L2 MULTIPLEX COMMUNICATION SYSTEM

CAN COMMUNICATION SYSTEM

1 OUTLINE

1-1 DESCRIPTION

1.A CAN[Å•g,DK_MÅ§] 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.).

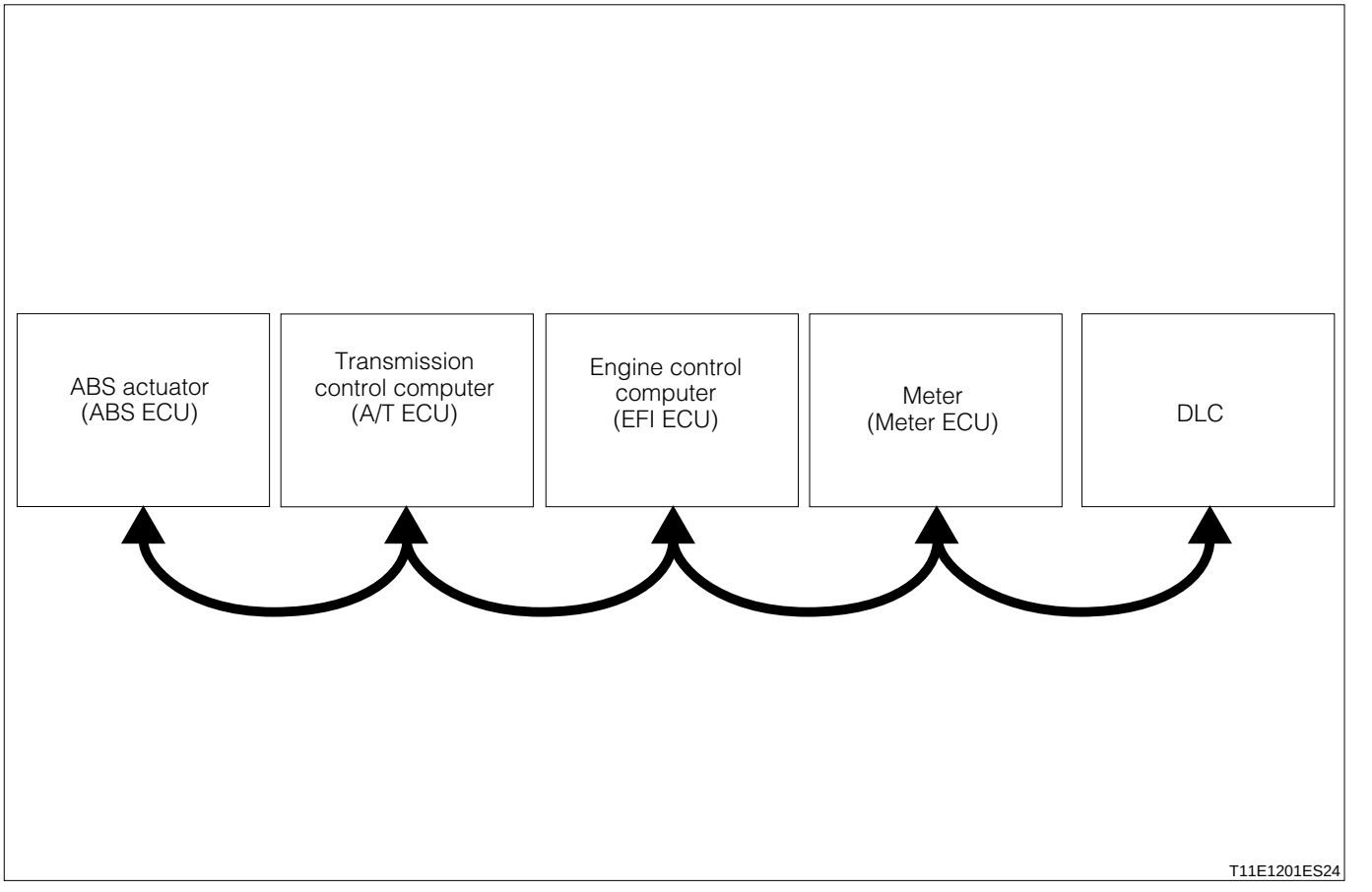
3.The CAN communication system in use is a daisy chain type network with several computers connected to a pair of communication lines.

NOTE

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

1-2 SYSTEM DRAWING

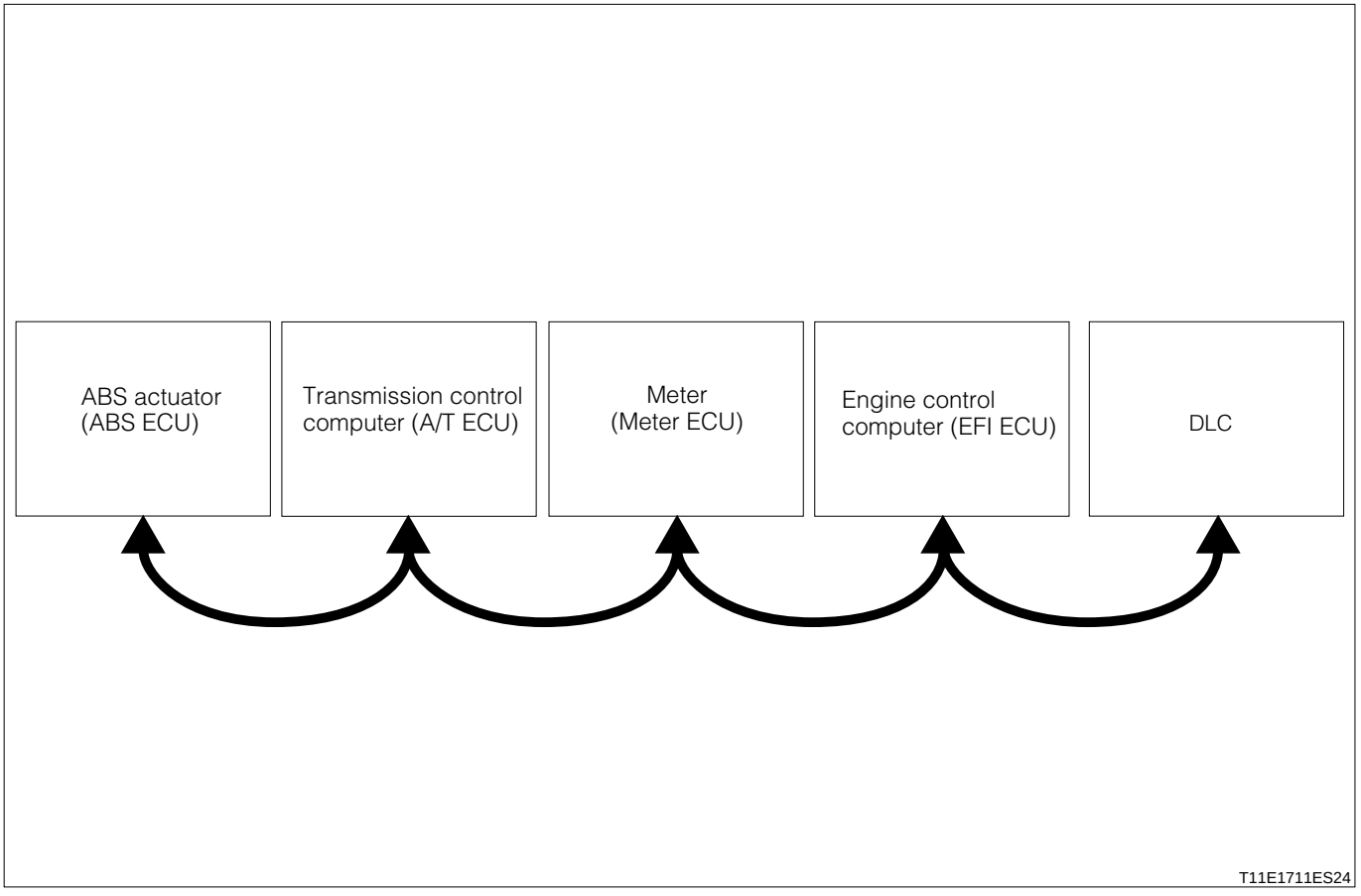
1-2-1 RHD VEHICLES



CAN communication connection system (RHD vehicles)

			ABS ECU	A/T ECU	EFI ECU	Meter ECU	DLC	Name of CAN communication system type
1KR	M/T	Vehicles not equipped with ABS	–	–	○	○	○	Type 1
		ABS-equipped vehicles	○	–	○	○	○	Type 2
K3	M/T	Vehicles not equipped with ABS	–	–	○	○	○	Type 1
		ABS-equipped vehicles	○	–	○	○	○	Type 2
	A/T	Vehicles not equipped with ABS	–	○	○	○	○	Type 3
		ABS-equipped vehicles	○	○	○	○	○	Type 4

1-2-2 LHD VEHICLES



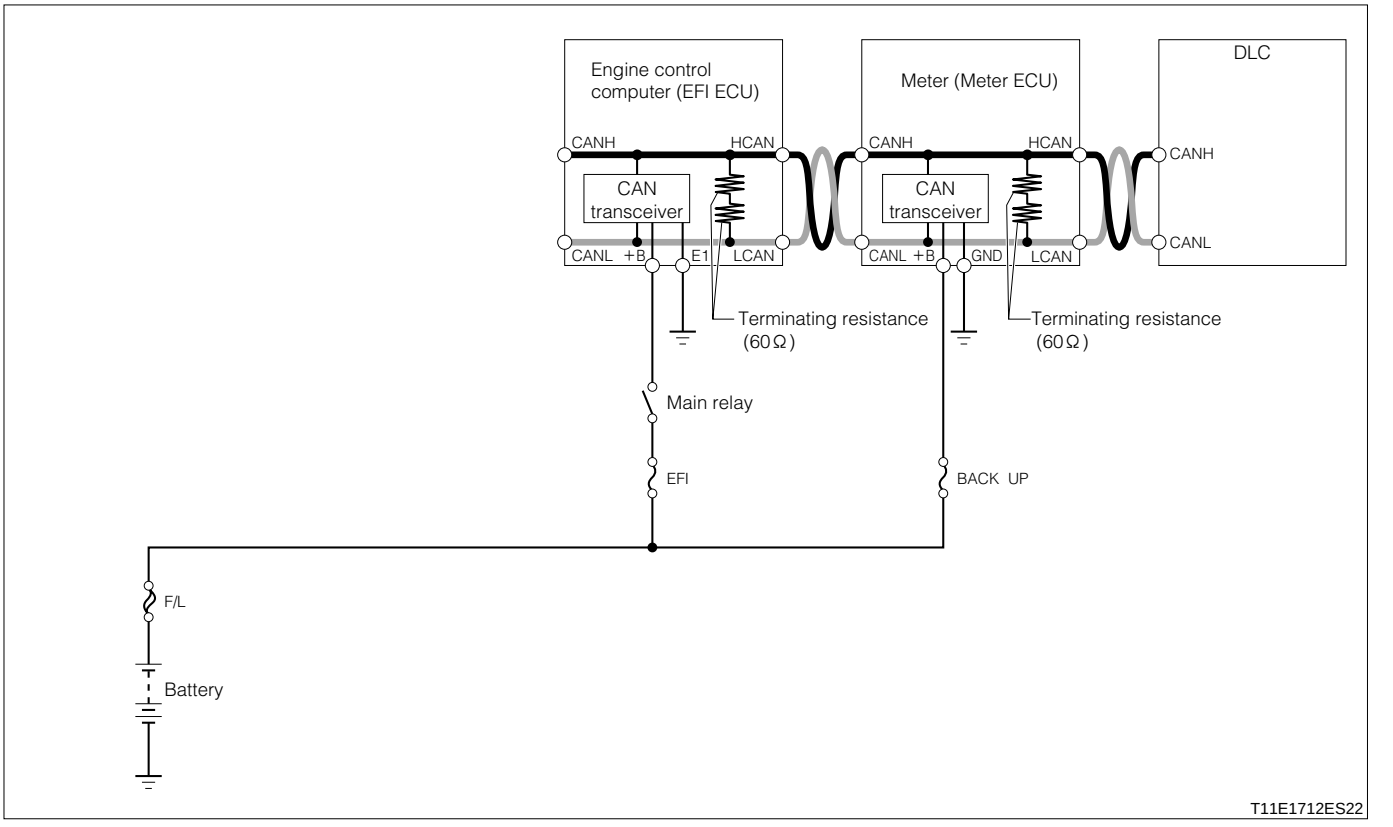
CAN communication connection system (LHD vehicles)

			ABS ECU	A/T ECU	Meter ECU	EFI ECU	DLC	Name of CAN communication system type
1KR	M/T	Vehicles not equipped with ABS	–	–	○	○	○	Type 5
		ABS-equipped vehicles	○	–	○	○	○	Type 6
K3	M/T	Vehicles not equipped with ABS	–	–	○	○	○	Type 5
		ABS-equipped vehicles	○	–	○	○	○	Type 6
	A/T	Vehicles not equipped with ABS	–	○	○	○	○	Type 7
		ABS-equipped vehicles	○	○	○	○	○	Type 8

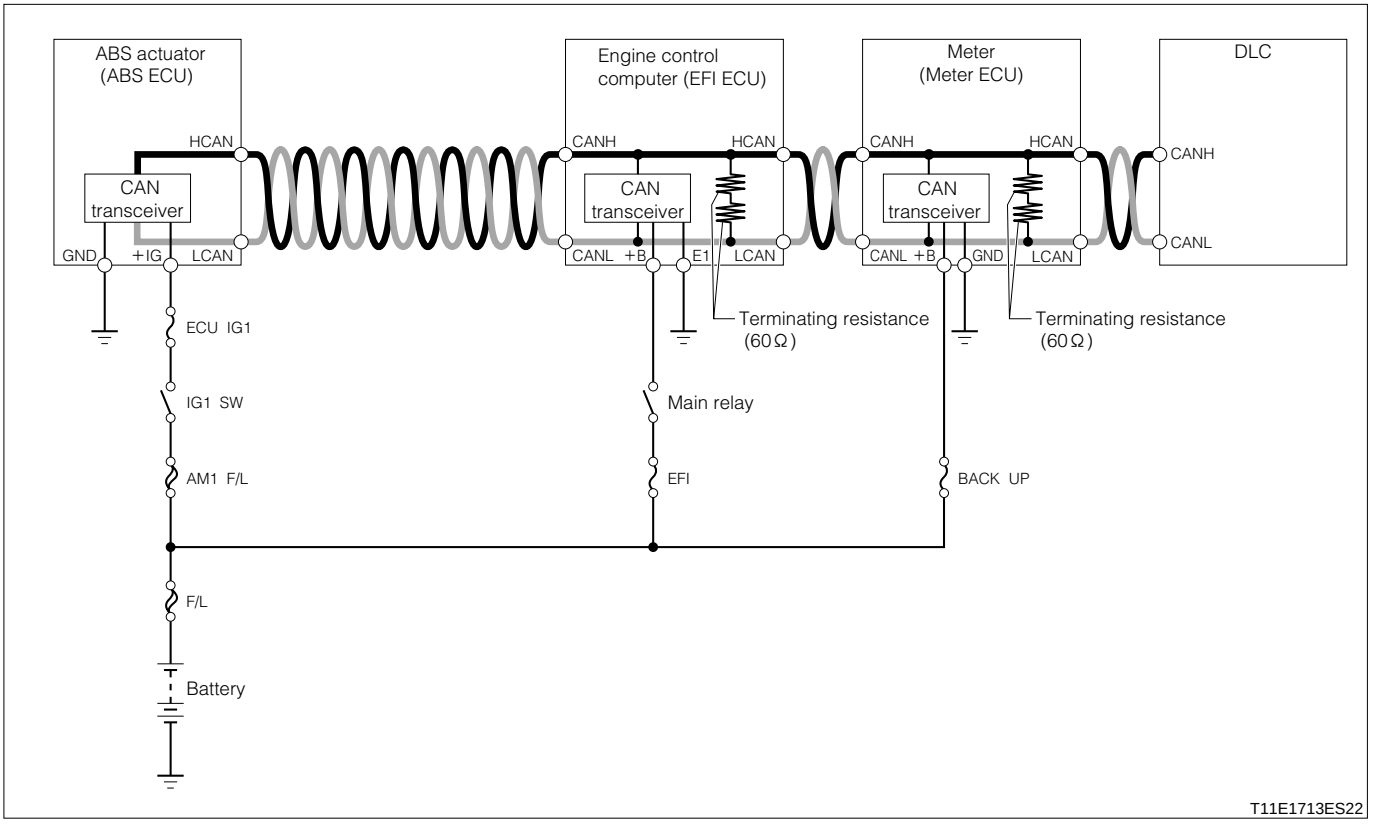
1-3 SYSTEM WIRING DIAGRAM

1-3-1 RHD VEHICLES

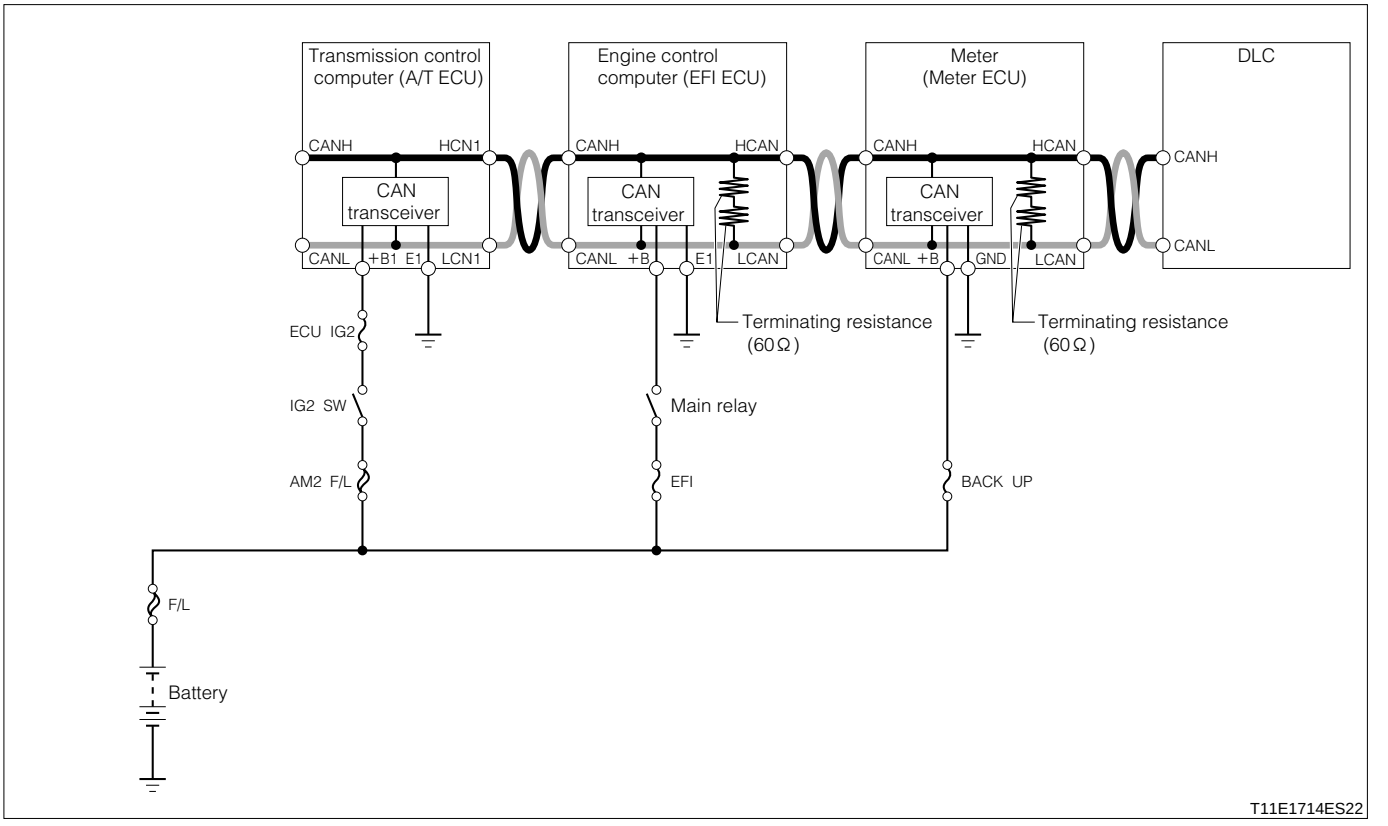
(1) Type 1



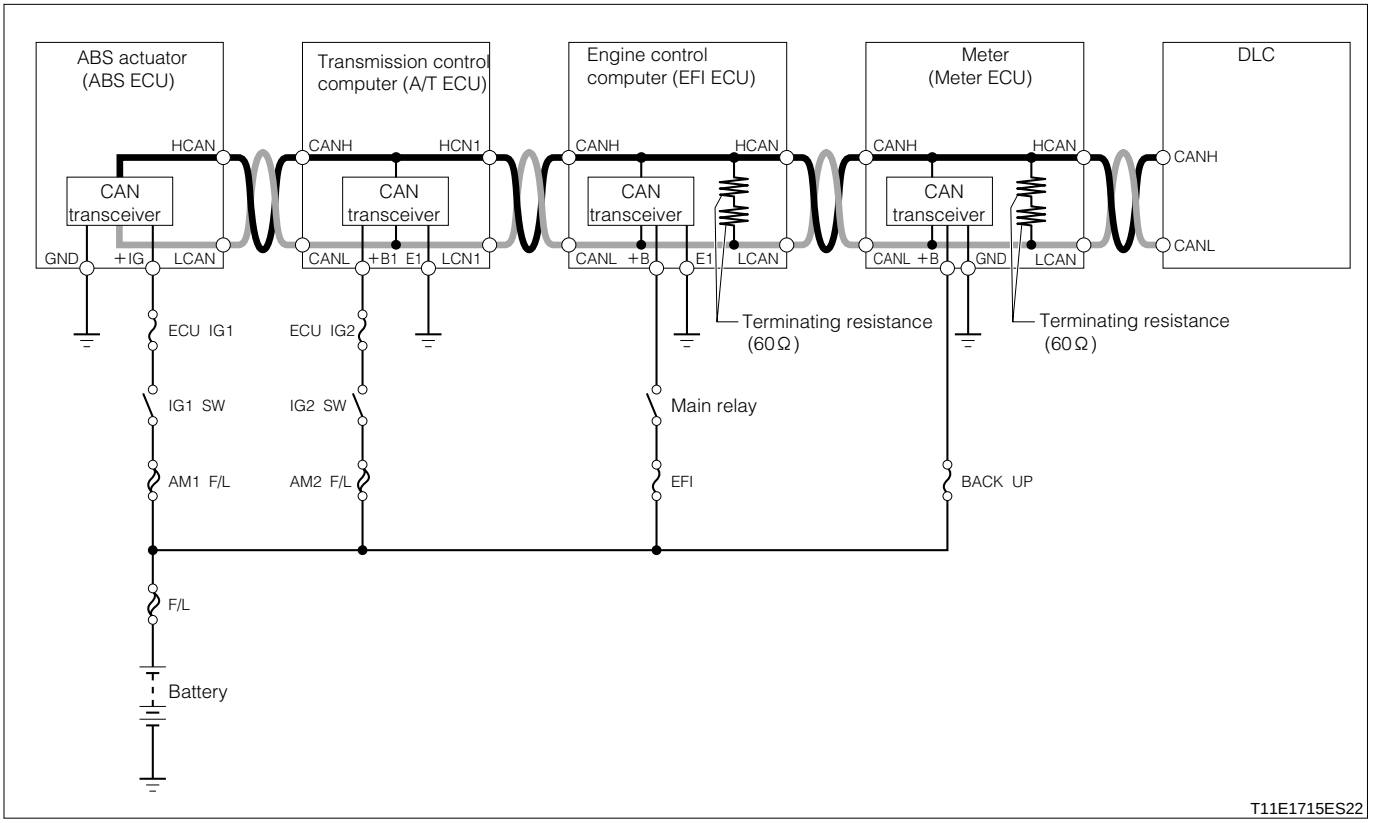
(2) Type 2



(3) Type 3

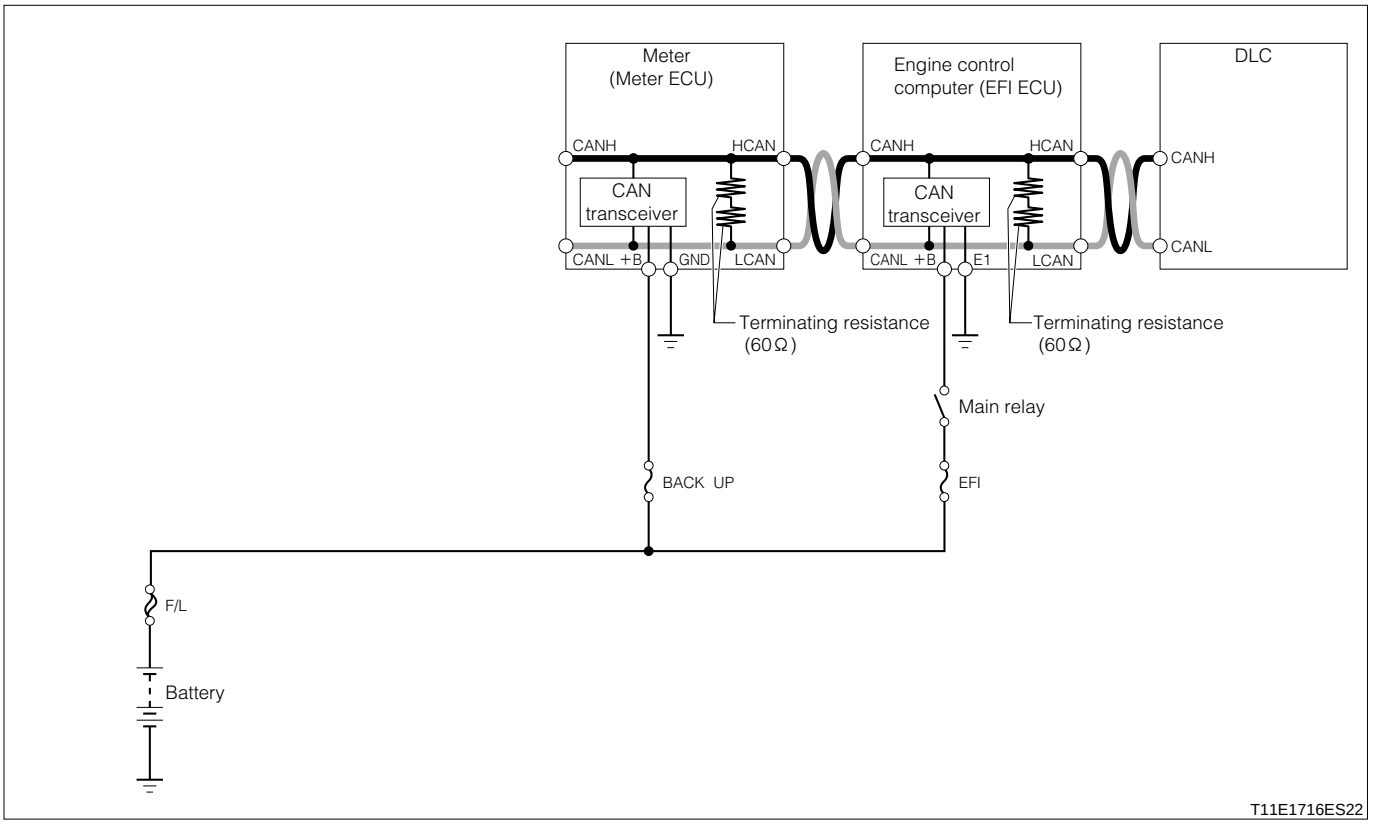


(4) Type 4

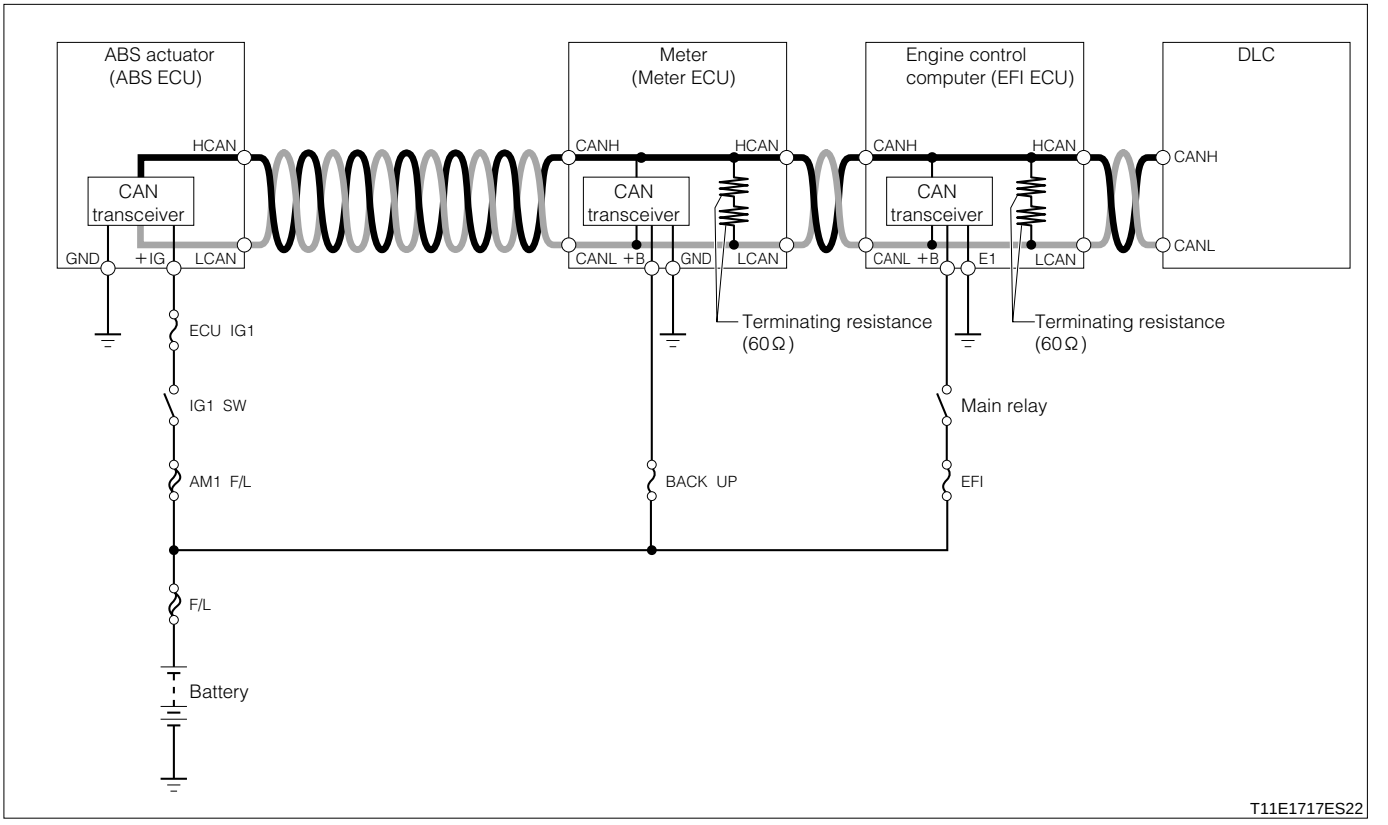


1-3-2 LHD VEHICLES

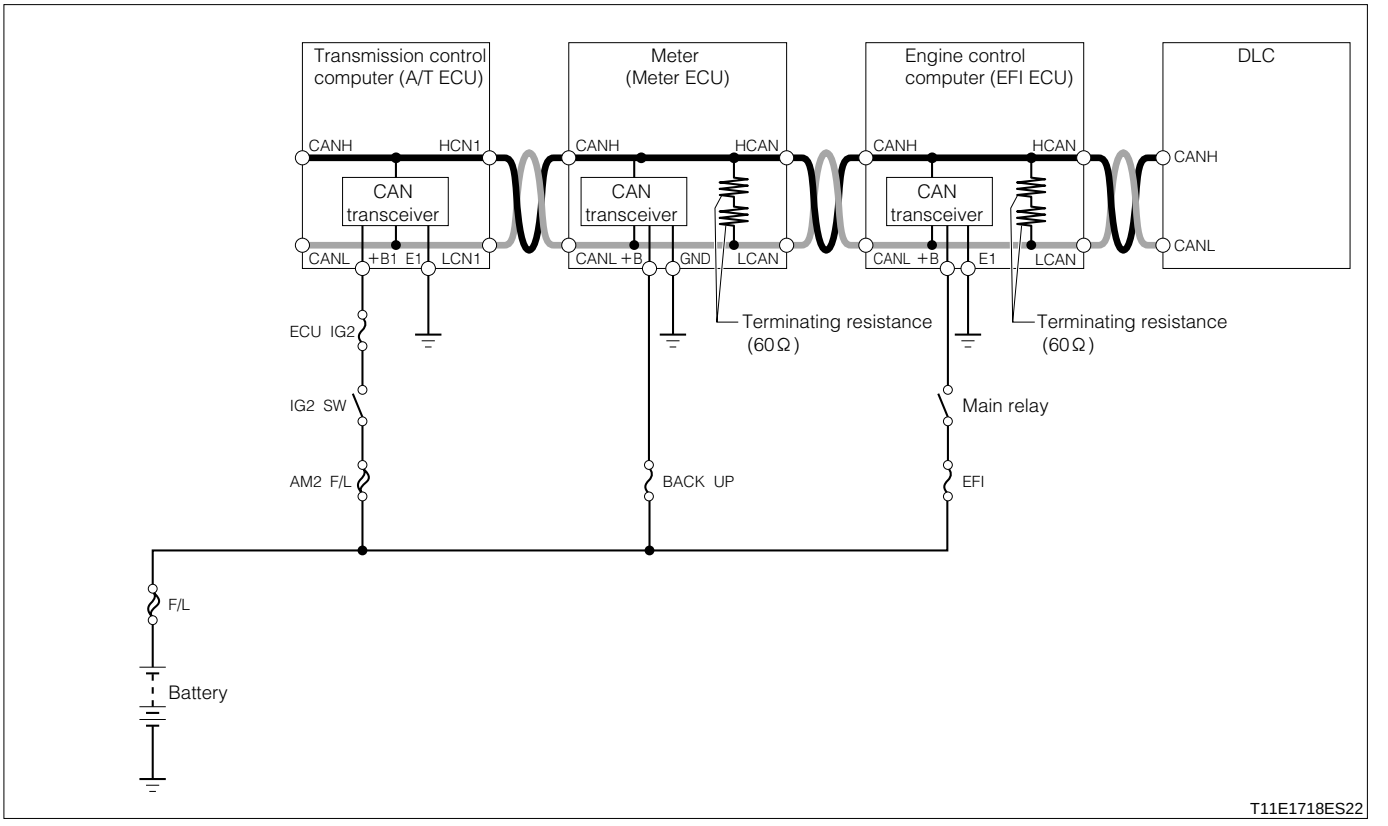
(1) Type 5



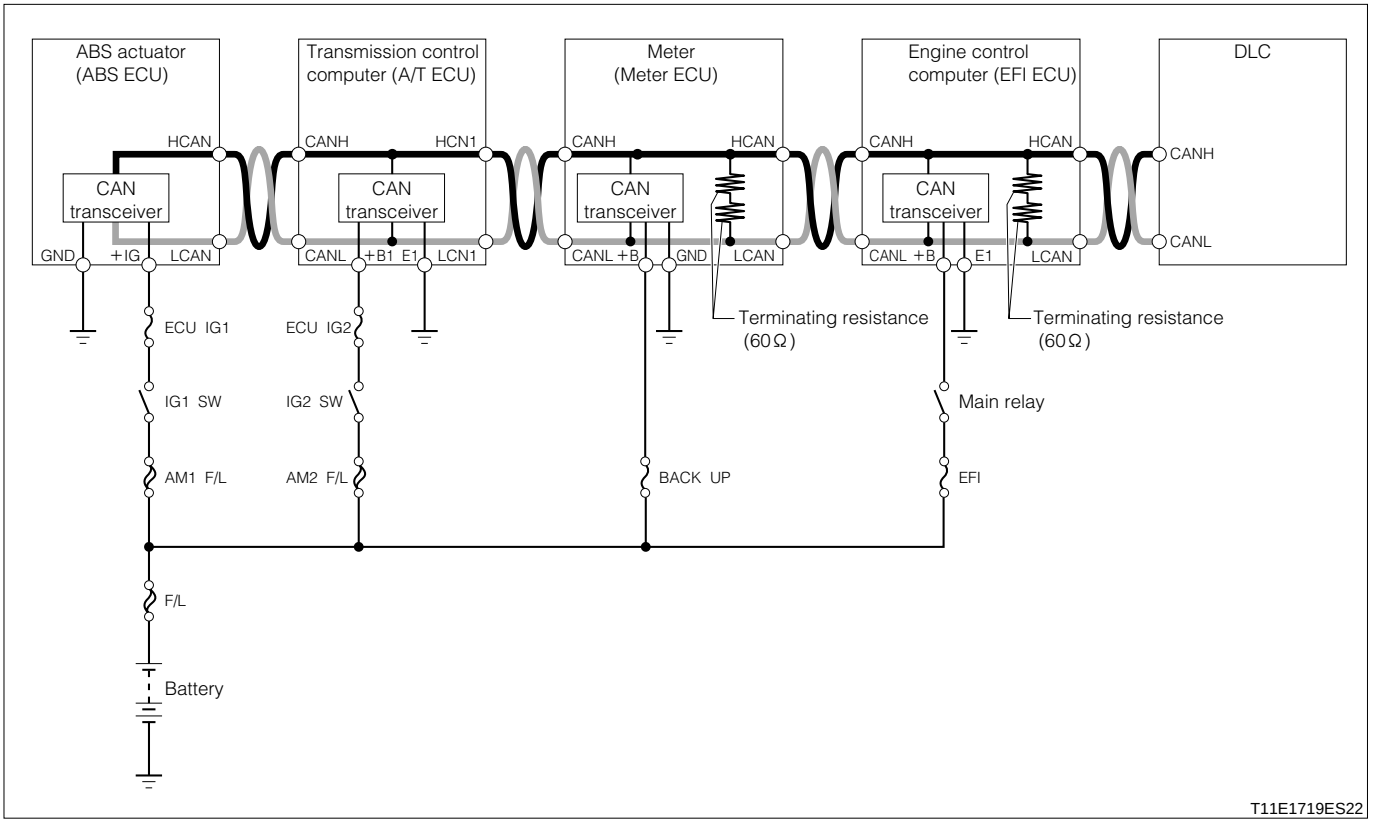
(2) Type 6



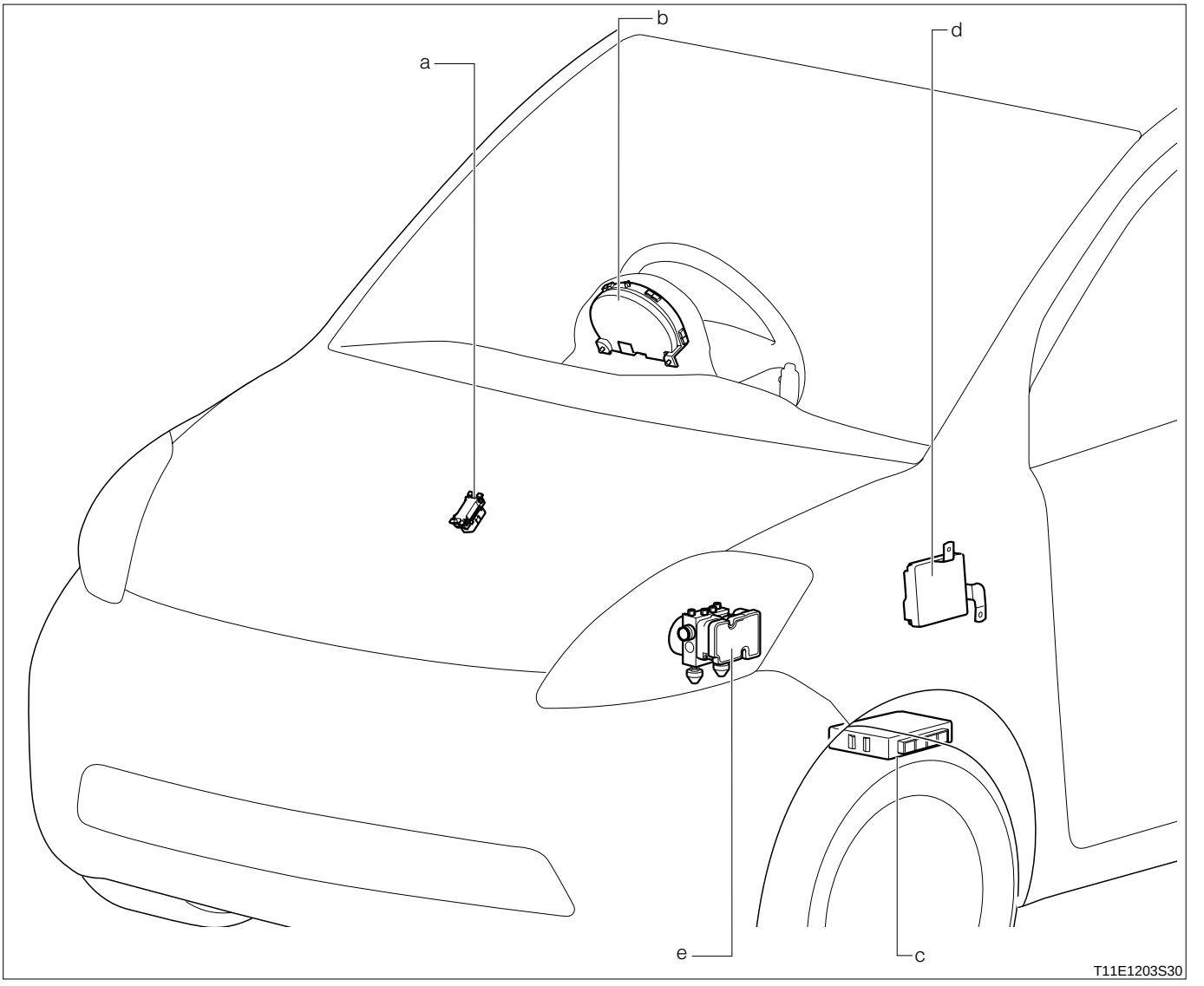
(3) Type 7



(4) Type 8


ABS actuator
(ABS ECU)
Transmission control
computer (A/T ECU)
Meter
(Meter ECU)
Engine control
computer (EFI ECU)
DLC
HCAN
CANH
HCN1
CANH
HCAN
CANH
HCAN
CANH
CANL
CAN
transceiver
CAN
transceiver
CAN
transceiver
CAN
transceiver
GND
+IG
LCAN
CANL
+B1
E1
LCN1
CANL
+B
GND
LCAN
CANL
+B
E1
LCAN
Terminating resistance
(60Ω)
Terminating resistance
(60Ω)
ECU IG1
ECU IG2
IG1 SW
IG2 SW
Main relay
AM1 F/L
AM2 F/L
BACK UP
EFI
F/L
Battery
T11E1719ES22

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	Transmission control computer (A/T ECU)
e	ABS actuator (ABS ECU)

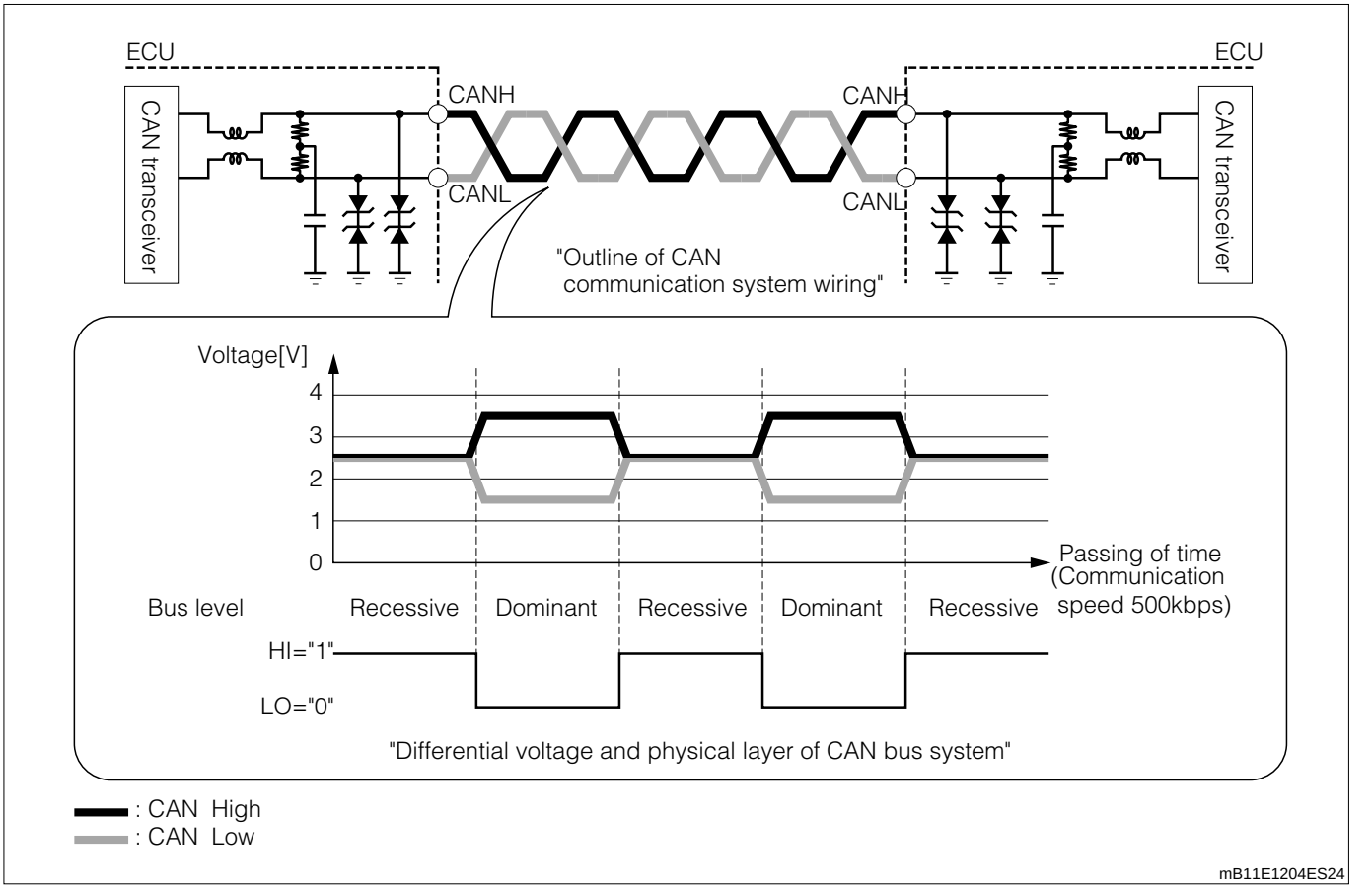
2 CONTROL

2-1 COMMUNICATION CONTROL

1. A CAN communication system has two communication lines (bus) acting as a pair and the bus level Å•g,DK_MÅ§Å•g,DK_MÅ§ 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 Å•g,DK_MÅ§ 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) Å•g,DK_MÅ§ 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 1, TYPE 5

CAN communication signal

Nomenclature of signals	Applicable ECU	
	EFI ECU	Meter ECU
Engine coolant temperature	●	○
Vehicle speed	○	●
Tail switch	○	●

●: signal sending, ○:signal receiving

2-3-2 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

2-3-3 TYPE 3, TYPE 7

CAN communication signal

Nomenclature of signals	Applicable ECU		
	EFI ECU	A/T ECU	Meter ECU
Throttle opening degree	●	○	–
Engine torque	●	○	–
Water temperature state	●	○	–
Engine coolant temperature	●	○	○
Request of deletion of MIL-related malfunction codes in A/T	●	○	–
Completion of deletion of MIL-related malfunction codes in A/T	○	●	–
Torque reduction request	○	●	–
Shift range information	○	●	○
O/D OFF lamp request	–	●	○
A/T warning request	–	●	○
A/T learning value erasure completion	–	●	○
Vehicle speed	○	●	○
ECU-T terminal	–	○	●
Tail switch	○	–	●

●: signal sending, ○:signal receiving

2-3-4 TYPE 4, TYPE 8

CAN communication signal

Nomenclature of signals	Applicable ECU			
	EFI ECU	A/T ECU	ABS ECU	Meter ECU
Throttle opening degree	●	○	–	–
Engine torque	●	○	–	–
Water temperature state	●	○	–	–
Engine coolant temperature	●	○	–	○
Request of deletion of MIL-related malfunction codes in A/T	●	○	–	–
Completion of deletion of MIL-related malfunction codes in A/T	○	●	–	–
Torque reduction request	○	●	–	–
Shift range information	○	●	–	○
O/D OFF lamp request	–	●	–	○
A/T warning request	–	●	–	○
A/T learning value erasure completion	–	●	–	○
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

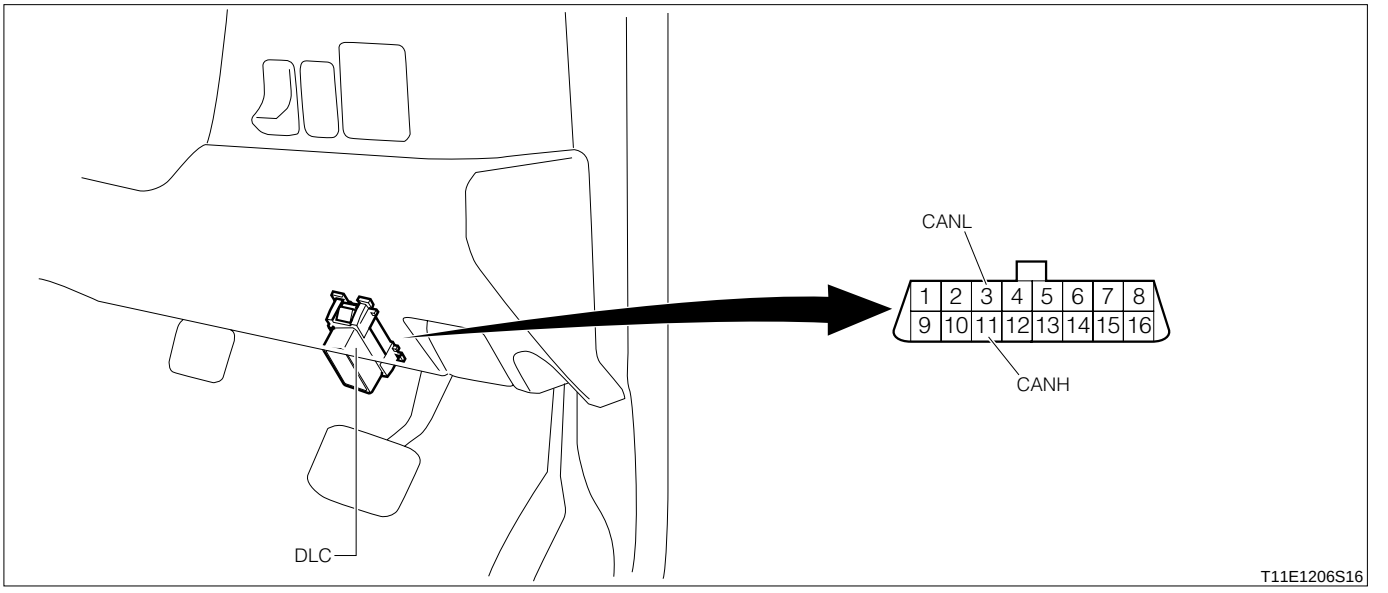
If the CAN communication system continues operating in the event of abnormalities such as open wires or short circuits in the CAN communication line and communication abnormality between ECU's, there may be the possibility that the abnormalities may effect the control of each system. Under these circumstances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

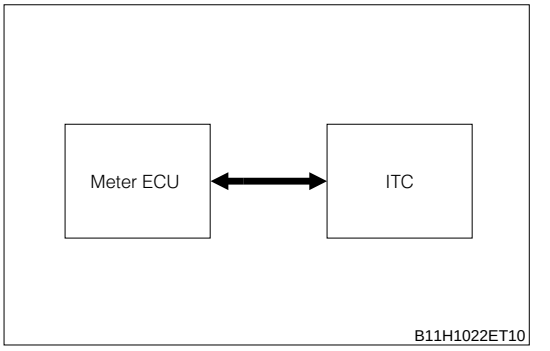
1.All vehicles are equipped with LIN communication (LIN: Local Interconnect Network) *.
2.The LIN communication consists of the meter ECU and ITC.
3.Multiplex communication is a system in which plural ECU's are connected to a single communication line to provide mutual data exchange. This has made it 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

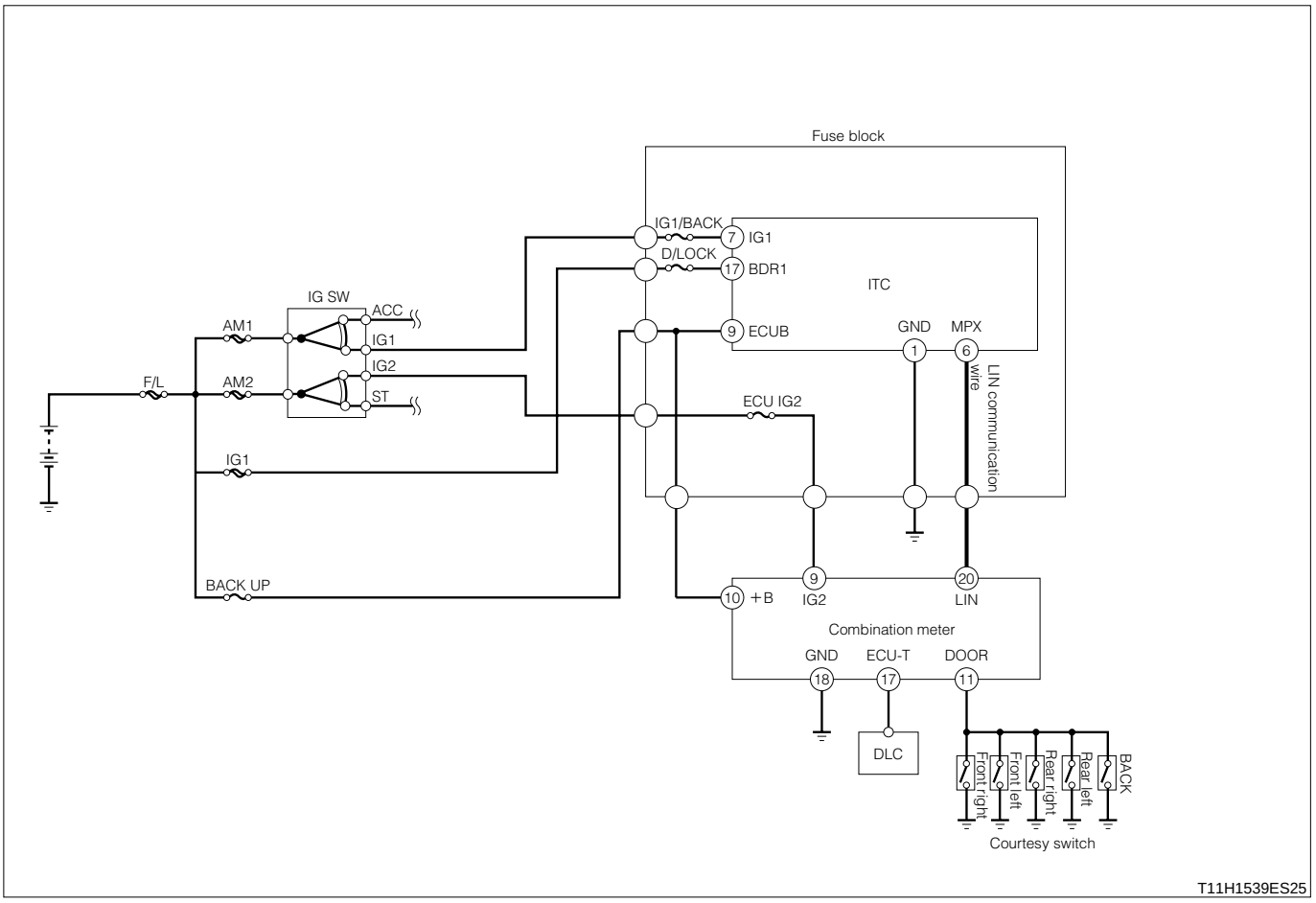
- *: The LIN communication is a multiplex communication network mainly intended for the data communications between the body-related control ECUs.

1-2 SYSTEM DRAWING

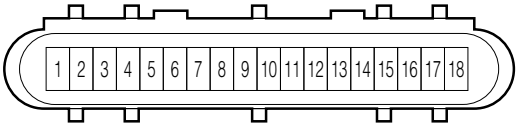
The LIN communication consists of the meter ECU and ITC.



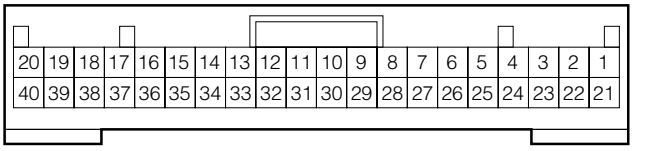
1-3 SYSTEM WIRING DIAGRAM



Arrangement of ECU terminal



ITC



Combination meter

T11H9502ES20

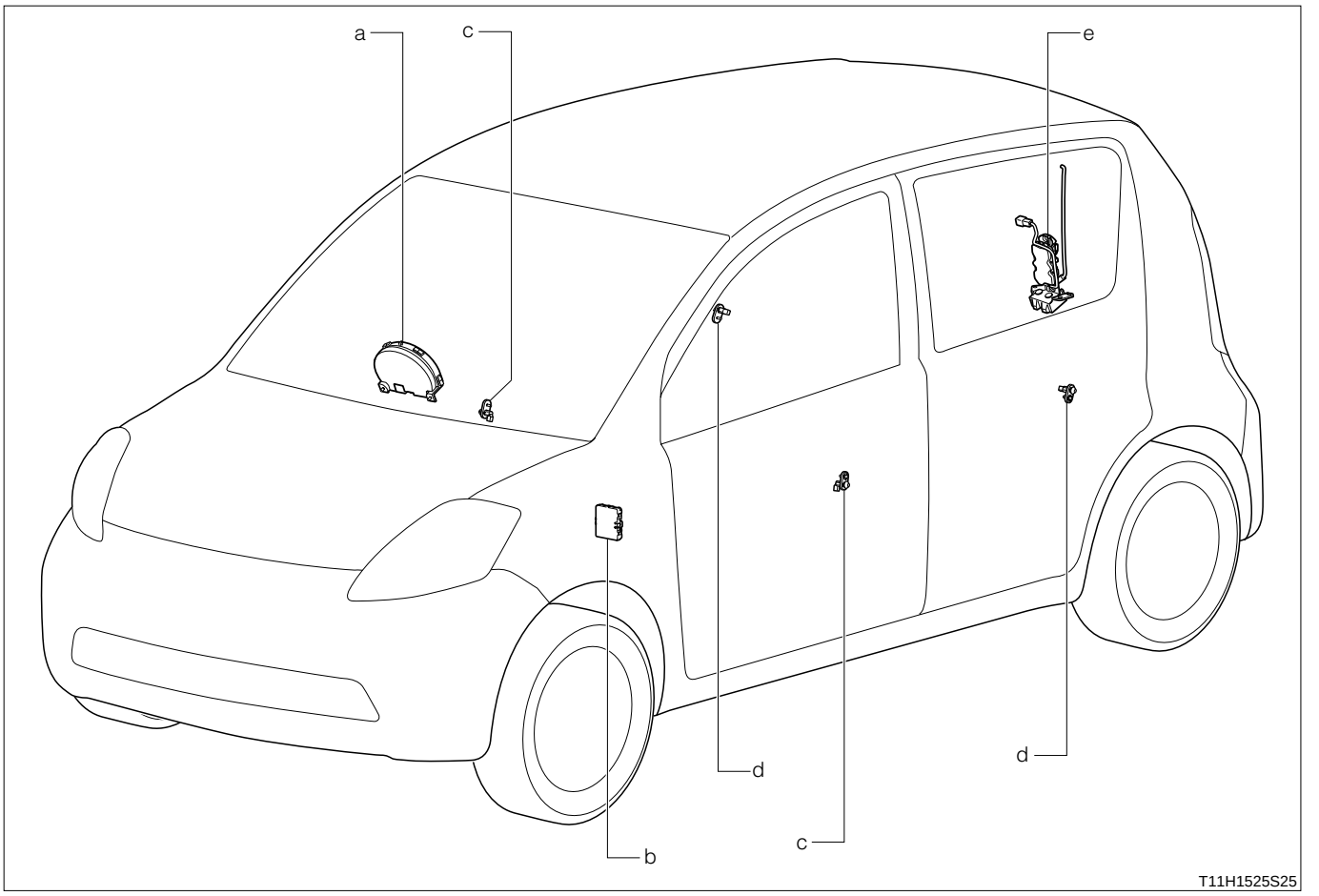
Meter terminal name (Multiplex communication system)

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.