passenger seat according to the specifications. As for the position of the warning lamp, the one of the driver seat is set in the meter and the other for the passenger seat is set in the air conditioner control panel.
2. The driver seat belt warning lamp blinks if the seat belt is not fastened on the driver seat.
3. As for the front passenger seat belt warning lamp, it blinks if the seat belt is not fastened on the front passenger seat when there is somebody seated on the passenger seat.
4. A passenger detection sensor which detects if the passenger is seated or not has been set below the skin of the front passenger seat cushion.



Driver's seat belt warning

Front passenger seat belt warning

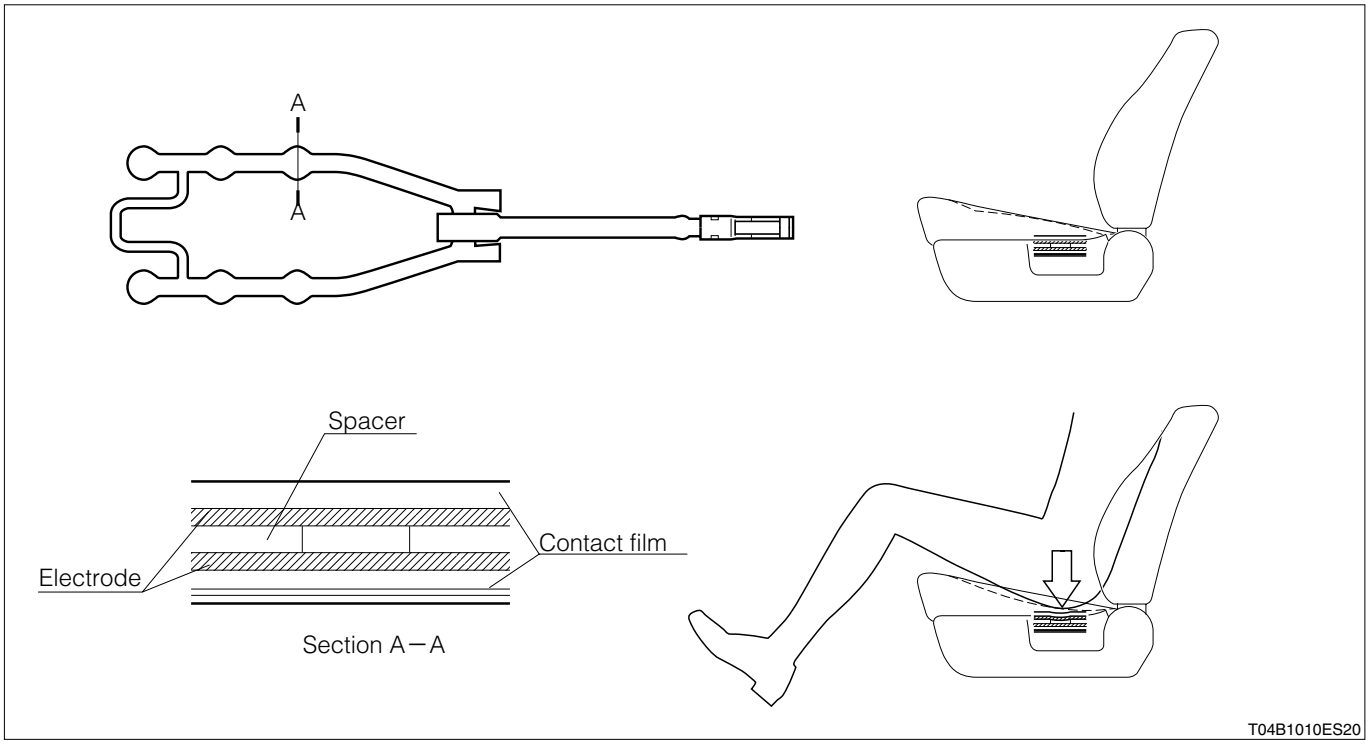
T11H1034ES16

(2) **Passenger detection sensor structure**

When the IG switch is "ON" and a passenger seats on the front passenger seat, the electrodes of the sensor have contact and let the warning lamp blink. Then, when the passenger seat belt is fastened, the seat belt switch is turned "OFF" and the warning lamp is turned off.

NOTE

- If a load above a certain level is applied to the seat cushion such as in the case of placing luggage on the passenger seat cushion, the sensor may detect this.



T04B1010ES20

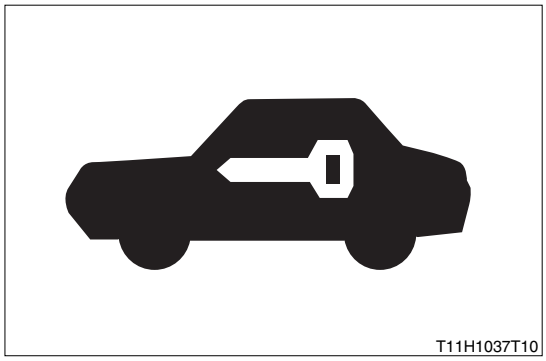
2-5-12 **SECURITY**

1. A security indicator has been set in the meter.

NOTE

- Please refer to the pages of the immobilizer system for details concerning lighting conditions.

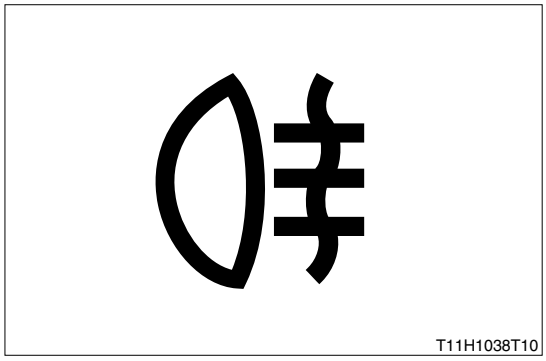
2. The diagnosis code of the immobilizer system is outputted.



T11H1037T10

2-5-13 **REAR FOG LAMP**

1. A rear fog lamp indicator has been set in the meter.
2. It is lighted when the rear fog lamp is lighted.



T11H1038T10

2-6 WARNING BUZZER

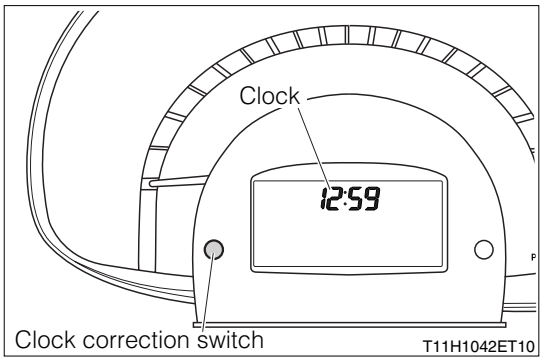
2-6-1 DESCRIPTION

2-6-2 SPECIFICATIONS

Category	Function
Key remaining in key cylinder Light remaining to be illuminated Reverse Seat belt remaining (Europe specification)	Warnings and abnormalities of each system are notified by sound.

2-7 CLOCK

1. A digital clock by LCD (Liquid Crystal Display) indication has been employed.
2. An excellent usability has been achieved by setting the installation position in the meter.
3. A clock adjusting switch to adjust the time has been set on the left side of the clock.



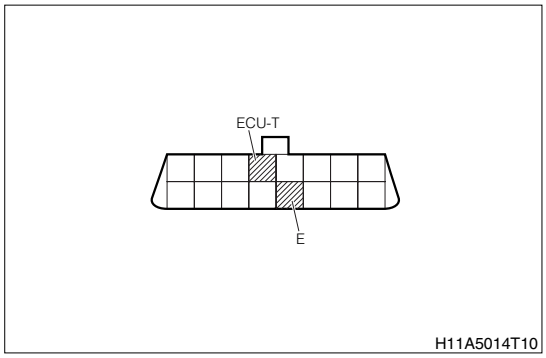
2-8 WATER TEMPERATURE INDICATION FUNCTION

2-8-1 DESCRIPTION

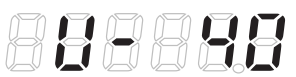
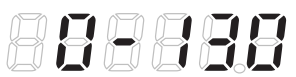
1. The water temperature may be indicated on LCD (Liquid Crystal Display) by the following procedures.
   (1) Turn "ON" the IG switch.
   (2) Short the terminal ECU-T and terminal E of the DLC.
   (3) Press on the selection switch for about a second.

CAUTION

- If the vehicle is driven with the terminal ECU-T ad terminal E of the DLC in the above (2) short-circuited, the figures on the liquid crystal display will remain to indicate the water temperature until the vehicle speed is above 8km/h and thus the odometer · trip meter cannot be seen. Please remove the short circuit between the terminal ECU-T and terminal E when the operation is finished.



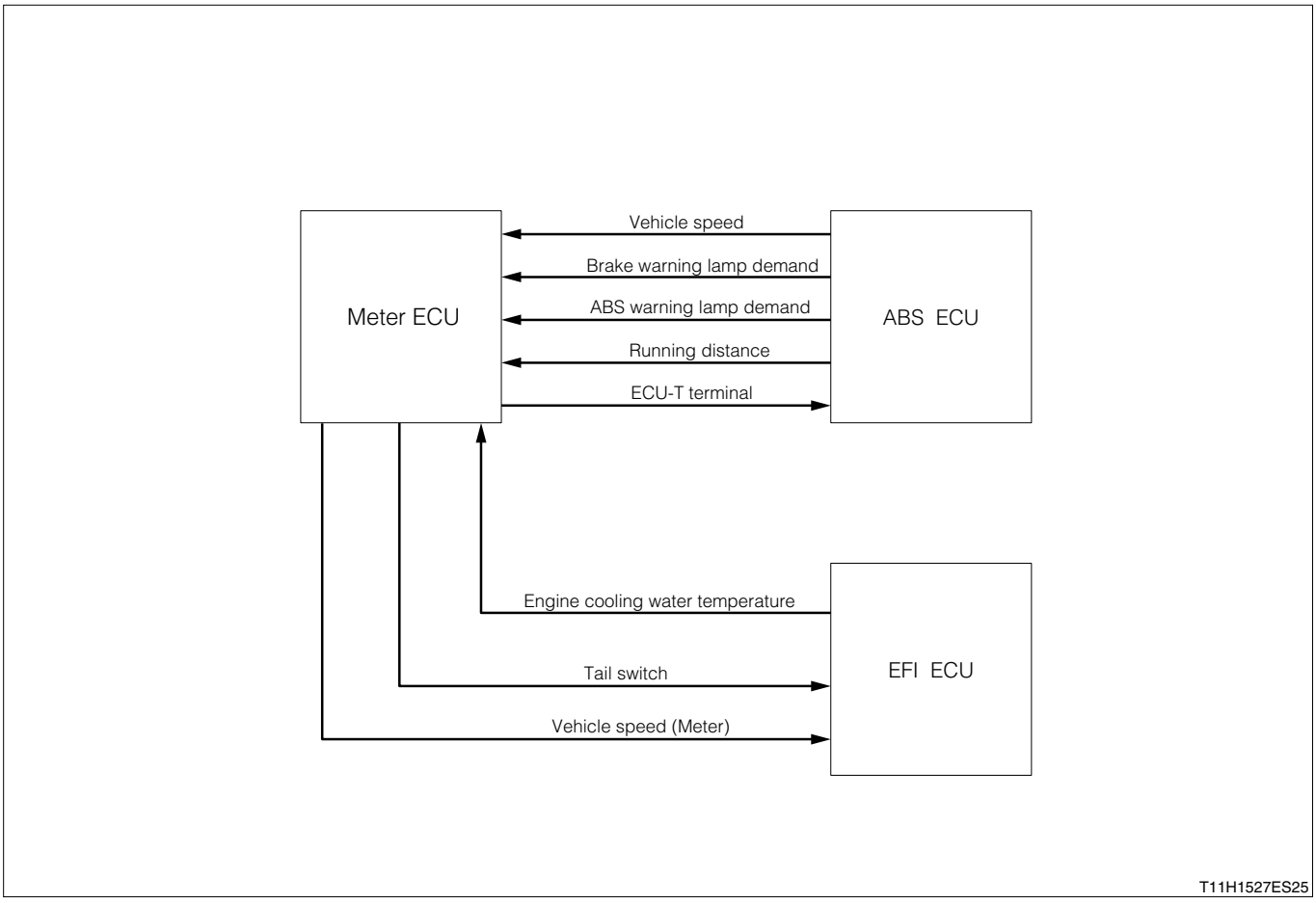
2. The temperature indicated on the LCD (Liquid Crystal Display) is from 40℃ to 130℃ with 1℃ intervals.

Water temperature	40˚C or less	108˚C	130˚C or more
Indication example			

T11H1040ES10

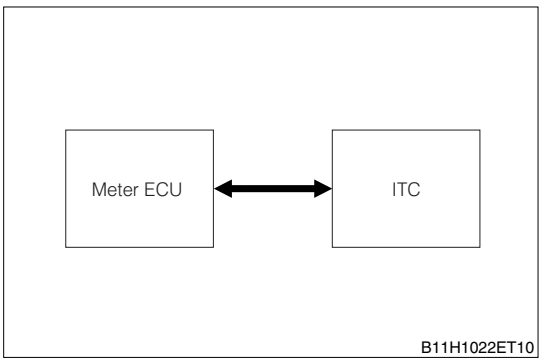
2-9 CAN COMMUNICATION

For the meter ECU in the meter, CAN communication is employed for some of the communications with other ECU's.
Please refer to the pages of the CAN communication system for the CAN communication.



2-10 LIN COMMUNICATION

For the meter ECU in the meter, the LIN communication is employed for some of the communications with other ECU's.
Please refer to the pages of the LIN communication system for the LIN communication.



Contents of meter ECU communication (LIN communication)

Nomenclature of signals	Meter ECU		Applicable ECU
	Receiving	Sending	
ITC sleep refusal	○	–	ITC
Request of keyless door lock	–	○	ITC
Request of keyless door unlock	–	○	ITC
Key switch	–	○	ITC
Terminal ECU-T	–	○	ITC
Door courtesy switch	–	○	ITC

2-11 DIAGNOSIS (ONBOARD DIAGNOSIS FUNCTION)

This is a function whereby the ECU informs the inspection operator of the abnormal items when there has been a failure in the system. When failure takes place, the ECU memorizes the abnormal item.
Please refer to the repair manual for details concerning the diagnosis.

2-12 FAIL-SAFE FUNCTION

When an abnormality takes place in each function, the meter shifts to the fail mode and carries out the processes as in the following.

List of fail mode

Function	Abnormality item	Process when failure takes place
Speedometer	Vehicle speed signal (CAN) communication disabled	Indicates 0km/h
	Abnormality in the meter	Indicates 0km/h
Odometer	Vehicle speed signal (CAN) communication disabled	Does not integrate mileage
	Abnormality in the meter	· Does not integrate mileage · Indicates "ODO" on the LCD. · Blinks indication of integrated mileage figure ·The running distance is measured in the unit of km. Either of the above is done.
Trip meter	Vehicle mileage signal (CAN) communication disabled	Does not integrate mileage
	Abnormality in the meter	· Blinks indication of integrated mileage figure ·The running distance is measured in the unit of km. Either of the above is done.
Fuel gauge	Signal analog / digital conversion error	Turns off of all segments until the IG switch is turned "ON" again.
High water temperature warning lamp/ Low water temperature indicator lamp	Engine water temperature signal (CAN) communication disabled	High water temperature warning lamp extinguished Low water temperature indicator lamp blinking
Brake warning lamp	Brake warning lamp request signal (CAN) communication disabled	Lamp illuminated
ABS warning lamp	ABS warning lamp request signal (CAN) communication disabled	Lamp illuminated

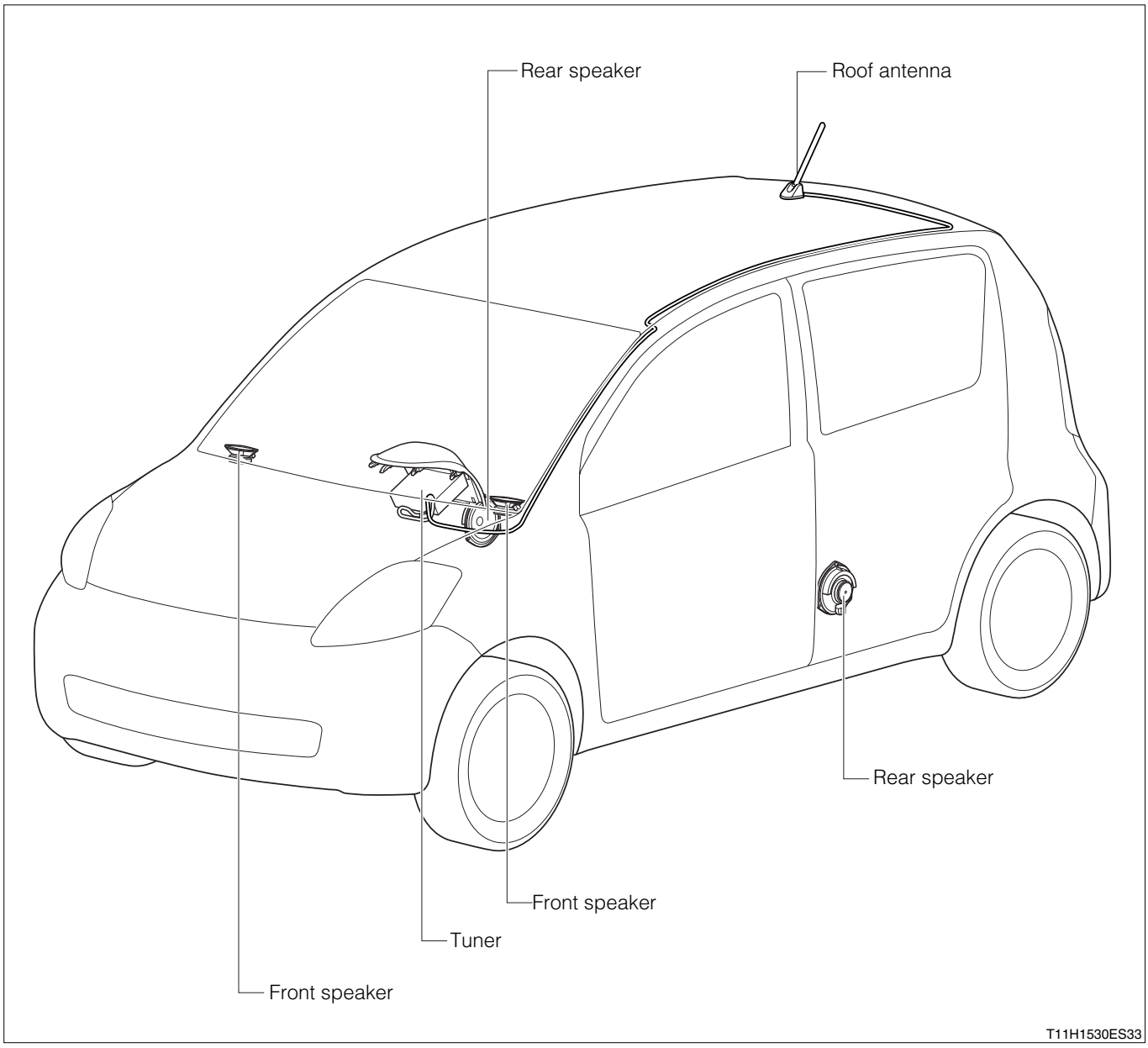
J4 AUDIO & VISUAL SYSTEM

1 CONSTRUCTION AND OPERATION

1-1 AUDIO SYSTEM

1-1-1 DESCRIPTION

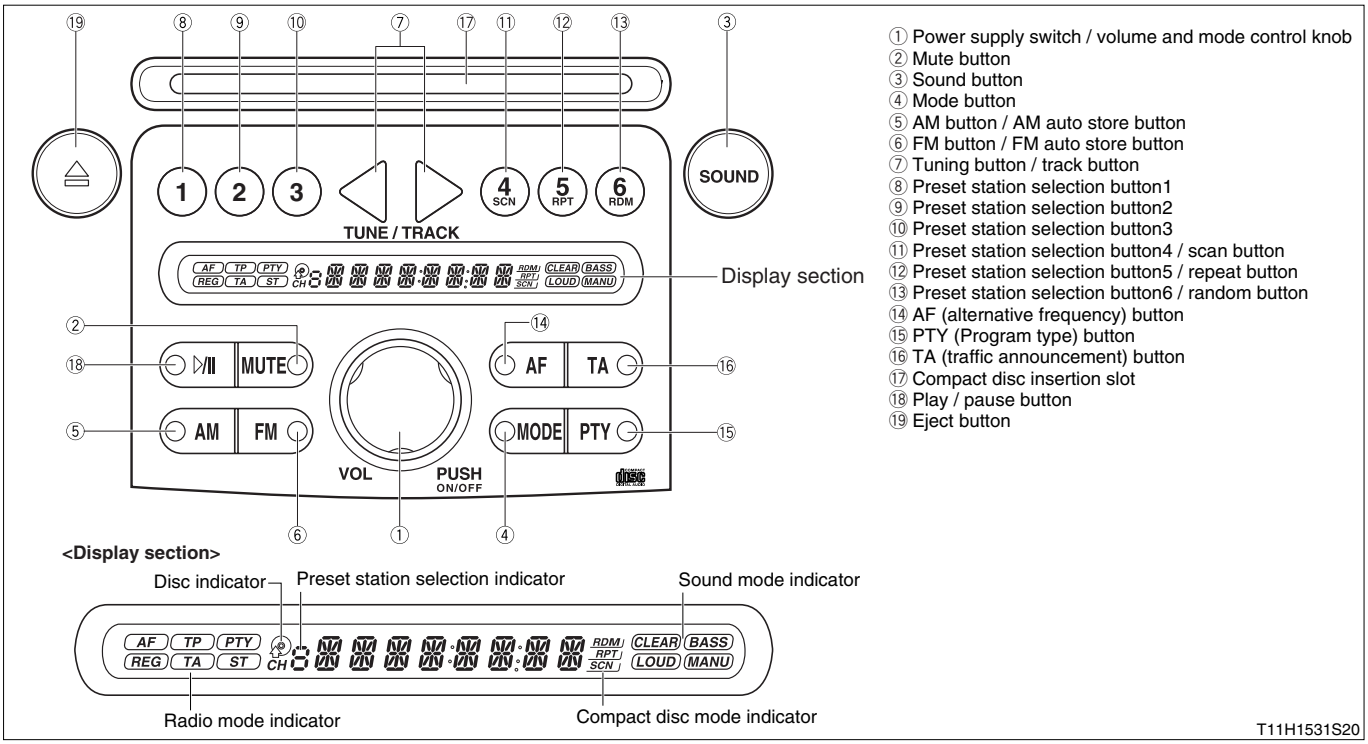
1. As for the speakers, 10cm front speakers or 10cm front speakers & 16 cm rear speakers are available according to the specifications.
2. As for the radio antenna, roof antennas have been employed for all models.



The illustration represents a typical example.

1-1-2 TUNER

1. An AM/FM radio with compact disc player employing a surface design which has a single surface with the center cluster is available in all specifications. The AM/FM radio with compact disc player has only buttons that are needed indispensably. For improved operation and easy reading, large indicating letters are employed.
2. For improved operation and easy reading, the mounting position has been set to the upper part of the instrument panel.



1-1-3 SPEAKER

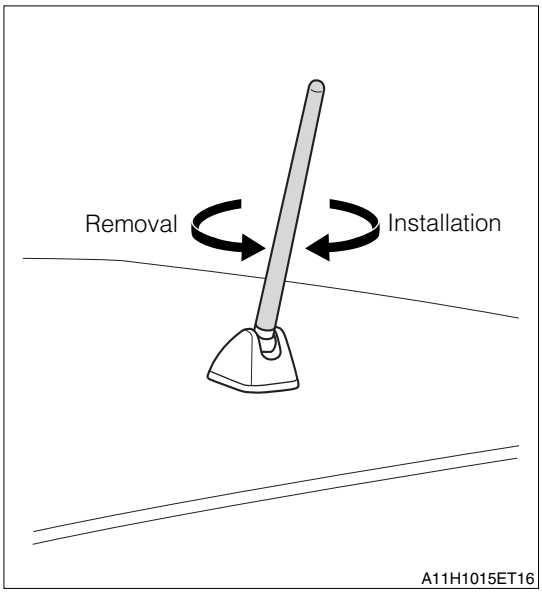
1. As for the speakers, 10cm front speakers or 10cm front speakers & 16 cm rear speakers are available according to the specifications.
2. The front speakers have been set on either side at the upper side of the instrument panel.
3. The rear speakers have been set on the bottom section of the door panels on either side.

Specification table

Applicable place	Front	Rear
Size (cm)	10	16
Rated input (W)	12	15
Momentary maximum input (W)	35	35
Impedance (Ω)	6±0.9	4±0.6
Output sound pressure level	85±3	85.5±3
Minimum resonance frequency (Hz)	95±19	90±18

1-1-4 RADIO ANTENNA

A roof antenna has been employed. As for this antenna, it is movable (in 180 degrees) in the backward and forward direction and its pole is detachable. Installation and removal may be done by turning the pole of the antenna.

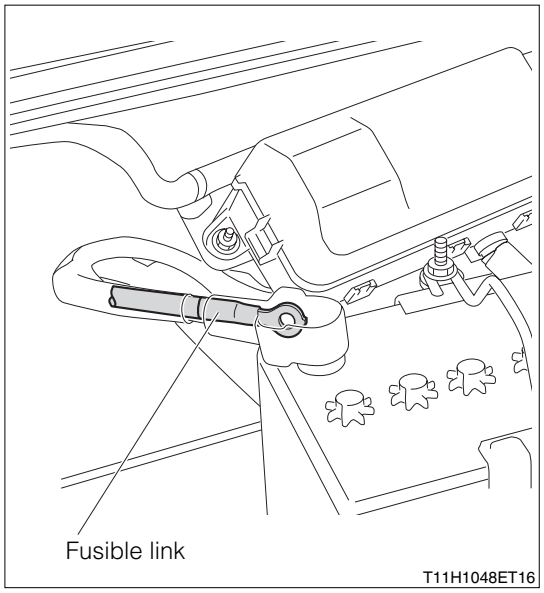


J5 WIRING

1 CONSTRUCTION AND OPERATION

1-1 FUSIBLE LINK

The wire type fusible link is provided at the side of the battery.



1-2 BATTERY

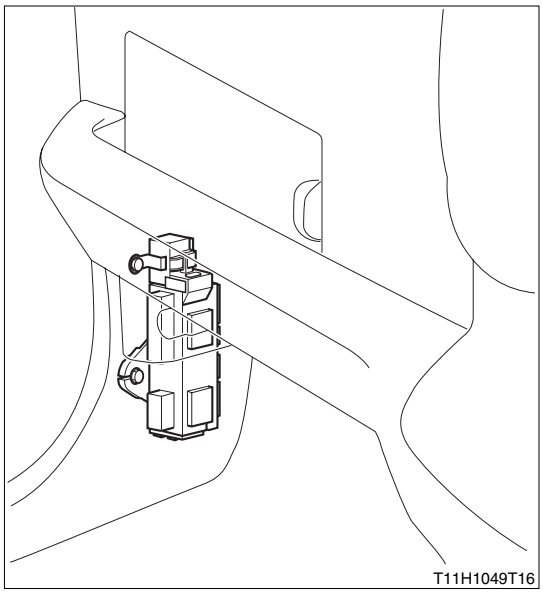
1. Two kinds of the batteries shown below have been provided.
2. The battery is provided at the left side of the engine compartment.

Specification table

Standard vehicle	40B19L
Cold region specification vehicle	44B20L

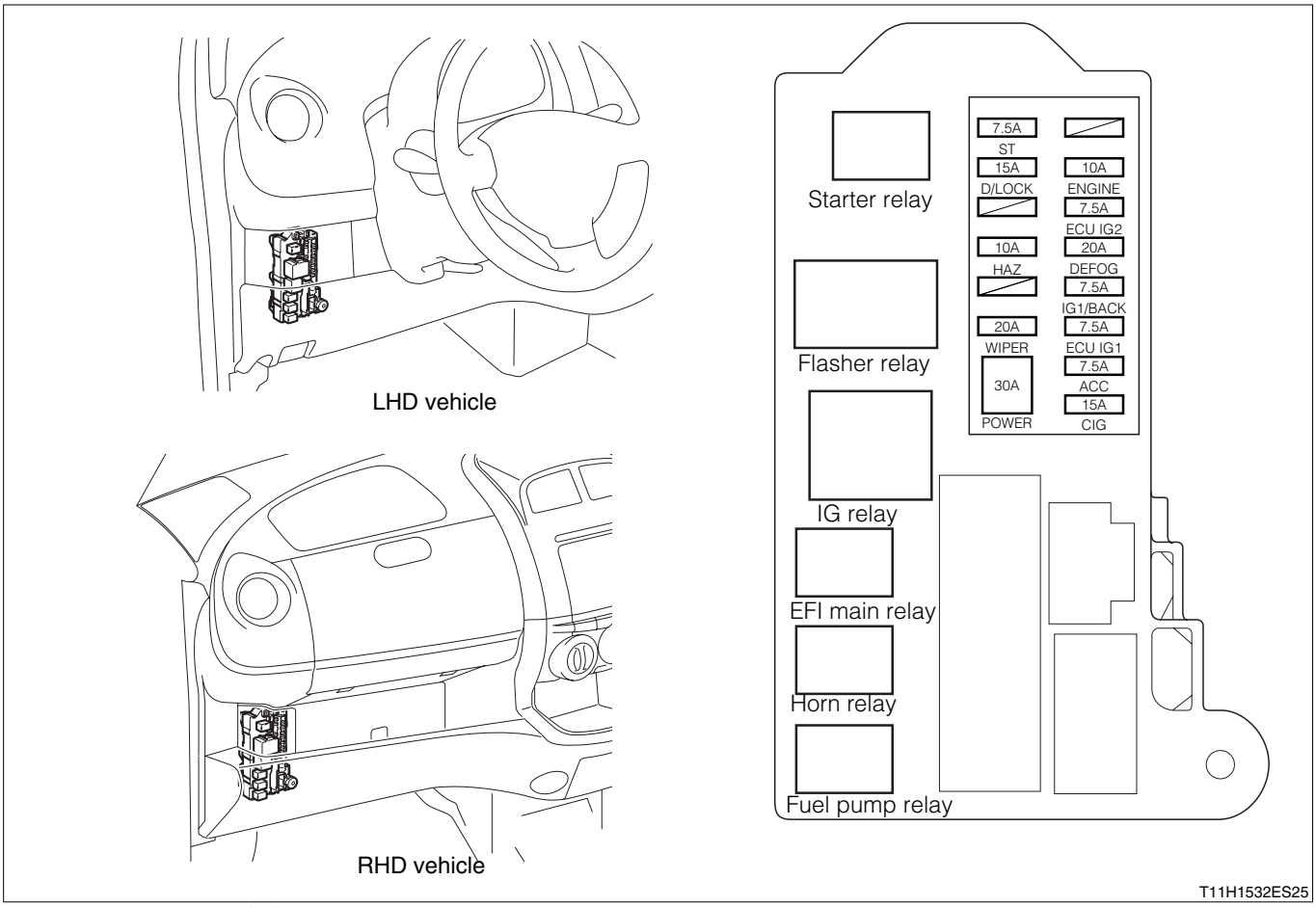
1-3 SIDE JUNCTION BLOCK

1. The side junction block integrates junction connectors that internally connect the wirings.
2. Use of the side junction block has made it possible to reduce the number of the junction connectors, thus simplifying wirings.
3. The side junction block is located at the foot area of the front left seat at the vehicle outer side.



1-4 FUSE BLOCK

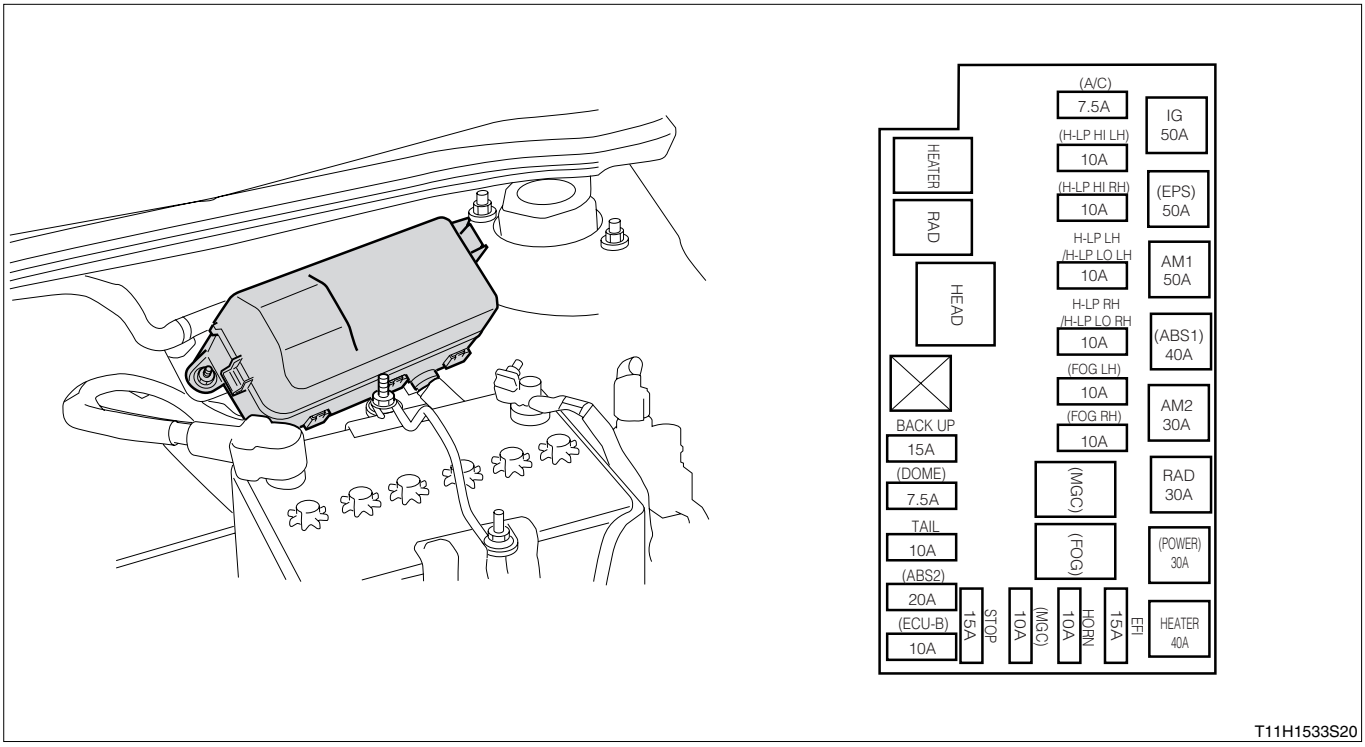
The fuse block is located at the left side of the instrument panel.



T11H1532ES25

1-5 RELAY BLOCK

The relay block is located at the rear of the battery.



T11H1533S20

J6 OTHER ELECTRICAL PARTS

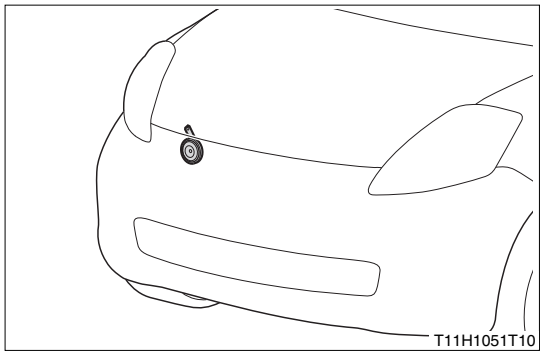
1 CONSTRUCTION AND OPERATION

1-1 HORN

The horn has employed the flat type high-pitch horn which features a compact design and light weight.

Specification table

Rated voltage (V)	12
Operating current (A)	3.0±1
Sound pressure level (dB)	113
Basic frequency (Hz)	420

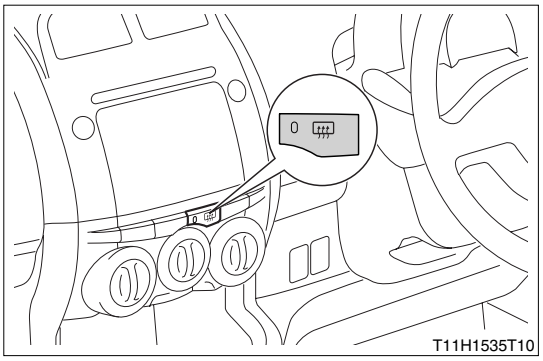


1-2 REAR WINDOW DEFOGGER

1. The rear window defogger is provided on all models.
2. The switch is provided inside the air conditioner control panel.
3. When the switch is turned ON, the operation indicating lamp provided at the switch illuminates.

Specification table

Number of wires	12
Rated voltage (V)	12
Consumption power (W)	93

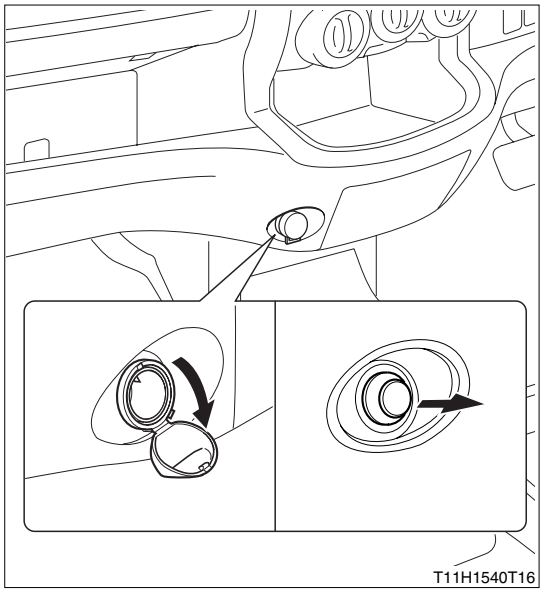


1-3 POWER OUTLET

1. The power outlet which can provide power to DC12V electric appliances is provided according to the specifications.
2. The installing location is at the central/lower section of the instrument panel.

Specification table

Rated voltage (V)	12
Maximum power capacity (W)	120
Maximum current (A)	10



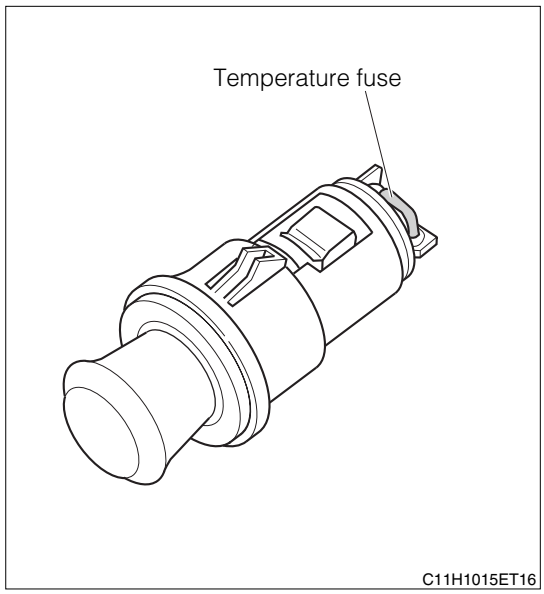
1-4 CIGARETTE LIGHTER

1. The cigarette lighter is provided according to the specifications.

2. The cigarette lighter body is provided with a temperature fuse. This fuse is melt down if current continues to flow to the cigarette lighter due to abnormality.

Specifications table

Rated voltage (V)	12
Maximum current (A)	less than 10
Temperature fuse melt time (sec)	90 - 145



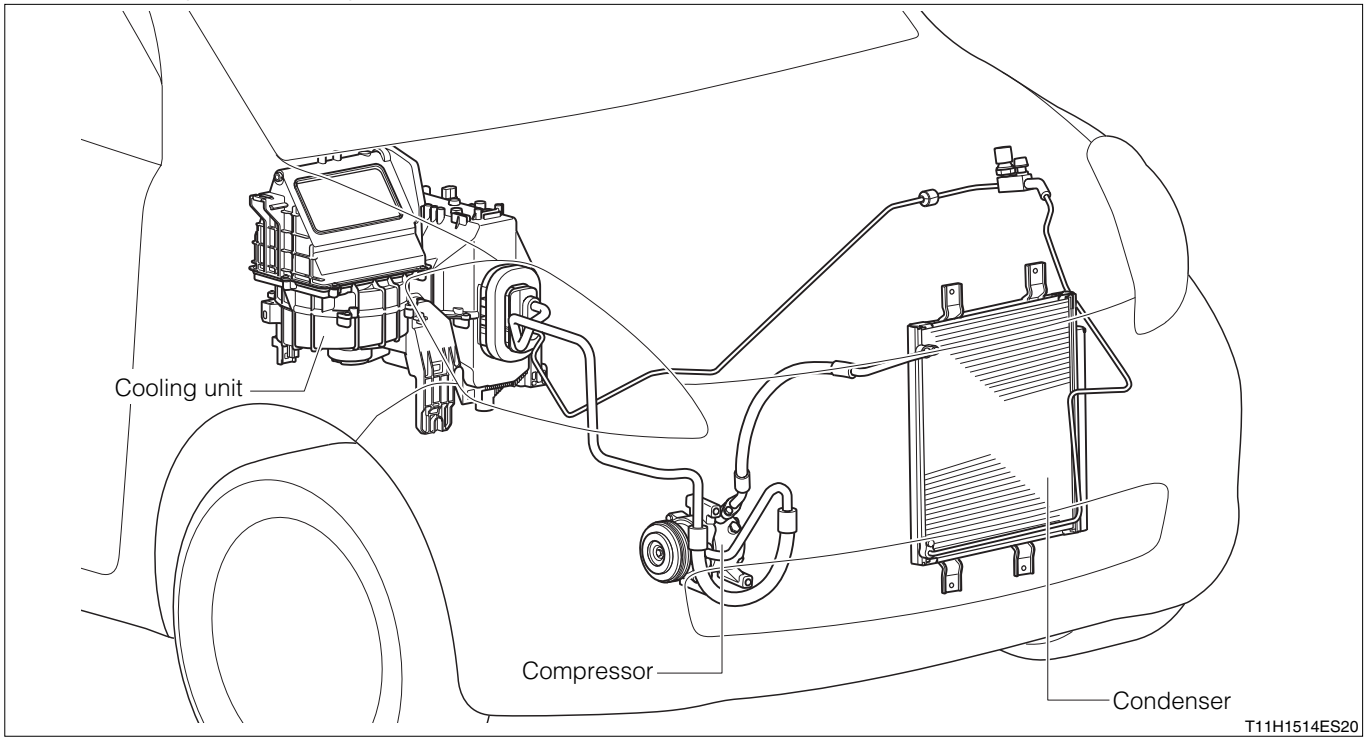
K1 HEATER & AIR CONDITIONER

■ HEATER AND AIR CONDITIONER

1 OUTLINE

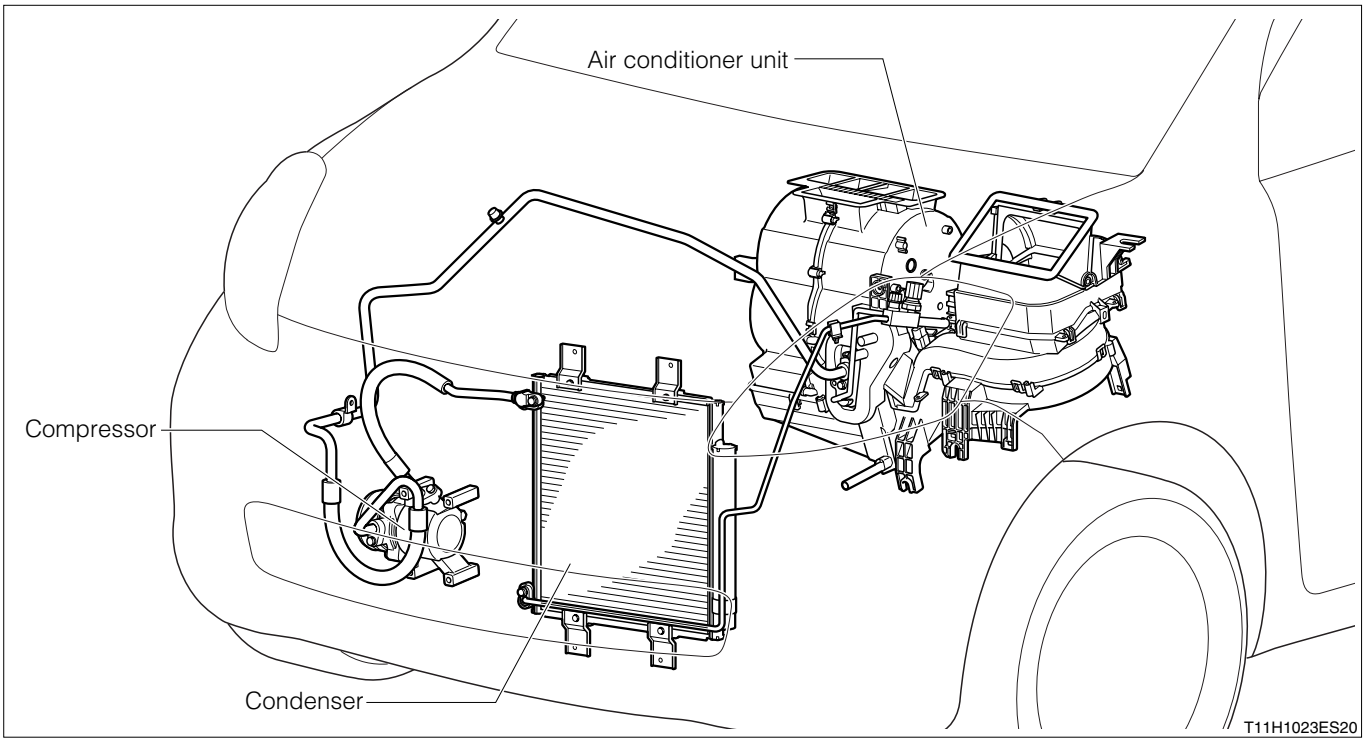
1. All specifications have an air conditioner with manual controls.
2. A Three-dial control panel has been set.
3. The evaporator employs a small, lightweight type RS Evaporator (RS: Revolutionary Super Slim) which improves the evaporator's heat exchange efficiency when the air conditioner is running.
4. The heater core employs a small, lightweight SFA heater core Ⅱ (SFA: straight flow aluminum) which should give superior heat transmission performance when the system is heating.
5. The refrigerant HFC-134a (R-134a) that contains no chlorine has been adopted as the air conditioner refrigerant, taking into consideration the need to prevent ozone layer depletion.

Front section (LHD vehicle)



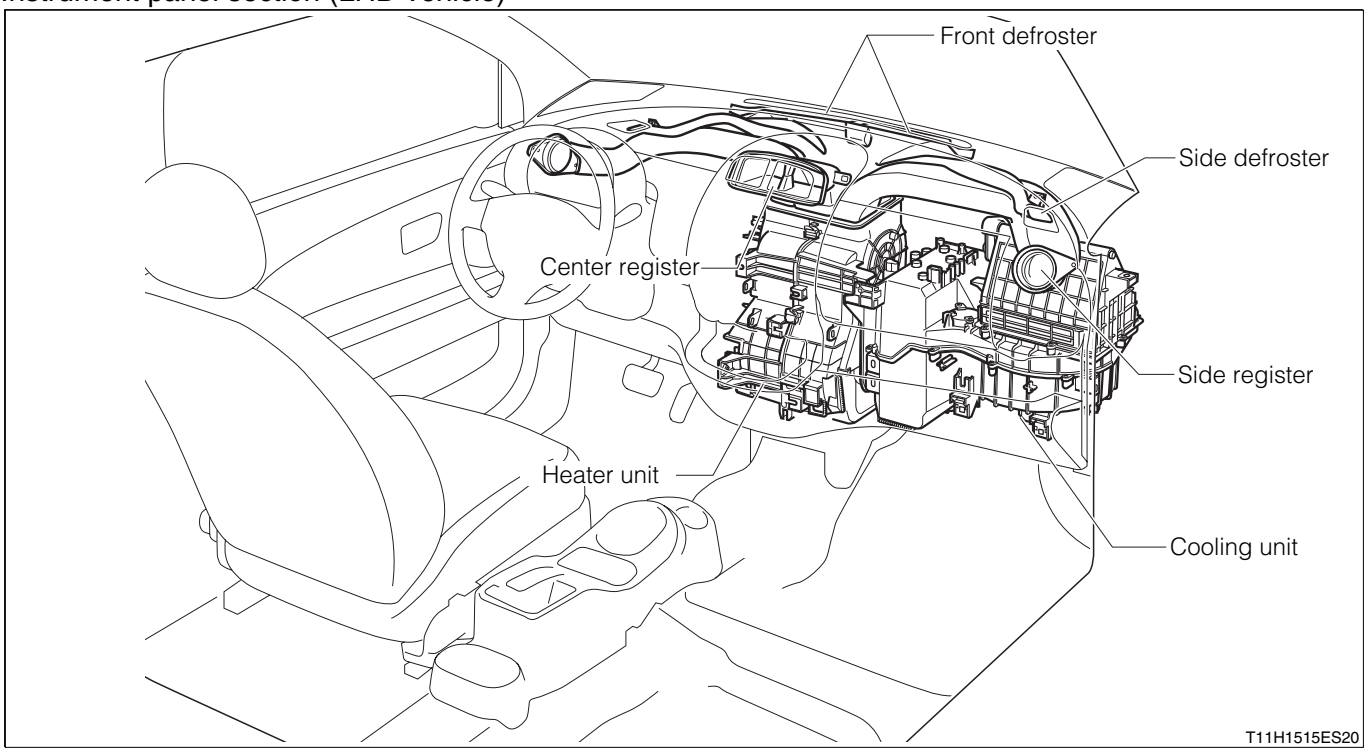
The illustration shows a typical example.

Front section (RHD vehicle)



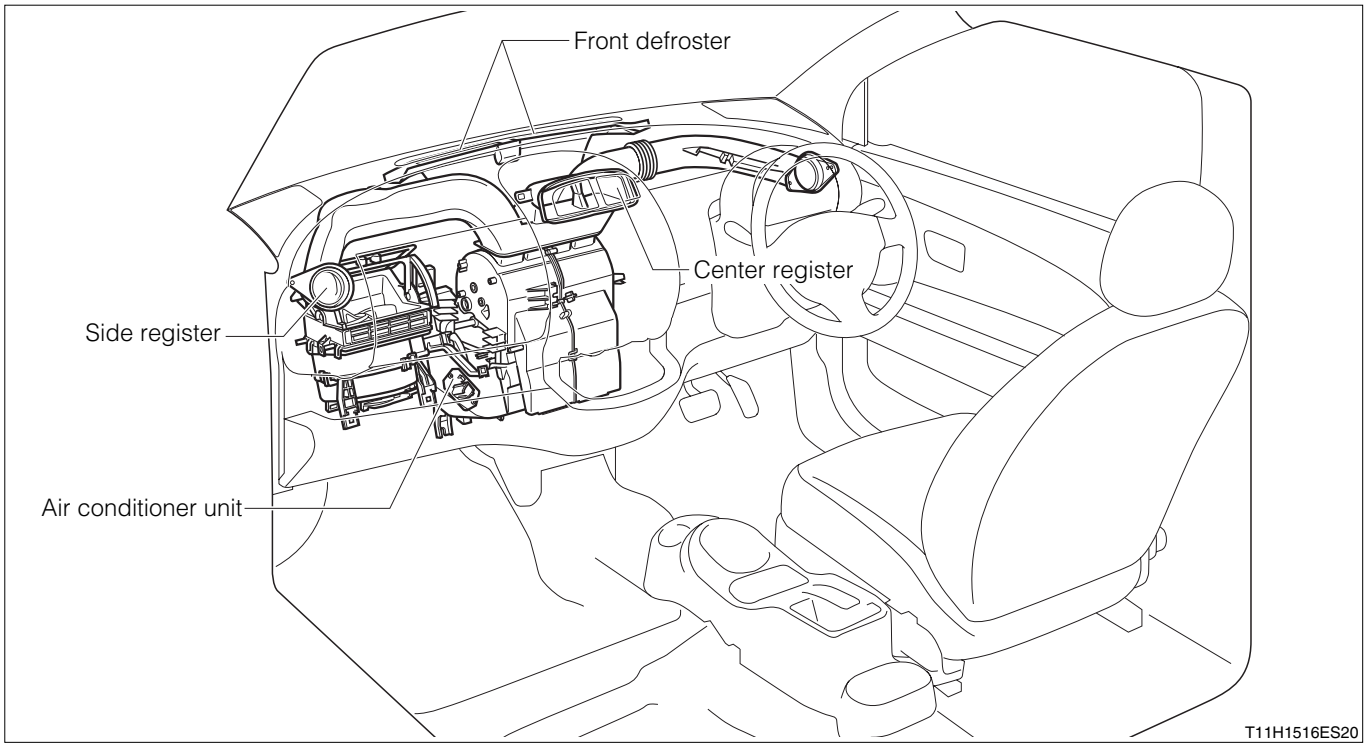
The illustration shows a typical example.

Instrument panel section (LHD vehicle)



The illustration shows a typical example.

Instrument panel section (RHD vehicle)



The illustration shows a typical example.

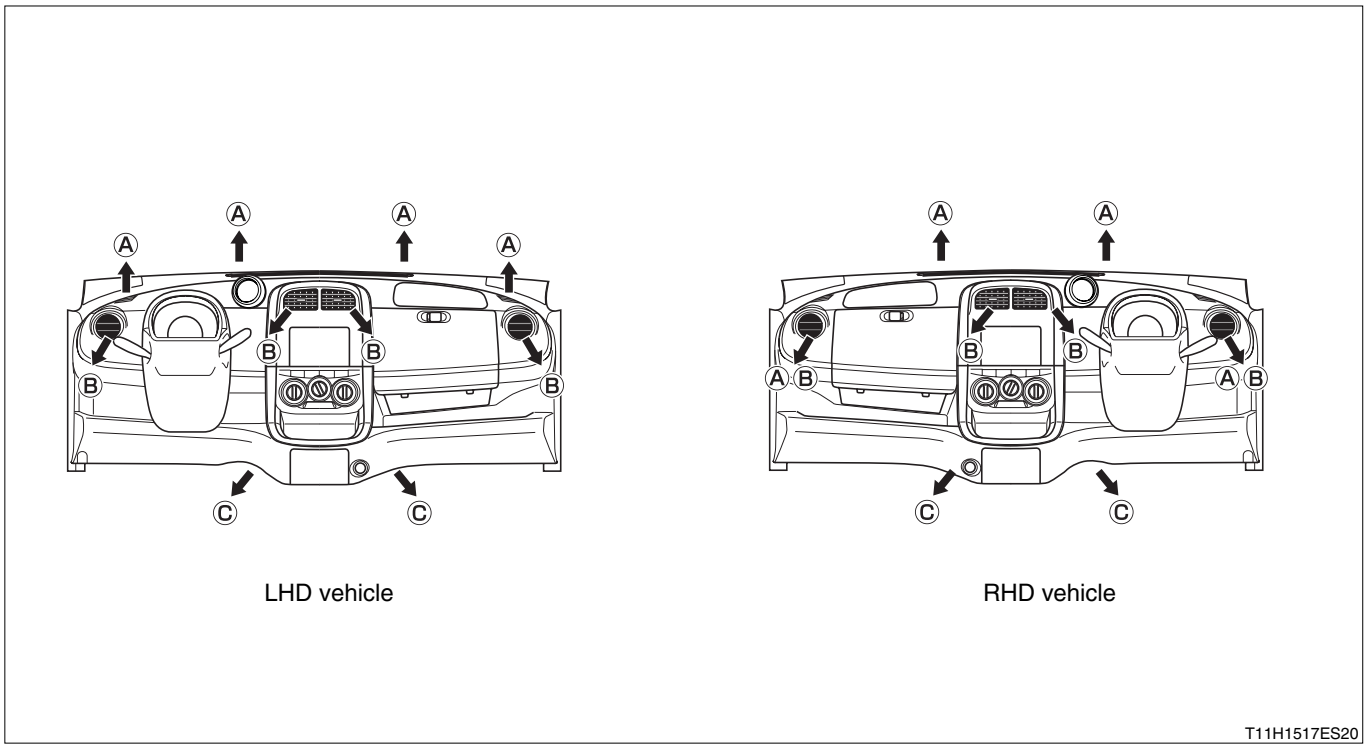
2 CONSTRUCTION AND OPERATION

2-1 REFRIGERANT

The refrigerant HFC-134a (R-134a) that contains no chlorine has been adopted as the air conditioner refrigerant, taking into consideration the prevention of deletion of ozone layer.

2-2 DISCHARGE PORT

The air outlets are located in the center of the instrument panel, on both side-sections, on the defroster and on the leg sections of people sitting in front seats.



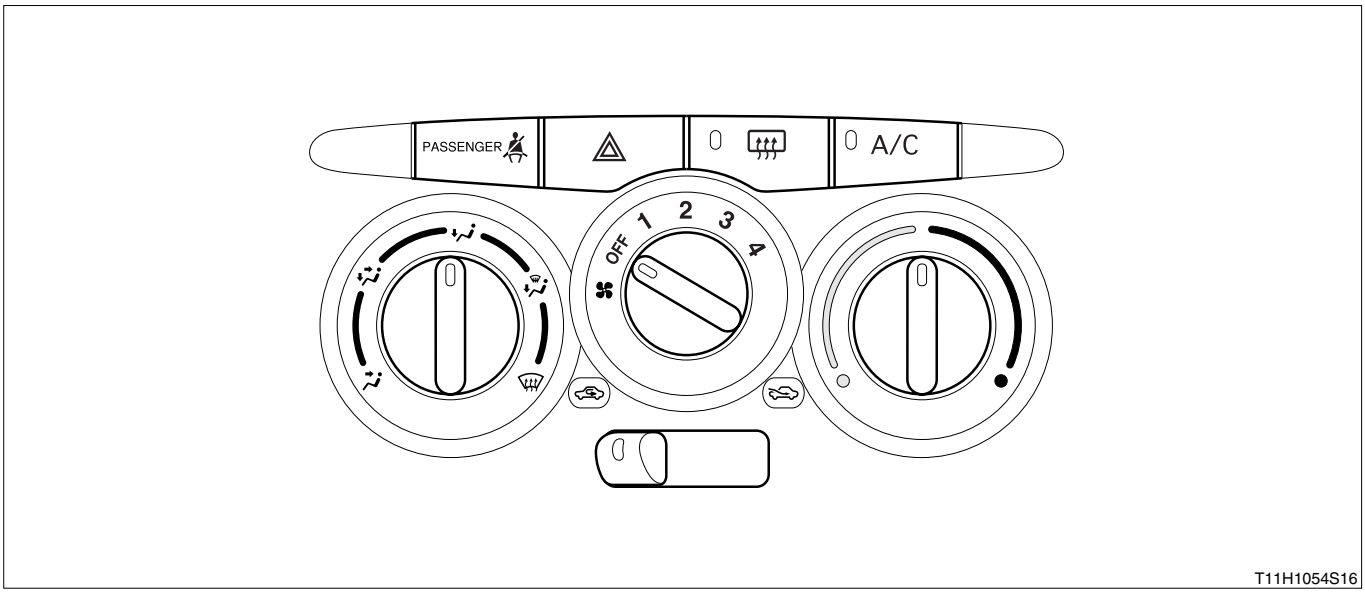
Air outlets according to mode

Mode					
	VENT	VENT / FOOT	FOOT	FOOT / DEF	DEF
Air outlet	Ⓑ	Ⓑ Ⓒ	Ⓒ (Ⓐ)	Ⓐ Ⓒ	Ⓐ

The one in ( ) shows the case of small air flow rate. T11H1067EL07

2-3 CONTROL PANEL

A three-dial type control panel is employed. The dial pointer adopts night illumination to assure easy operation and reading night time. The blower switch can be adjusted over four stages.



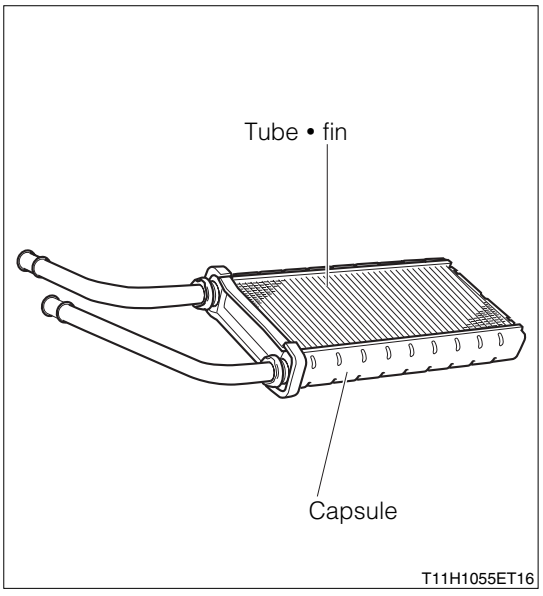
T11H1054S16

The illustration shows a typical example.

2-4 HEATER CORE

The heater core employs a small, lightweight SFA heater core Ⅱ (SFA: straight flow aluminum).

The SFA heater core Ⅱ is more compact than conventional SFA heater cores because of the reduction in tank width and height/miniaturization of the core (core area expansion). This has achieved increased air flow, noise reduction, and an improvement in heating capacity. The SFA heater core Ⅱ is constructed from tubes, fins and capsules and the result has been that by flattening the tubes the heat transfer rate has been improved as well as producing a lightweight, small size heater. Further, the use of aluminum makes the heater more environmentally friendly.

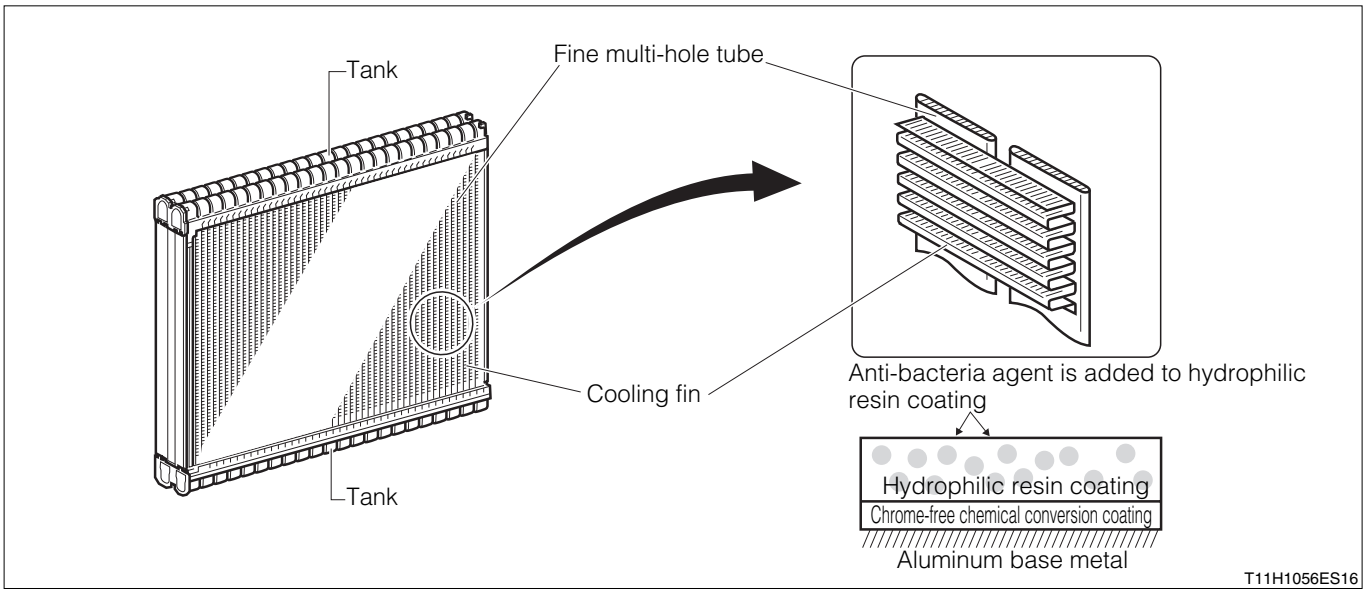


T11H1055ET16

2-5 EVAPORATOR

The evaporator employs a small, lightweight type RS Evaporator (RS: Revolutionary Super Slim).

The RS evaporator consists of a tank, tubes and cooling fins. Thanks to the press molding of the tube, minute flow paths have been formed and this leads to improved heat transfer capability and very thin dimensions. Further, the RS evaporator has improved heat transfer due to the reduced fin height, tube thickness, and fin pitch, and the unit is much reduced in size and weight due to the reduced stock thickness of the core material. The evaporator is coated with a hydrophilic plastic film which contains anti-bacteria agent to control the breeding of germs and bacteria which can lead to unpleasant smells. In consideration of the environment the surface treatment is chrome-free.



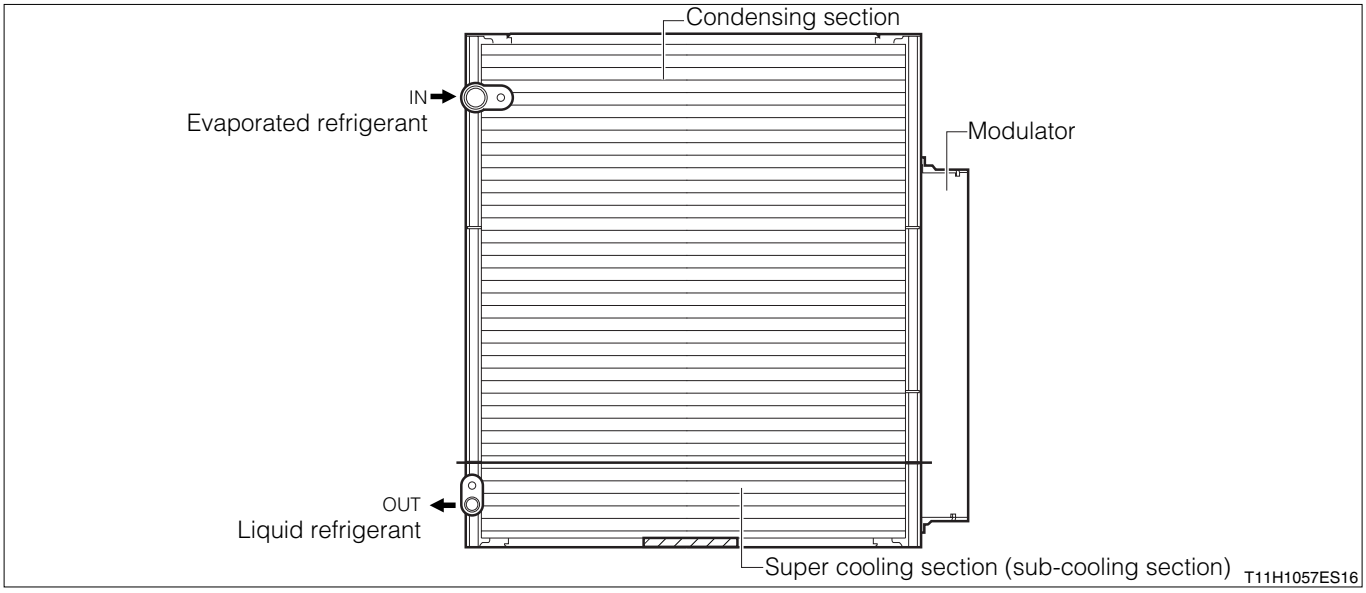
2-6 COMPRESSOR

Vane type compressor is employed.

2-7 CONDENSER

A new type of sub cooling condenser is used which has improved performance with its miniaturized core and an increased effective surface area, compared with the conventional ones. Inside the sub cooling condenser are provided the condensing section, the modulator and the over cooling section (sub cooling section). The refrigerant vapor goes through a 2-stage condensation process which lead to nearly 100% liquidizing.

Further, the modulator separates the gas and liquid.

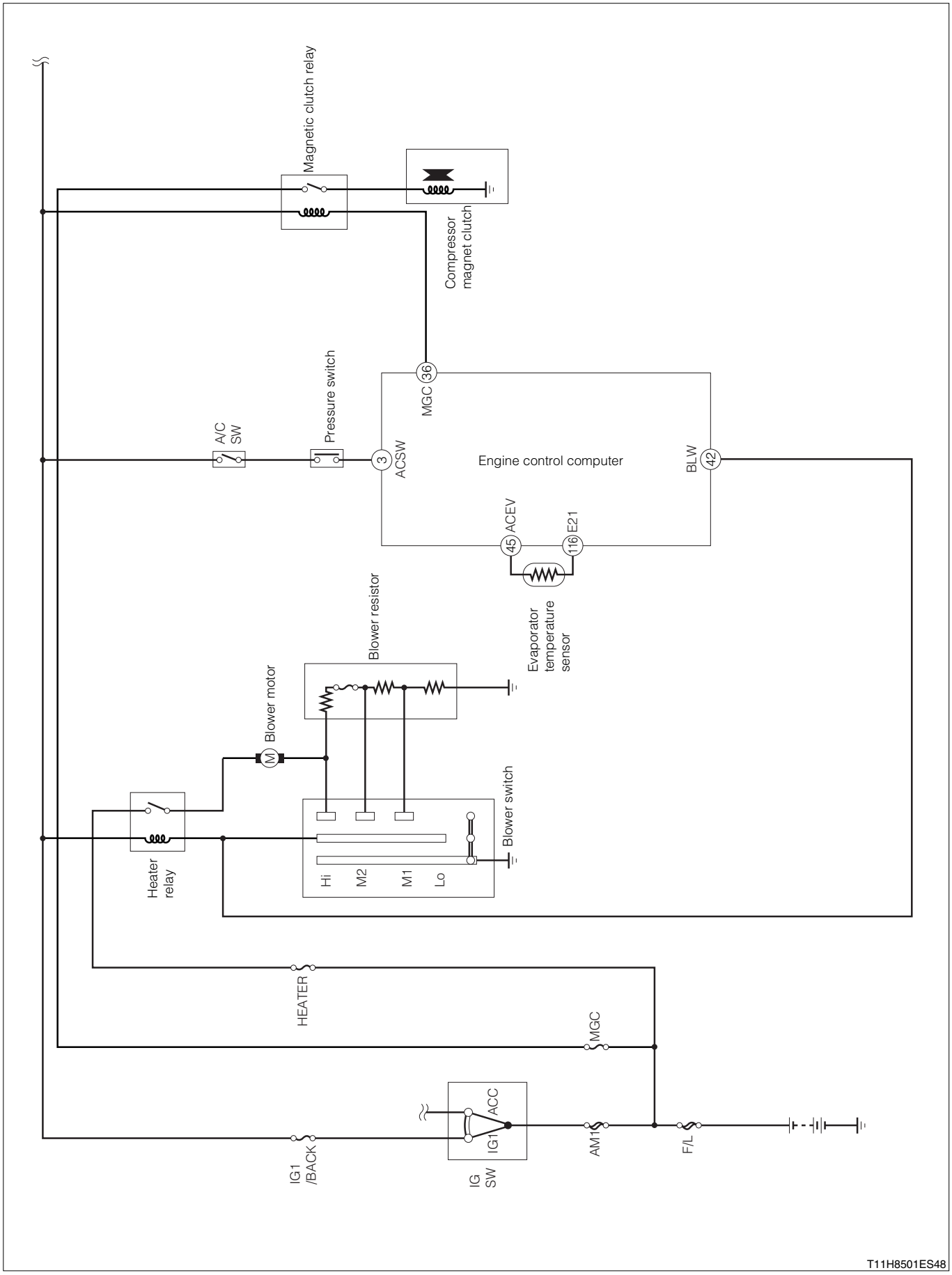


The illustration shows a typical example.

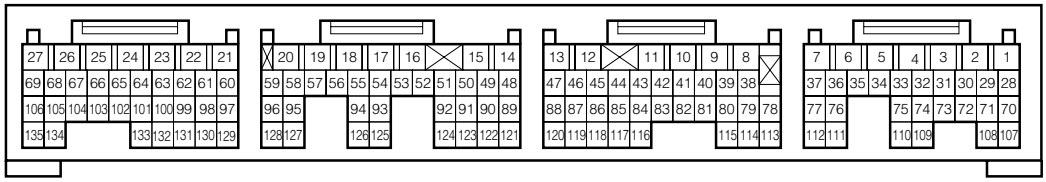
■ MANUAL AIR CONDITIONER SYSTEM

1 OUTLINE

1-1 SYSTEM WIRING DIAGRAM



Arrangement of ECU terminal

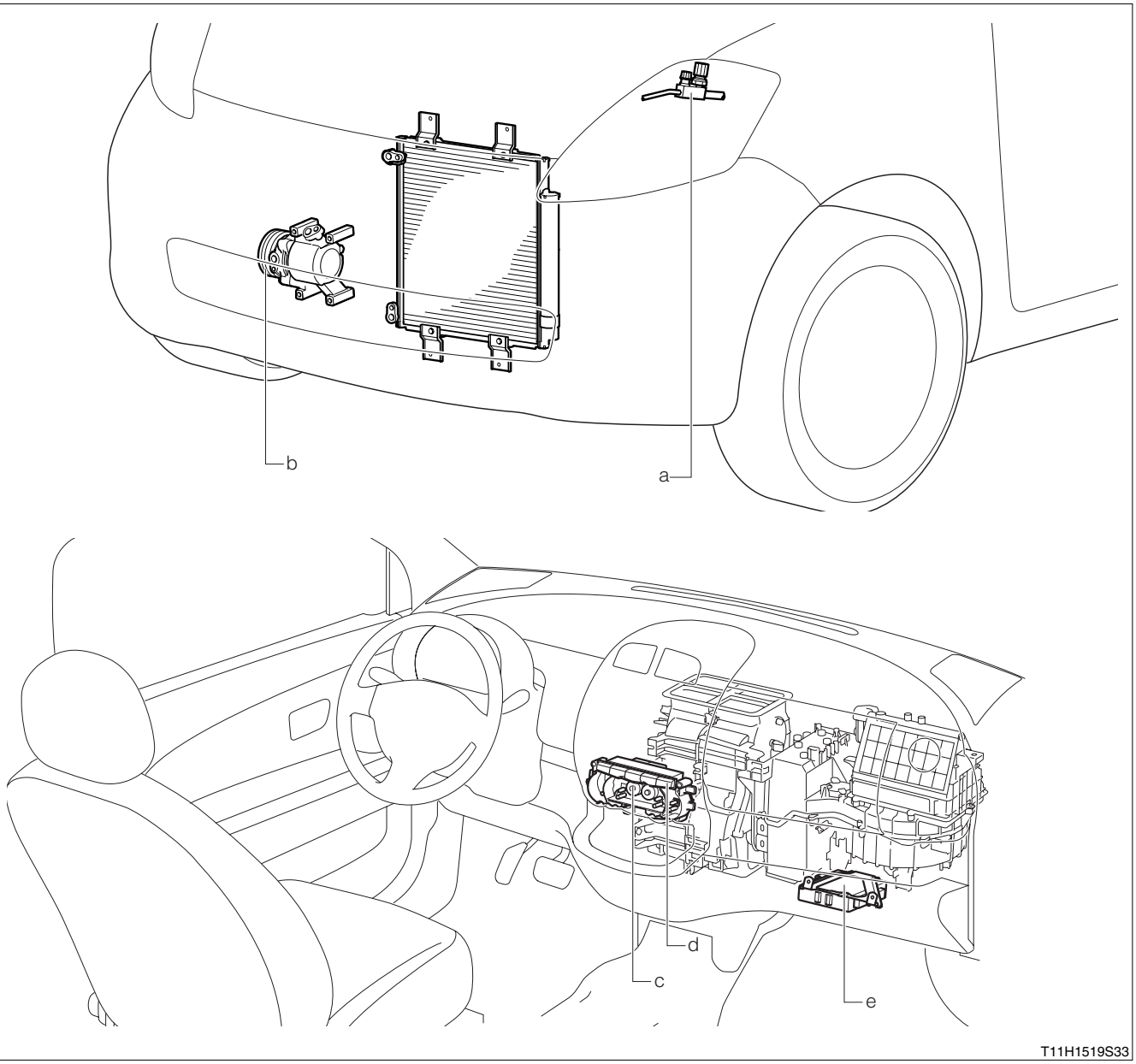


H11E6091S10

Engine Control Computer terminal name

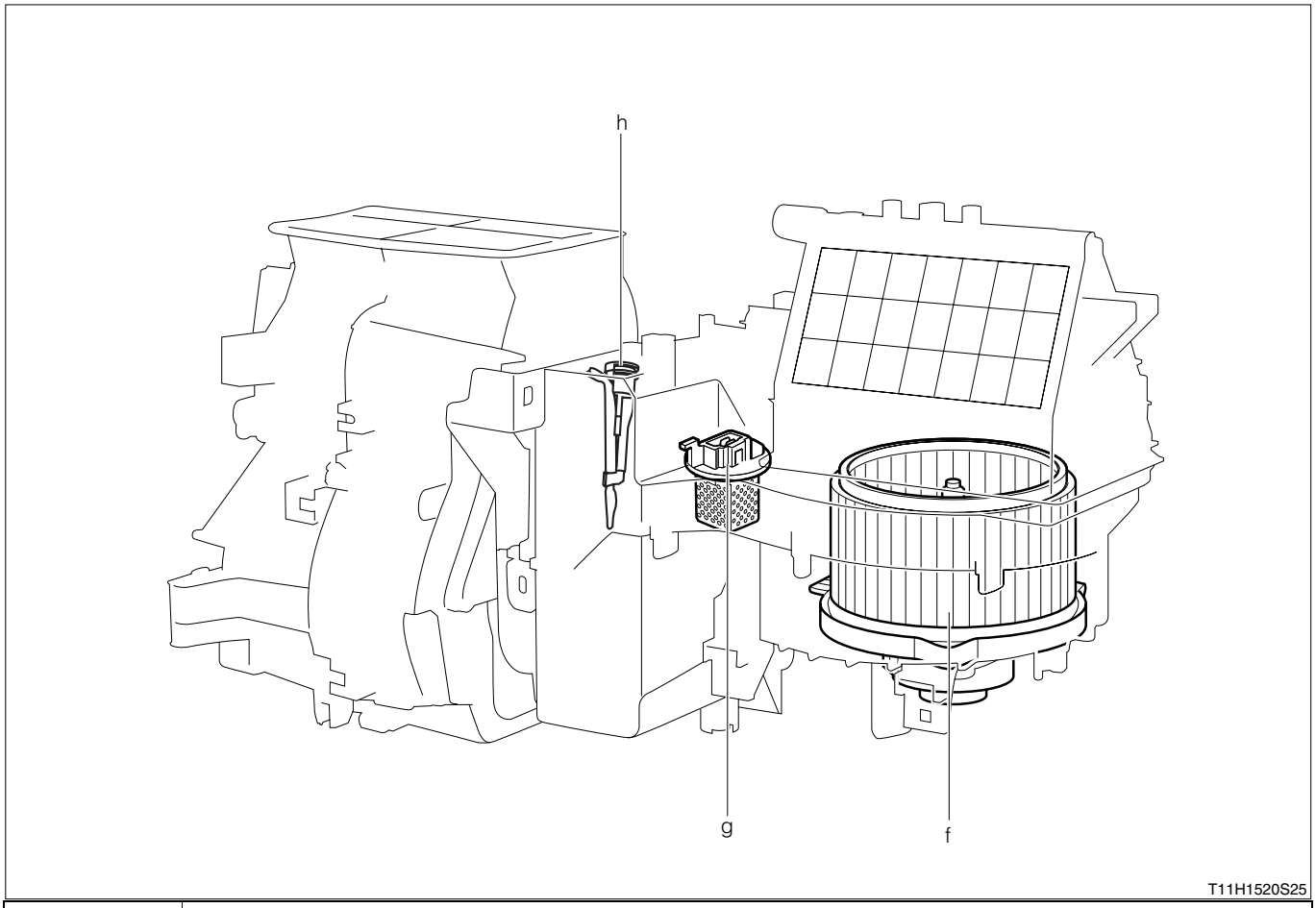
Terminal No.	Terminal code	Terminal name
3	ACSW	A/C switch input
36	MGC	Magnet clutch drive output
42	BLW	Heater blower operation input
45	ACEV	Evaporator temperature sensor input
116	E21	Sensor earth

1-2 **LOCATION OF COMPONENTS(LHD VEHICLE)**



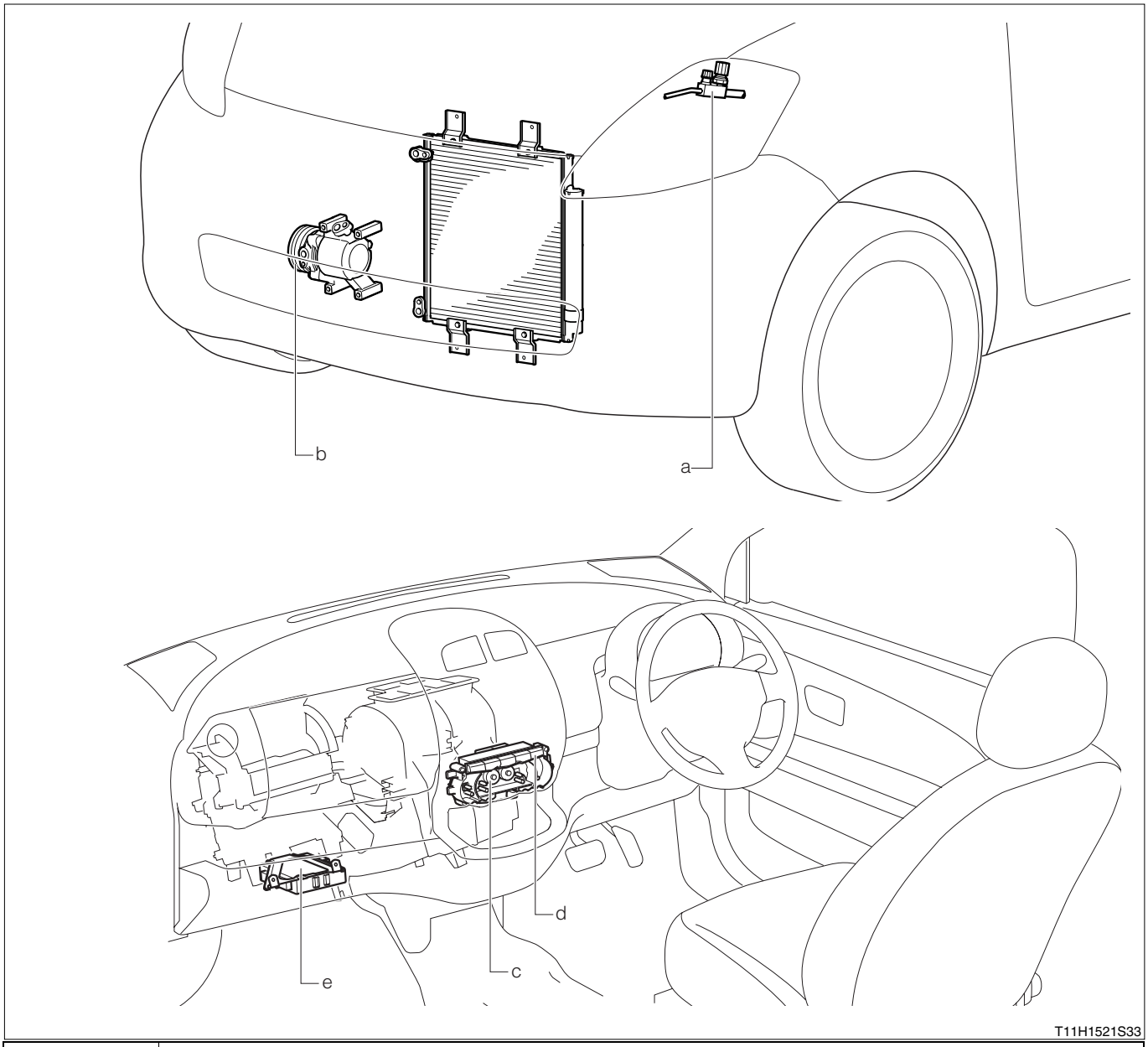
T11H1519S33

a	Pressure switch
b	Compressor magnet clutch
c	Blower switch
d	A/C switch
e	Engine control computer

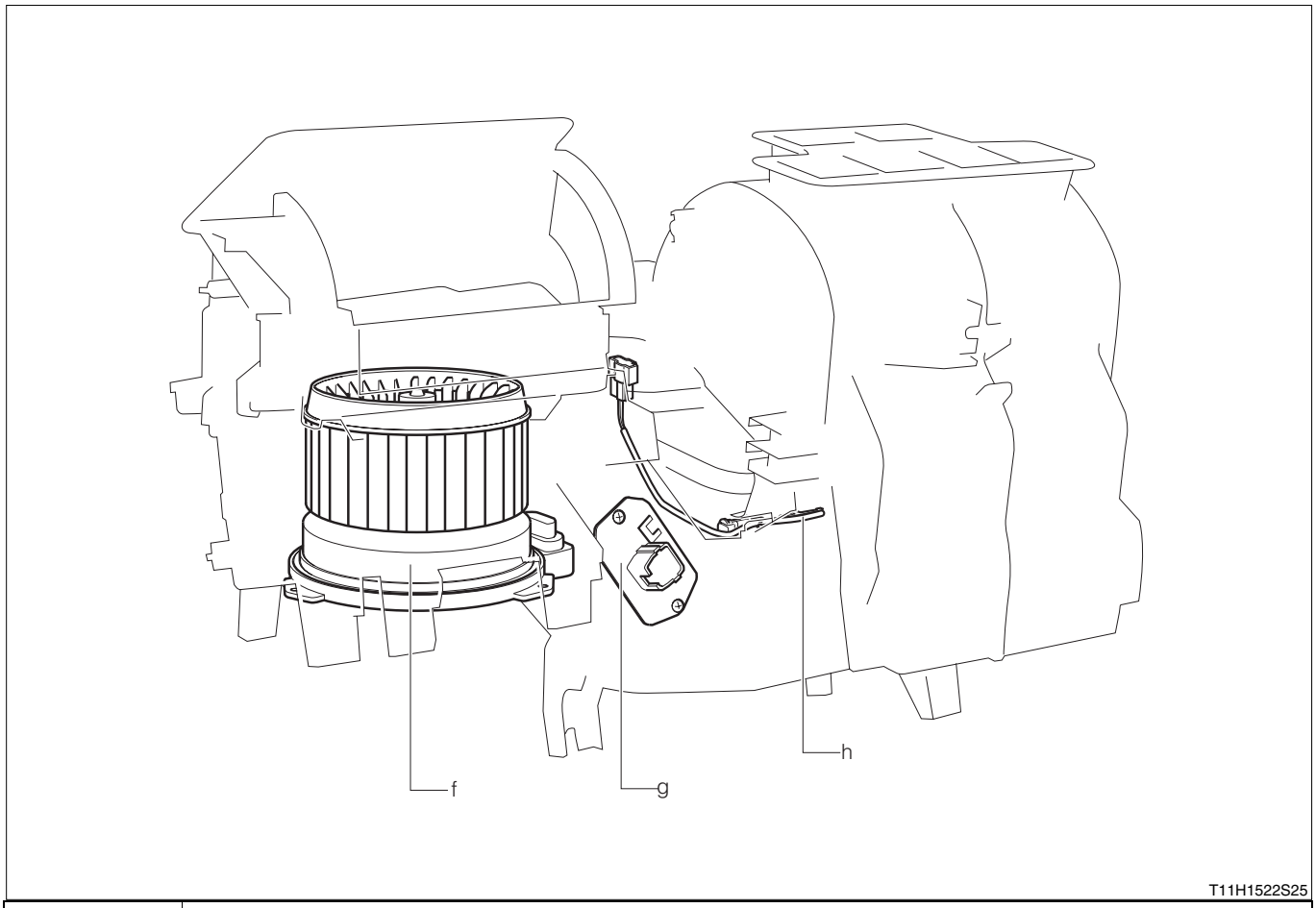


f	Blower motor
g	Blower resistor
h	Evaporator temperature sensor

1-3 LOCATION OF COMPONENTS(RHD VEHICLE)



a	Pressure switch
b	Compressor magnet clutch
c	Blower switch
d	A/C switch
e	Engine control computer



T11H1522S25

f	Blower motor
g	Blower resistor
h	Evaporator temperature sensor

2 CONTROL

2-1 AIR CONDITIONER CONTROL BY ENGINE CONTROL COMPUTER

2-1-1 AIR CONDITIONER CUT CONTROL

Type 1KR-FE engine mounted vehicles

2-1-2 RADIATOR FAN MOTOR CONTROL

Type 1KR-FE engine mounted vehicles

2-1-3 AIR CONDITIONER IDLE-UP CONTROL

Type 1KR-FE engine mounted vehicles

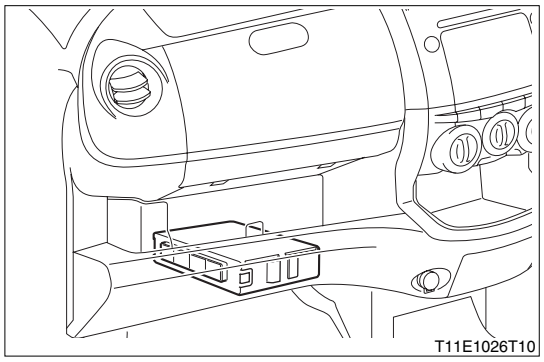
2-1-4 MAGNETIC CLUTCH CONTROL

Type 1KR-FE engine mounted vehicles

3 COMPONENTS

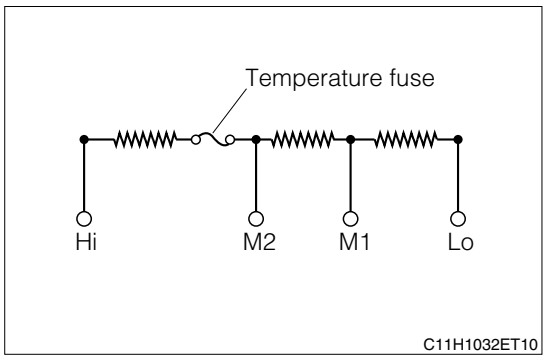
3-1 ENGINE CONTROL COMPUTER

This is attached below the air conditioning unit. It controls the compressor magnetic clutch ON/OFF function depending on the state of the A/C switch, vehicle conditions and each sensor's input.



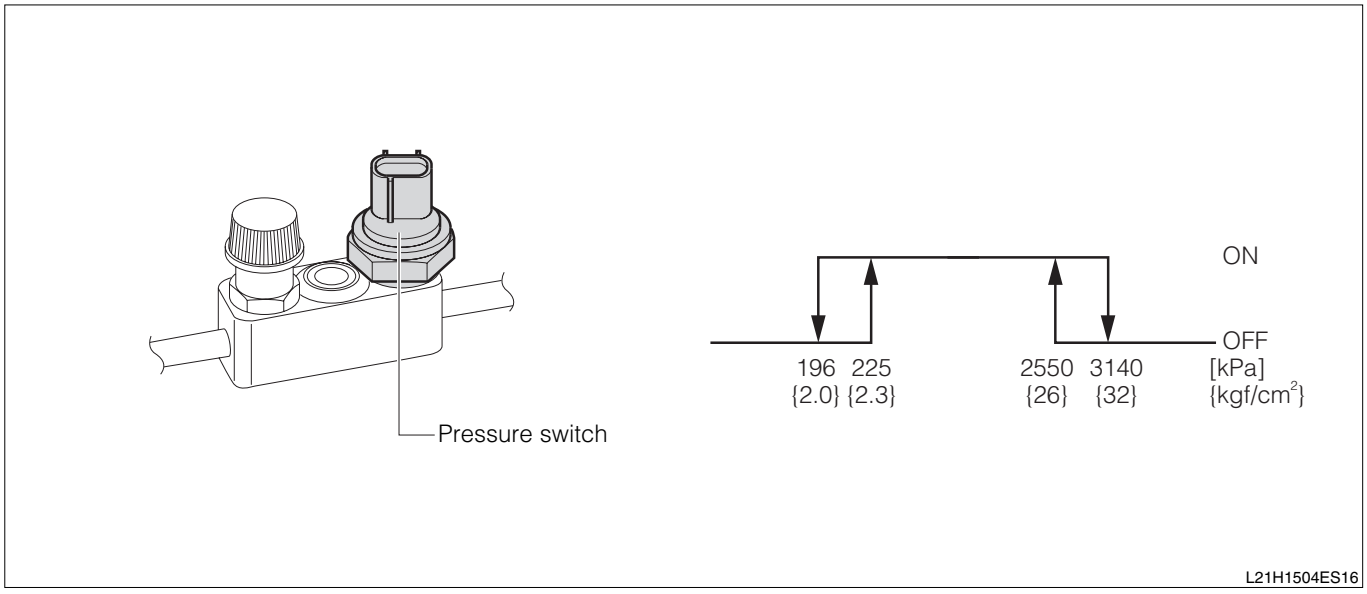
3-2 BLOWER RESISTOR

The blower resistor controls the speed of the blower motor. A temperature fuse is fitted. The mounting location is on the air conditioning unit.



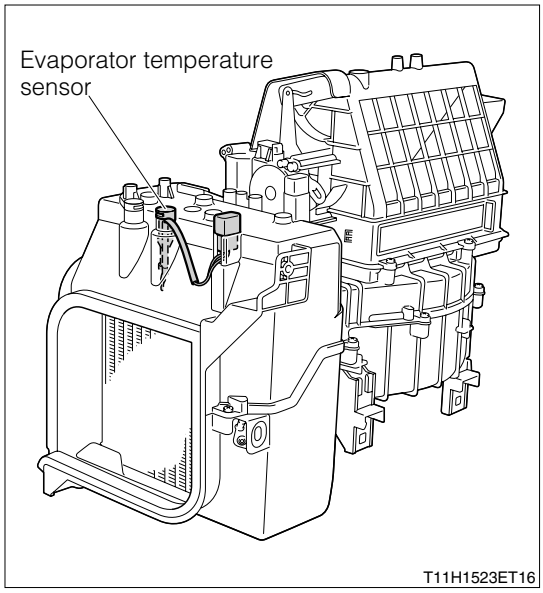
3-3 PRESSURE SWITCH

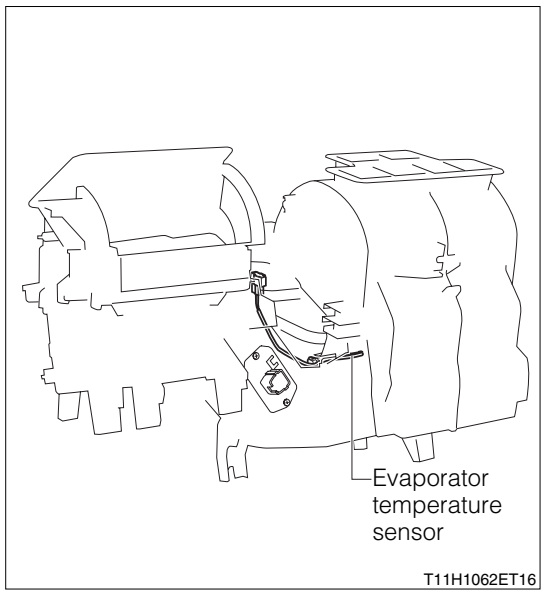
A pressure switch, which corresponds to abnormal pressure variation inside the liquid tube, is provided inside the liquid tube. When the pressure inside the liquid tube becomes excessively high or low, the wire between the A/C switch and the engine control computer is interrupted, thus stopping the rotation of the compressor.



3-4 EVAPORATOR TEMPERATURE SENSOR

This sensor detects the air temperature at a point immediately downstream of the evaporator as a change in resistance. Thus, the outputted value is sent to the engine control computer.





3-5 CONTROL PANEL

Refer to Page K1-4.

L2 MULTIPLEX COMMUNICATION SYSTEM

■ CAN COMMUNICATION SYSTEM

1 OUTLINE

1-1 DESCRIPTION

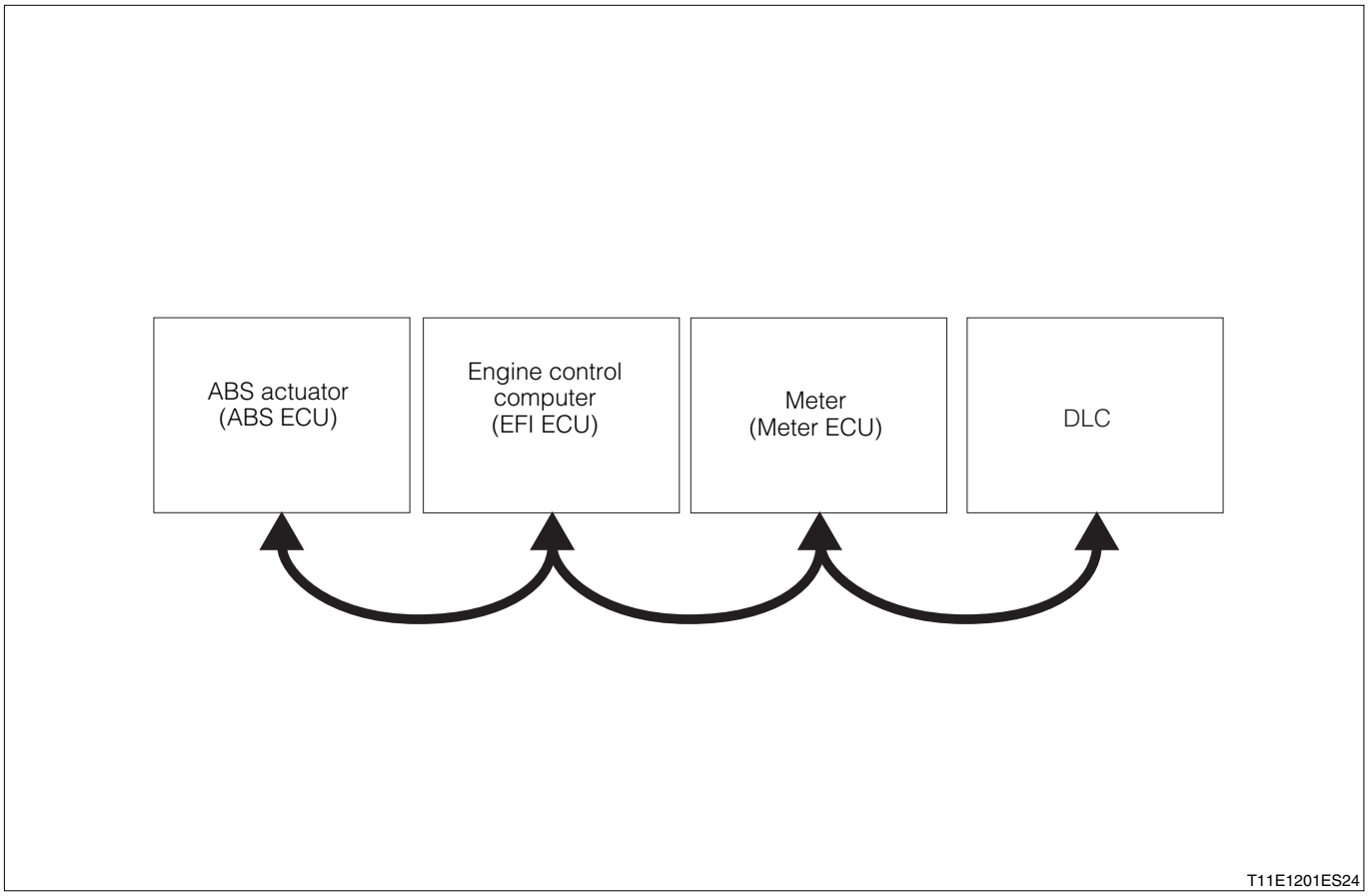
1. A CAN※1 communication system which controls data relating to the power train at a higher speed is used in all vehicles.
2. The CAN system sends over a single communications line (twisted pair cable) multiple items of information and data which have been converted into digital form by a communication circuit.
   This system reduces the number of the wiring harnesses and the size of the electronic control system for the systems that connect the input side (sensors, switches, etc.), the control units and the output side (display lamps, etc.).
3. The CAN communication system in use is a daisy chain type network with several computers connected to a pair of communication lines.

NOTE

- ※1:CAN stands for Controller Area Network. It is the serial communication based on the ISO standard (ISO011898).

1-2 SYSTEM DRAWING

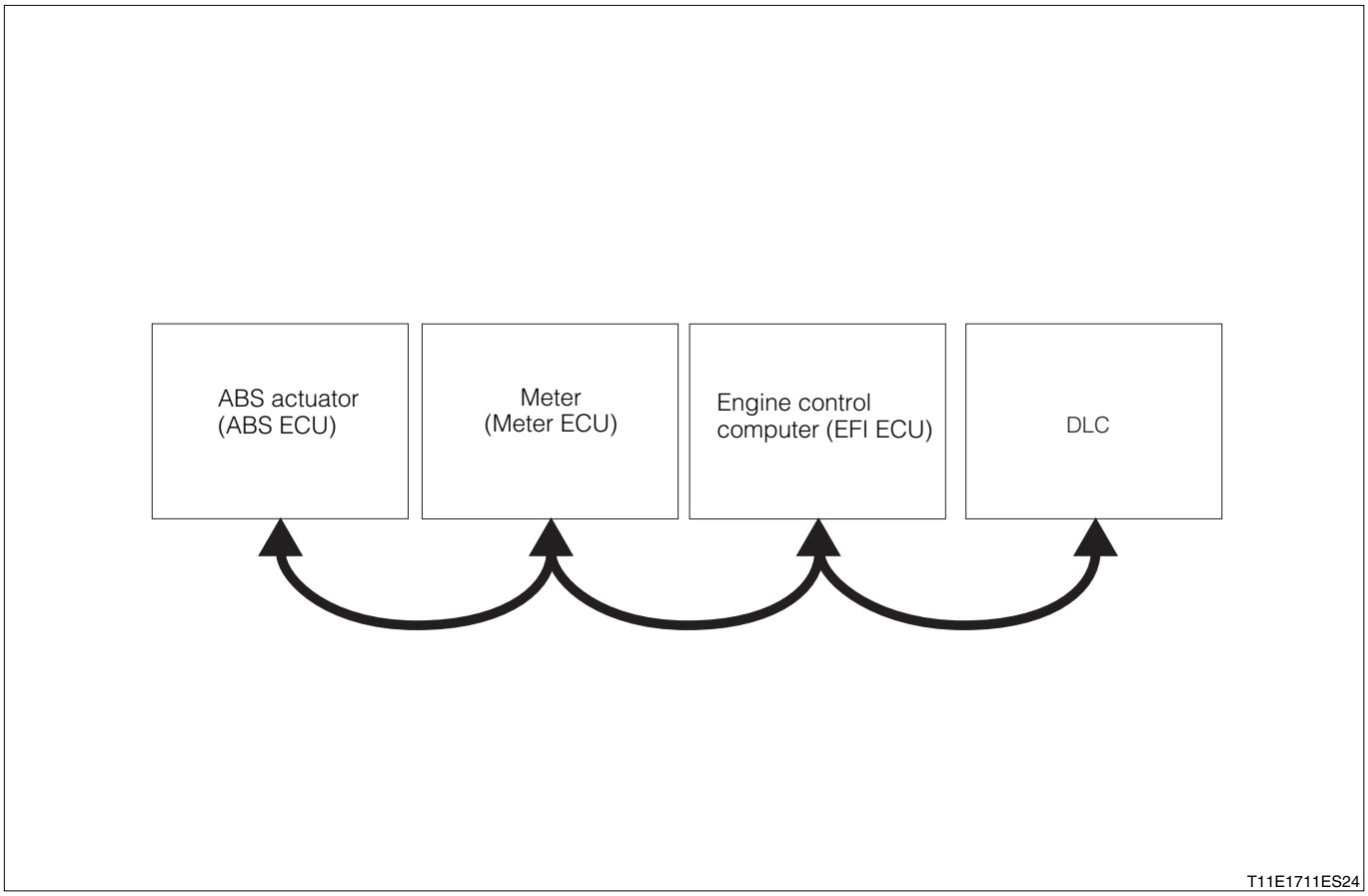
1-2-1 RHD VEHICLES



CAN communication connection system (RHD vehicles)

			ABS ECU	EFI ECU	Meter ECU	DLC	Name of CAN communication system type
1KR	M/T	ABS-equipped vehicles	○	○	○	○	Type 2

1-2-2 LHD VEHICLES



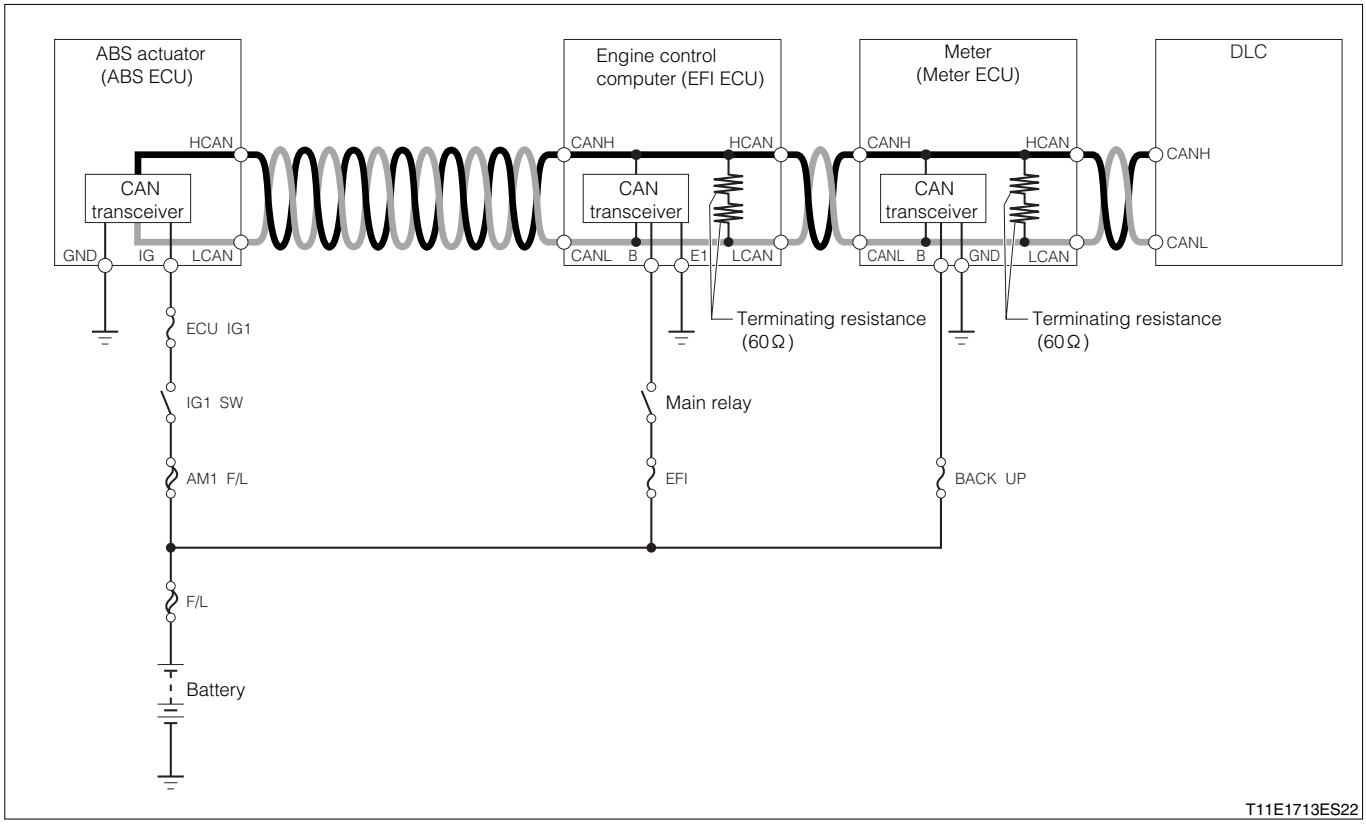
CAN communication connection system (LHD vehicles)

			ABS ECU	Meter ECU	EFI ECU	DLC	Name of CAN communication system type
1KR	M/T	ABS-equipped vehicles	○	○	○	○	Type 6

1-3 SYSTEM WIRING DIAGRAM

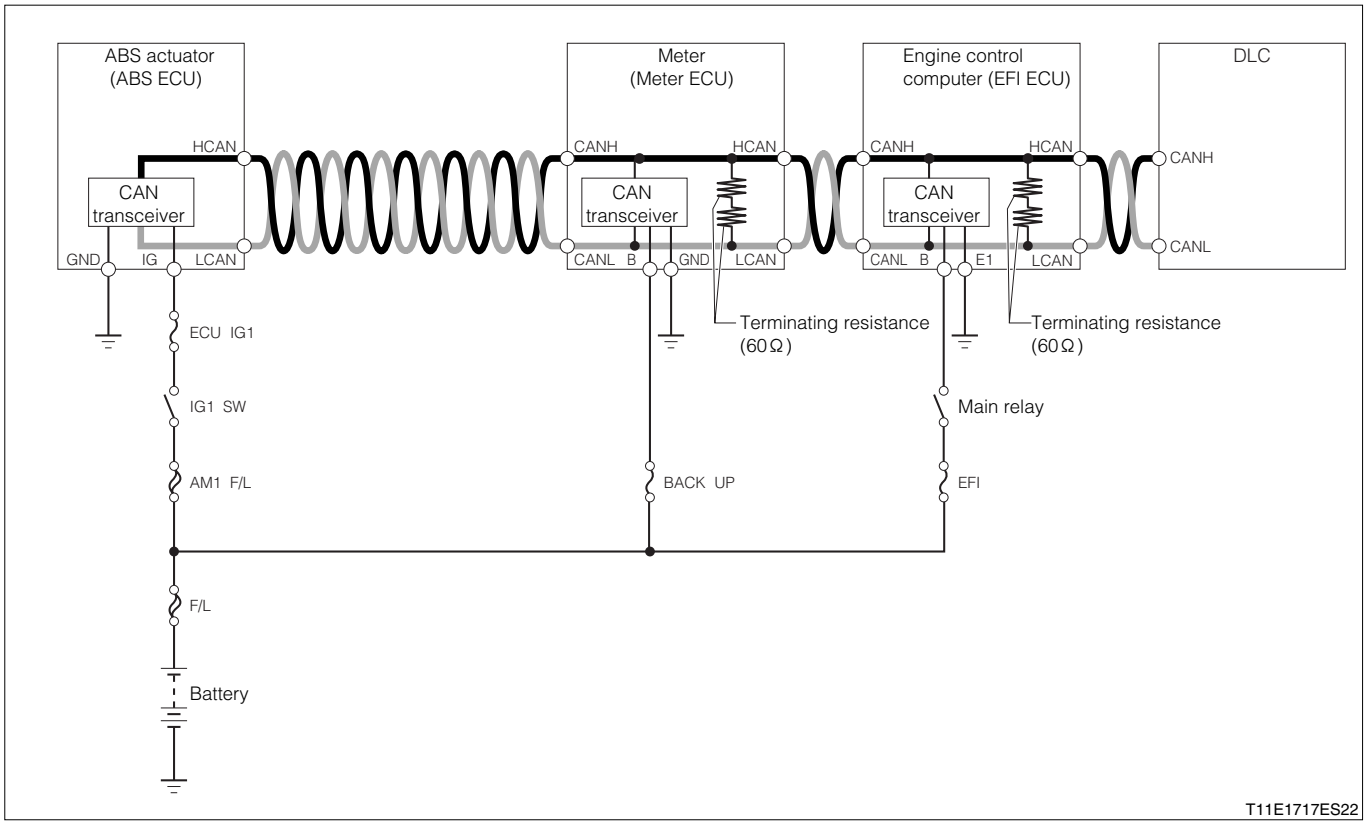
1-3-1 RHD VEHICLES

(1) Type 2

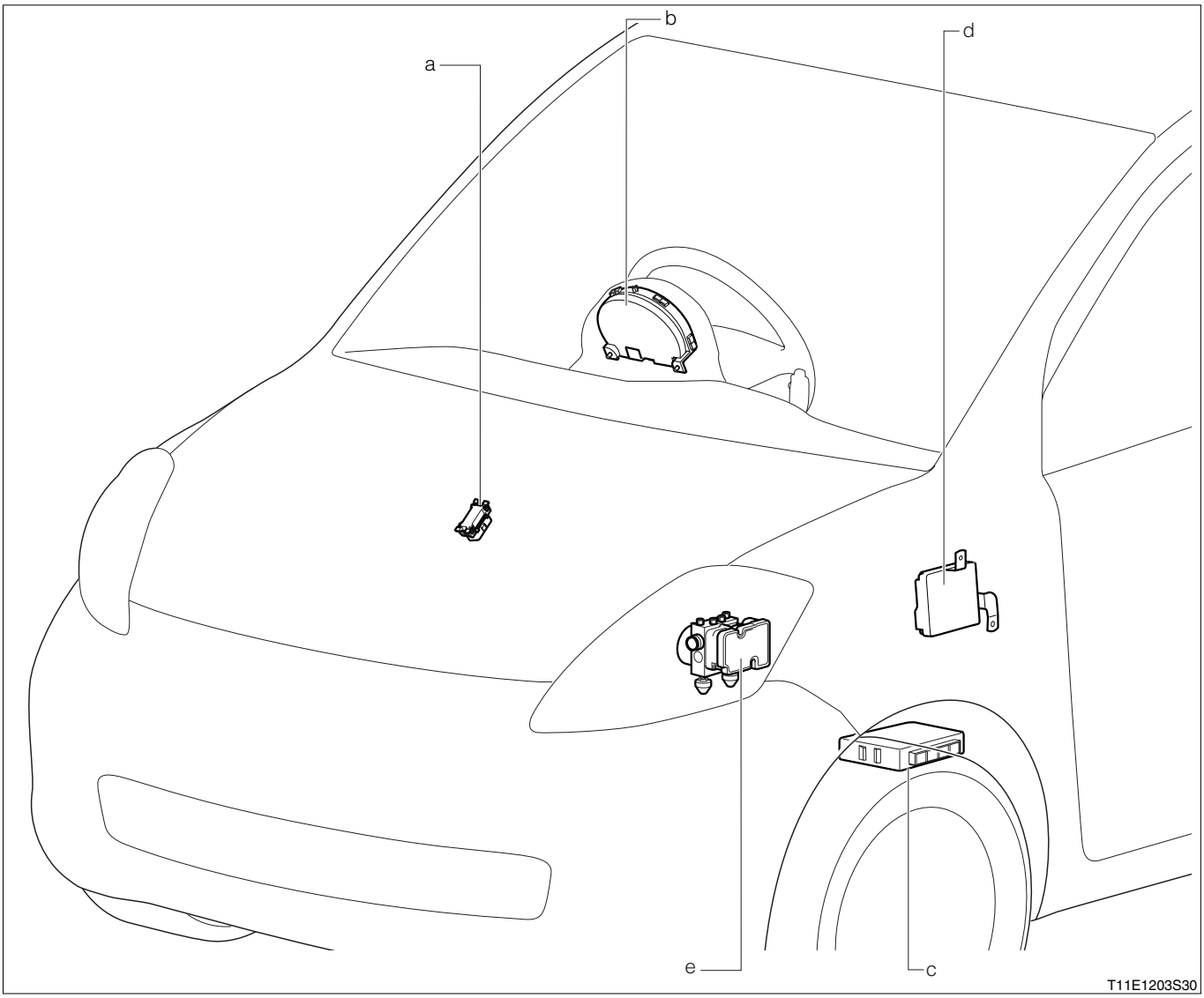


1-3-2 LHD VEHICLES

(1) Type 6



1-4 LOCATION OF COMPONENTS



The illustration show a right-hand drive vehicle.

	Part name
a	DLC
b	Meter (meter ECU)
c	Engine control computer (EFI ECU)
d	ABS actuator (ABS ECU)

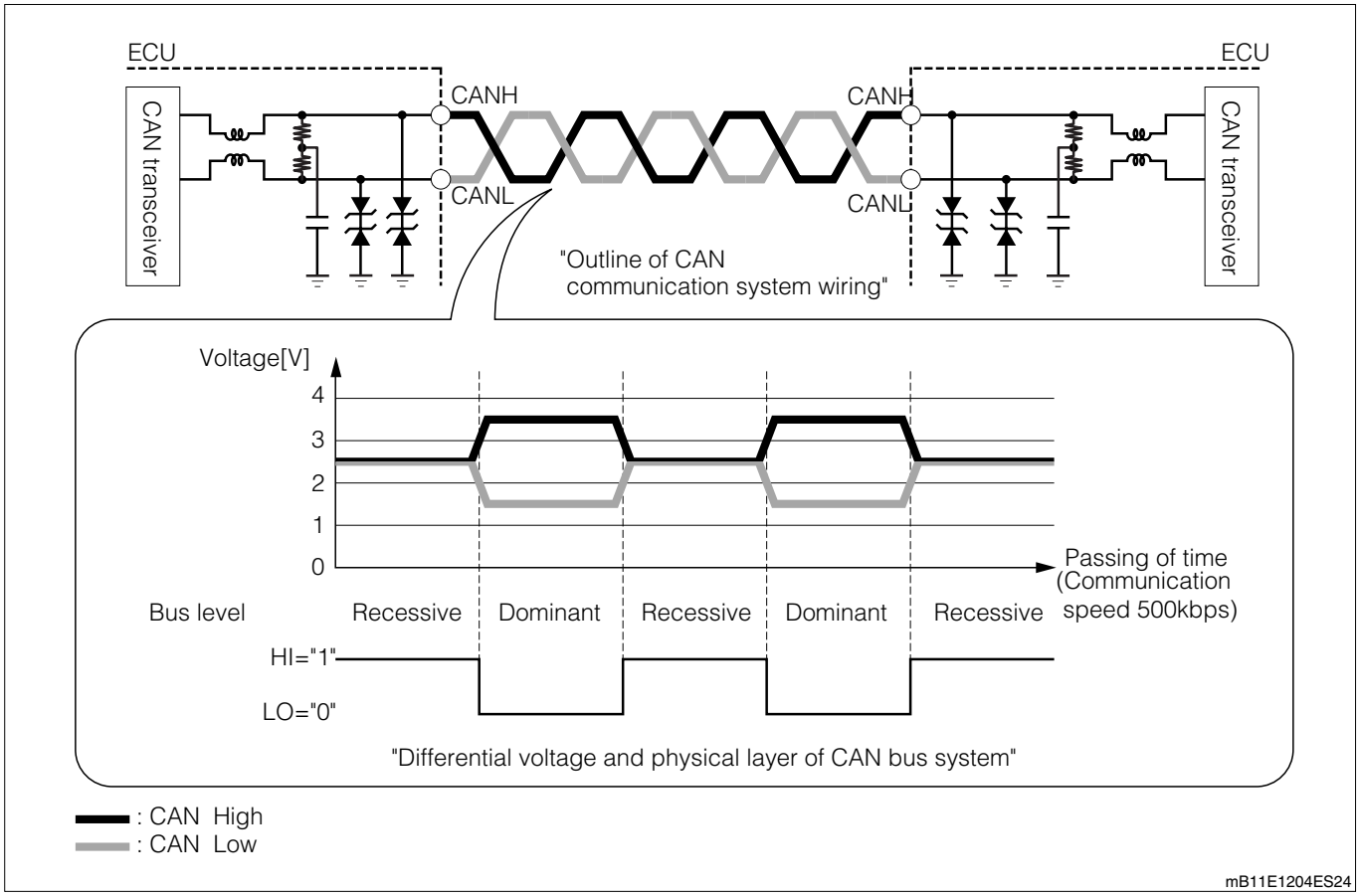
2 CONTROL

2-1 COMMUNICATION CONTROL

1. A CAN communication system has two communication lines (bus) acting as a pair and the bus level ※2 is determined by the voltage differential between them. The two lines are called CAN high (CANH) and CAN low (CANL) respectively. Data is transmitted at the rate of 500kbps ※3 as a digital signal according to the CAN dedicated communication protocol.

NOTE

- ※2: The bus level has a dominant level and a recessive level. CAN communication system logic deems dominant to be ″0″ and recessive to be ″1″.
- ※3: The signal rate of data transmission is expressed in bits per second (bps). ″500kbps″ means that 500,000 bits of data are transmitted per second.



2-2 COMMUNICATION PROTOCOL

1. The CAN communication system is a multiplex systems in which all the ECU's in the network use a pair of communication lines (bus). Any of the ECU's can transmit data if the CAN bus is in an idol (open) state. Therefore, each ECU performs the communication according to the common communication protocol so that the communication can be done smoothly and securely.
2. Under CAN communication protocol all the ECU's share a common pair of communication lines and have the right to start transmitting data. CSMA/CD (Carrier Sense Multiple Access / Collision Detection) ※4 is the protocol used for sending data to the communication line.

NOTE

- ※4: CSMA/CD stands for Carrier Sense Multiple Access with Collision Detection. It is a communication access protocol where ECU's check the status of the communication line (carrier) and only if there is no other data flowing will they start to send data of their own. Further, in addition to this, if a collision of data is detected (i.e. with data that has been transmitted by another ECU at the same time), the offending ECU will wait for a fixed period of time and then resend the data.

3. ECU's start to transmit data when other data is not flowing in the CAN bus, but if two or more ECU's start to transmit data simultaneously then the priority of the data is determined by the ID which the transmitted data itself contains.

2-3 COMMUNICATION DATA

2-3-1 TYPE 2, TYPE 6

CAN communication signal

Nomenclature of signals	Applicable ECU		
	EFI ECU	ABS ECU	Meter ECU
Engine coolant temperature	●	–	○
Stop lamp switch	–	●	–
Vehicle speed	○	●	○
Brake warning lamp request	–	●	○
ABS warning lamp request	–	●	○
Running distance	–	●	○
ECU-T terminal	–	○	●
Tail switch	○	–	●

●: signal sending, ○:signal receiving

2-4 DIAGNOSIS (SELF-DIAGNOSIS) FUNCTION

Diagnostics means failure diagnosis. This is a function by which if there are any abnormalities in the input signal the ECU will inform a mechanic/technician of the abnormal item.

CAN communication failure diagnosis sets up a separate diagnosis code for each ECU which constitutes the CAN.

Please refer to the repair/maintenance manual for details of the failure diagnosis function.

2-5 FAIL-SAFE CONTROL

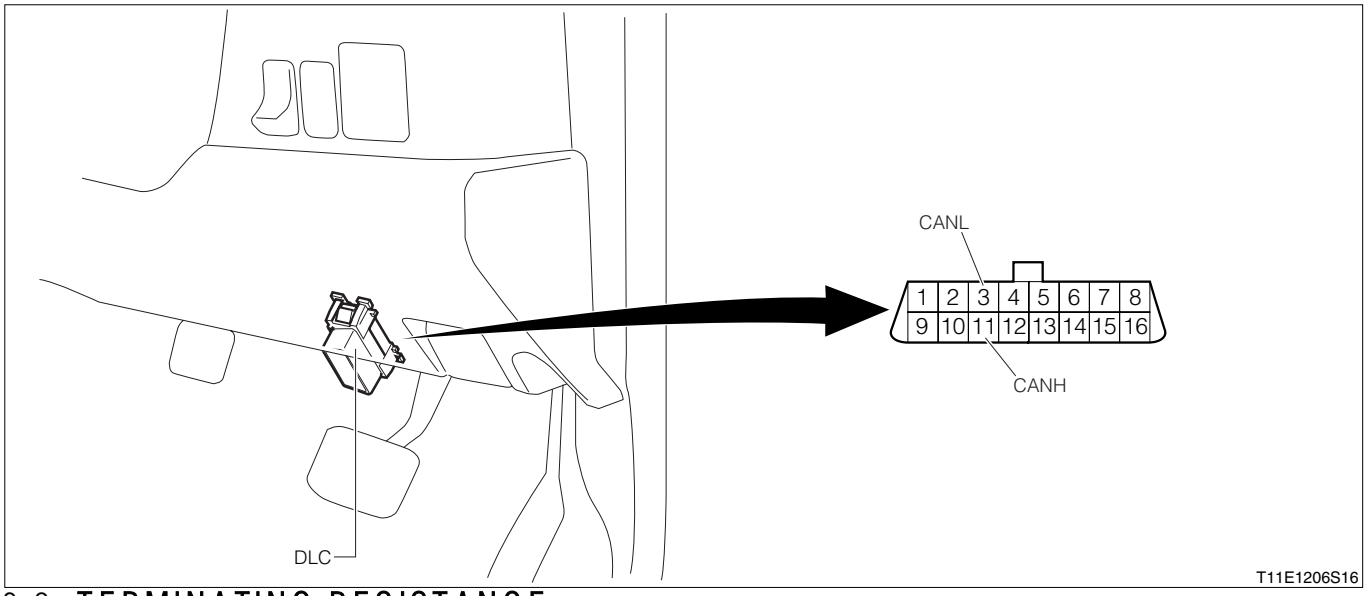
If the CAN communication system continues operating in the event of abnormalities such as open wires or short circuits in the CAN communication line and communication abnormality between ECU's, there may be the possibility that the abnormalities may effect the control of each system. Under these circumstances each ECU will come under the control of a preset internal control system.

For details of the fail-safe controls please refer to the item of each system which makes up the CAN.

3 COMPONENTS

3-1 DLC

A DLC (Data Link Connector) is installed forward of the driver's seat (lower portion of the instrument panel, driver's seat door side).
CANH and CANL terminals have been added to the DLC with the adoption of a CAN communication system.



3-2 TERMINATING RESISTANCE

The terminating resistance is located in the combination meter and in the engine control computer.
As the terminating resistance, there are two 60 Ω resistors in series. As a result, the differential voltage can be judged from the loop connected network.

■ LIN COMMUNICATION SYSTEM

1 OUTLINE

1-1 DESCRIPTION

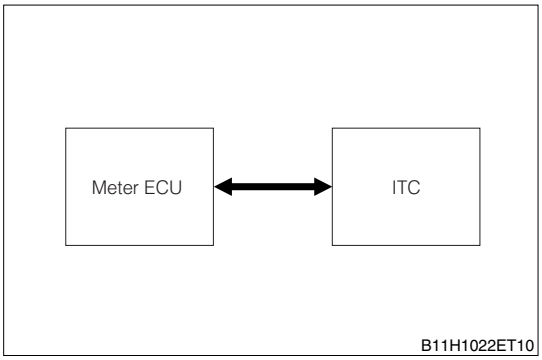
1. All vehicles are equipped with LIN communication (LIN: Local Interconnect Network) *.
2. The LIN communication consists of the meter ECU and ITC.
3. Multiplex communication is a system in which plural ECU's are connected to a single communication line to provide mutual data exchange. This has made it possible to integrate the system and prevent the number of wires from increasing when a function is added.
4. Controls actually taking place in the multiplex communications are the wake-up/sleep controls, system controls by applicable ECU and so forth.
5. A diagnosis function is provided that will inform the operator of any abnormality of the system. Also, fail-safe functions are provided that will assure the minimum functions for each ECU and protect the systems when abnormal communications occur between the ECUs.
6. The communication method employs a single master system in which the meter ECU controls the sleep (low current mode), wake-up (standby mode), etc. of the communication applicable ECU.

NOTE

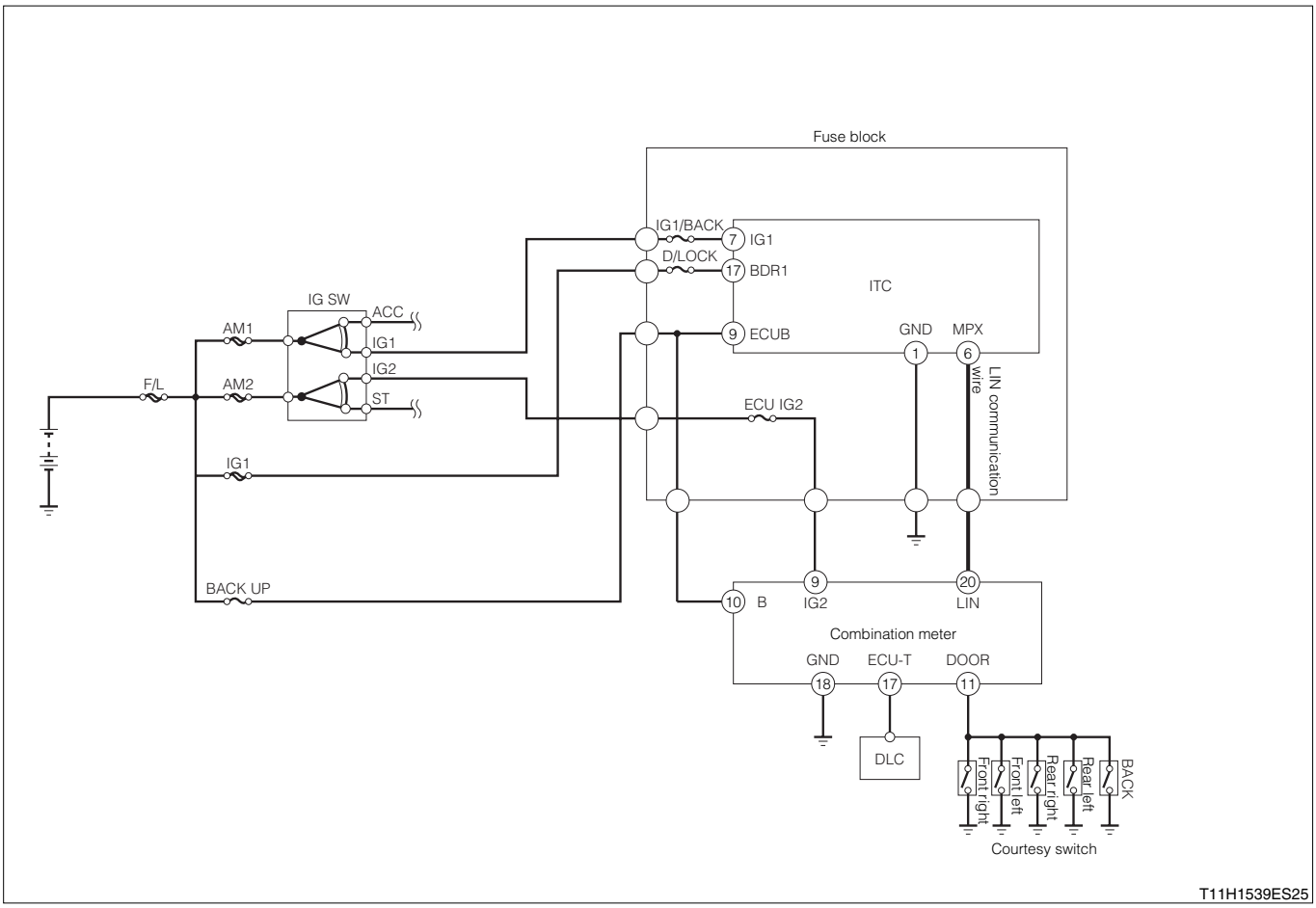
- *: The LIN communication is a multiplex communication network mainly intended for the data communications between the body-related control ECUs.

1-2 SYSTEM DRAWING

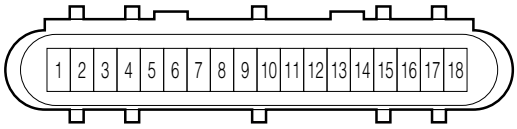
The LIN communication consists of the meter ECU and ITC.



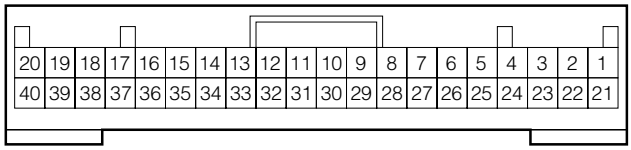
1-3 SYSTEM WIRING DIAGRAM



Arrangement of ECU terminal



ITC



Combination meter

T11H9502ES20

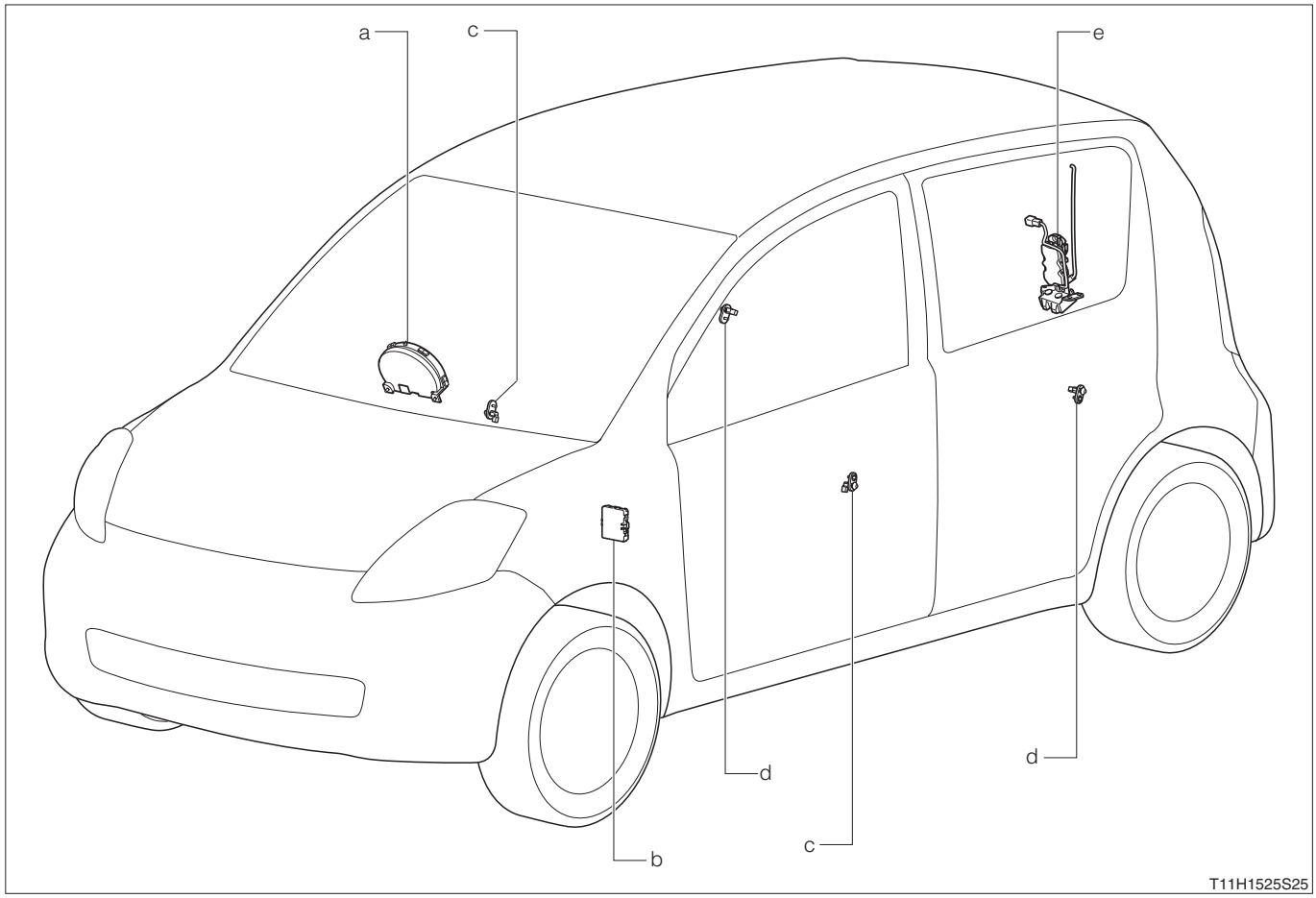
Meter terminal name (Multiplex communication system)

Terminal No.	Terminal code	Terminal name
9	IG2	IG power supply
10	+B	+B power supply
11	DOOR	Input of courtesy switch signal
17	ECU-T	ECU-T terminal signal input
18	GND	Earth
20	LIN	LIN communication input/output

ITC terminal name (Multiplex communication system)

Terminal No.	Terminal code	Terminal name
1	GND	Earth
6	MPX	Multiple communication input/output
7	IG1	ECU power supply
9	ECU B	ECU power supply
17	BDR1	Power supply

1-4 LOCATION OF COMPONENTS



The illustration represents the RHD vehicle. In the case of the LHD vehicle, the combination meter is located at the left side.

a	Meter ECU (inside the combination meter)
b	ITC
c	Front door courtesy switch
d	Rear door courtesy switch
e	Back door courtesy switch (inside the back door lock Ay)

2 CONTROL

2-1 COMMUNICATION CONTROL

2-1-1 DESCRIPTION

The meter ECU controls the following items.

1. Evaluation of presence/non-presence of ECU
2. Communication start informing control
3. Wake-up/sleep control

2-1-2 EVALUATION OF PRESENCE/NON-PRESENCE OF ECU

The meter ECU detects the presence of the ECU every time the battery power supply is turned on.

1. When the LIN communication applicable ECU is not connected to the meter ECU, or when it does not respond to the meter ECU due to failure, etc. of the LIN communication applicable ECU, the meter ECU transmits a command to other ECUs that have been judged to be present to perform such communication control that is to be carried out when the ECU that has made no response is not mounted (Evaluation of ECU non-presence).
2. The meter ECU, after detecting the presence of the ECU, continues to monitor ECU connecting status at constant intervals.
3. When the LIN communication applicable ECU responds properly to the meter ECU during the ECU presence/non-presence evaluation, or when the ECU that has made no response returns to the normal condition and makes a proper response after the ECU has been judged not to be present, the meter ECU transmits a command to other LIN communication applicable ECUs to perform such communication control that is to be carried out when the ECU that has made a response is mounted (Evaluation of ECU presence).

2-1-3 COMMUNICATION START CONTROL

The communication start is always started from the meter ECU. The signal of communication start is transmitted to other ECU.

2-1-4 WAKE-UP/SLEEP CONTROL

When transferring to the sleep (the low current mode), or transferring from the sleep (the low current mode) to the wake-up (the standby mode), the meter ECU transmits a transfer start command to the other LIN communication applicable ECUs, thereby transferring to the wake-up/sleep control.

2-2 WAKE-UP/SLEEP FUNCTION

2-2-1 DESCRIPTION

The LIN communication system is equipped with a wake-up/sleep function to reduce the current used when the IG switch is in the ACC and LOCK positions.

2-2-2 CONDITIONS FOR REALIZING SLEEP

When the following conditions 1 and 2, or the condition 3 is satisfied, the meter ECU sends a sleep command to each ECU, thus transferring to the sleep state (the low current mode).

1. The IG switch is set to the ACC position or the LOCK position.
2. The meter ECU received the information that the control of each ECU is complete, and the control of the meter itself is complete.
3. Ten minutes have passed after the IG switch was set to the ACC position or the LOCK position, with the door open (the battery discharging prevention function).

2-2-3 CONDITIONS FOR REALIZING WAKE-UP

When either of the following conditions is satisfied, the meter ECU sends a wake-up command to each ECU, thus transferring to the wake-up state (the standby mode).

1. Cases where there is a change in the data to be communicated at each ECU, and the ECU transmits a wake-up (the standby mode) signal to the meter ECU.
2. Cases where the IG switch is turned from the ACC or LOCK position to the ON position.
3. Immediately after connecting a battery.

2-3 LIN COMMUNICATION PROTOCOL (COMMUNICATION REGULATION)

1. The LIN communication system is a two-way interactive time-division multiplexing communication system, where all ECUs that make up the network can send and receive data by delaying the timing for using a communication line in order to share a single communication line. Each ECU, therefore, communicates according to the common communication protocol (communication regulation) to ensure smooth and reliable communication.
2. The data used by the LIN communication system consist of digital signals that include information such as ID to identify each ECU (node ID) and contents of communication data.
3. In order for all ECUs to be able to communicate by sharing a single communication line, based on the specified transmission time schedule, the single master system is employed as a communication regulation for the communication line, in which the meter ECU controls the communication timing, sleep (the low current mode) and wake-up (the standby mode), etc. of the communication applicable ECU.

2-4 DIAGNOSIS (ONBOARD DIAGNOSIS FUNCTION)

This is a function whereby the ECU informs the inspection operator of the abnormal items when there has been a failure in the system. When failure takes place, the ECU memorizes the abnormal item.
Please refer to the repair manual for details concerning the diagnosis.

2-5 FAIL-SAFE FUNCTION

When communication remains unestablished between the applicable ECU and the meter ECU for a certain length of time, the predetermined control is performed by transferring to the fail-safe mode.

Conditions of each system during the fail-safe mode

Applicable ECU	Condition
ITC	·The keyless operation will not take place. ·The room lamp control will not take place. *: The power door locking operates normally.

CAUTION

- When the meter ECU transfers to the fail-safe mode, the ITC, being unable to communicate with the meter ECU, will transfer to the fail-safe mode.