

GROUP 54C

CONTROLLER AREA NETWORK (CAN)

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GENERAL DESCRIPTION

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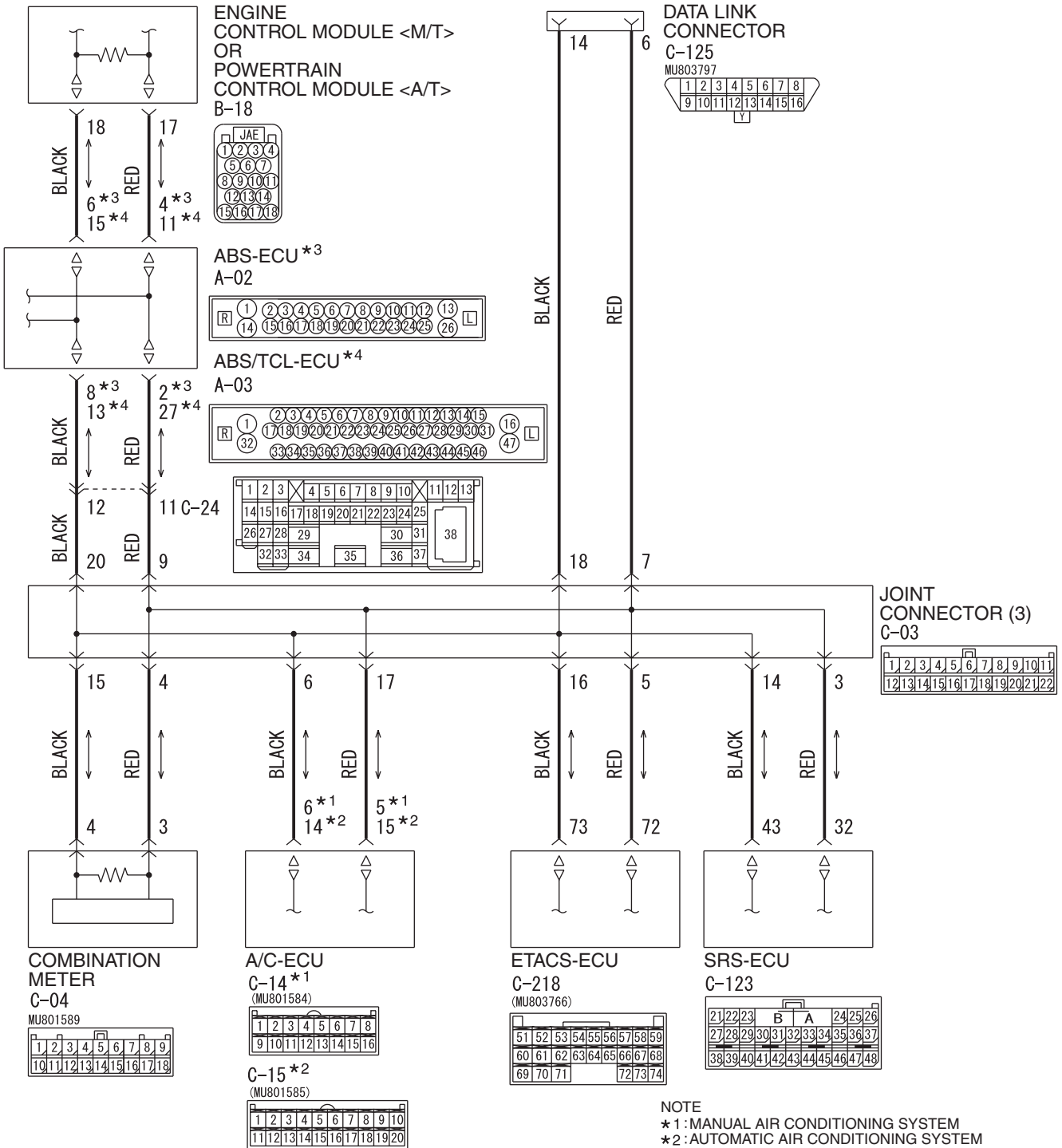
CAN, an abbreviation for Controller Area Network, is an ISO-certified international standard for a serial multiplex communication protocol*.

*NOTE: *: The regulations have been decided in detail, from software issues such as the necessary transmission rate for communication, the system, data format, and communication timing control method to hardware issues such as the harness type and length and the resistance values.*

A communication circuit applying the CAN protocol connects each ECU, and sensor data can be shared among ECUs, which enables a reduction in wiring.

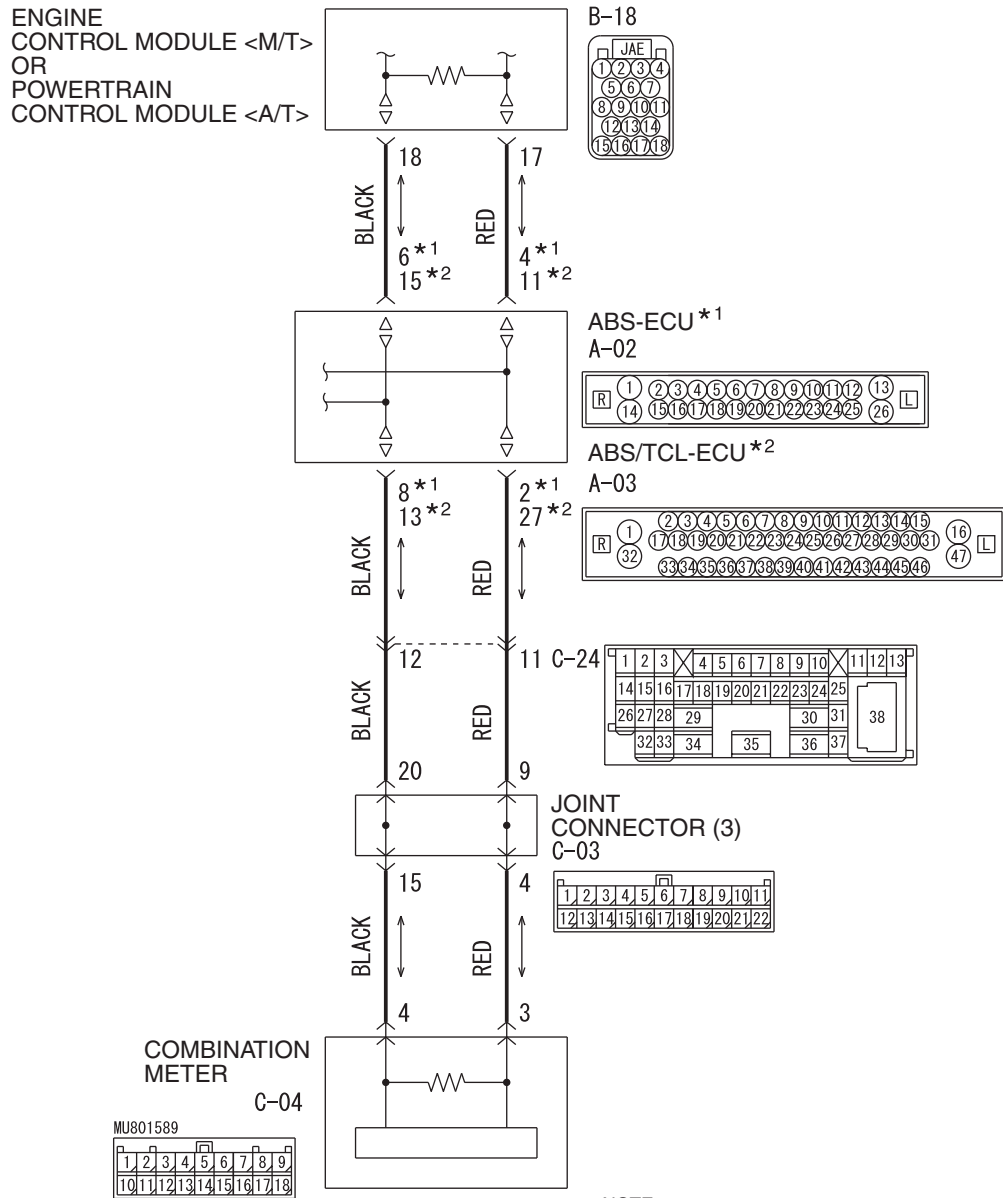
CAN offers the following advantages.

- Transmission rates are much faster than those in conventional communication (up to 1 Mbps), allowing much more data to be sent.
- It is exceptionally immune to noise, and the data obtained from each error detection device is more reliable.
- Each ECU connected via the CAN communicates independently, so if the ECU enters damaged mode, communications can be continued in some cases.



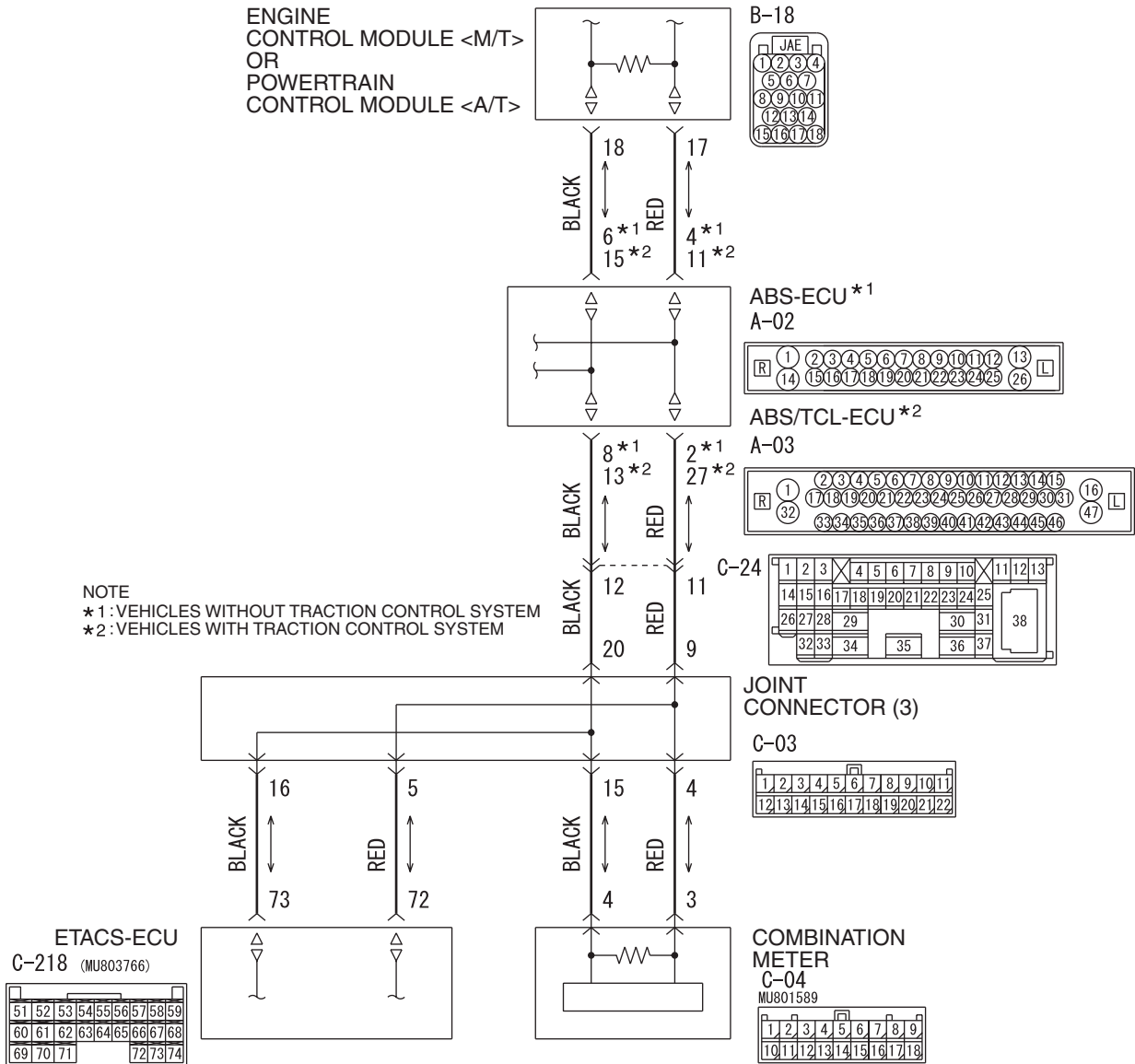
NOTE
 *1 : MANUAL AIR CONDITIONING SYSTEM
 *2 : AUTOMATIC AIR CONDITIONING SYSTEM
 *3 : VEHICLES WITHOUT TRACTION CONTROL SYSTEM
 *4 : VEHICLES WITH TRACTION CONTROL SYSTEM

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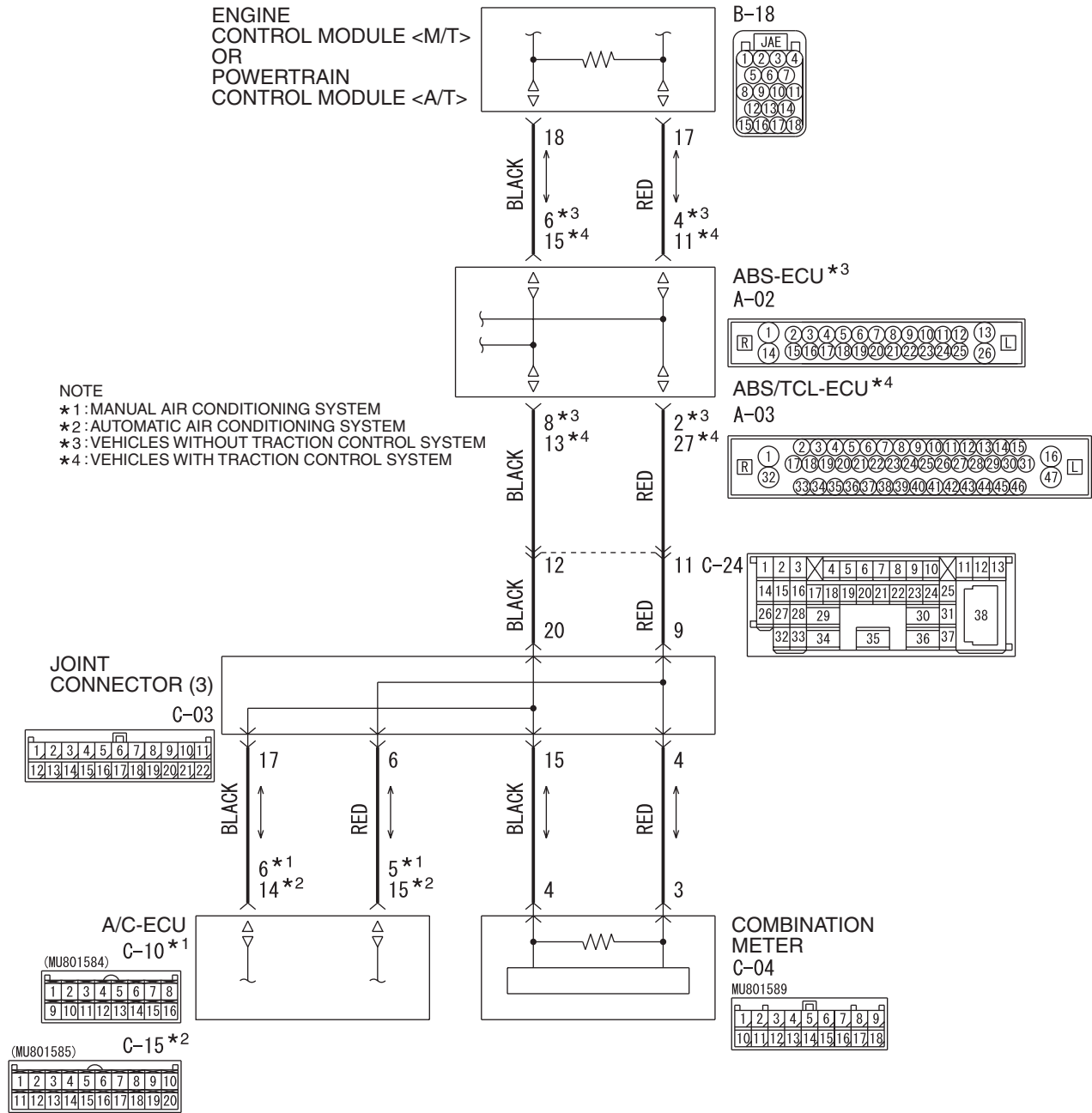


NOTE
*1 : VEHICLES WITHOUT TRACTION CONTROL SYSTEM
*2 : VEHICLES WITH TRACTION CONTROL SYSTEM

W6P54M001A



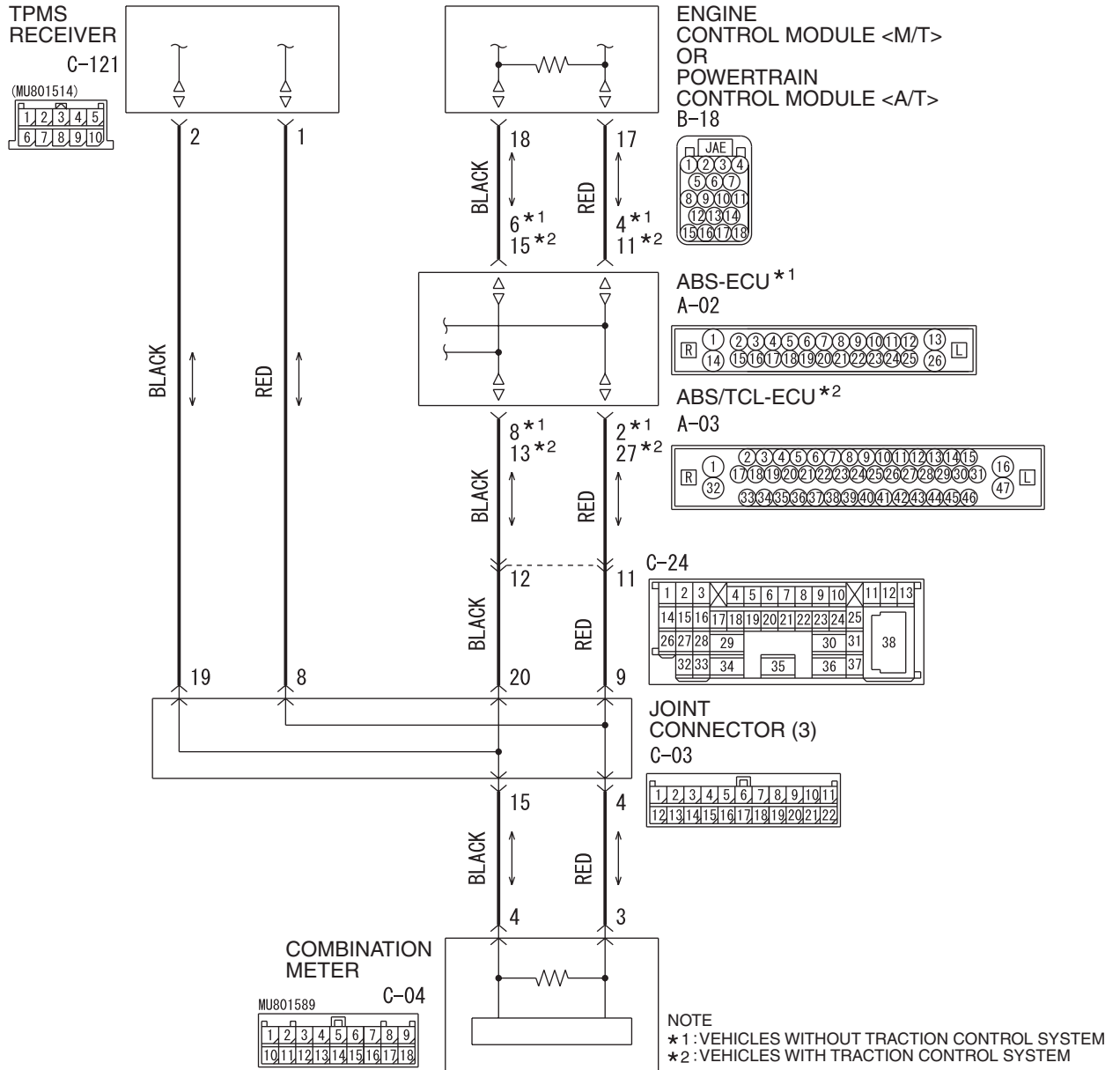
W6P54M002A



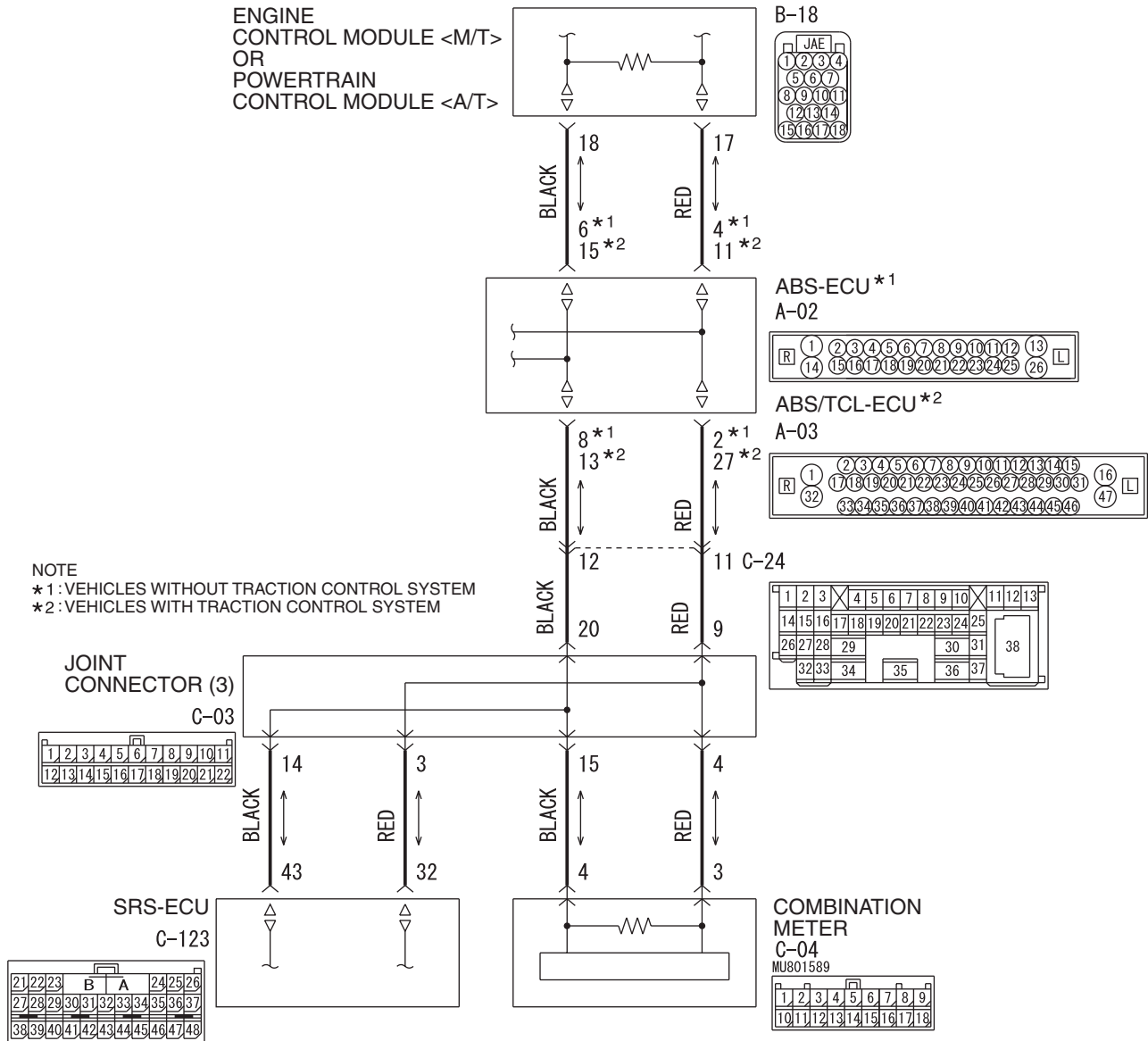
W6P54M003A

CONTROLLER AREA NETWORK (CAN) GENERAL DESCRIPTION

54C-7

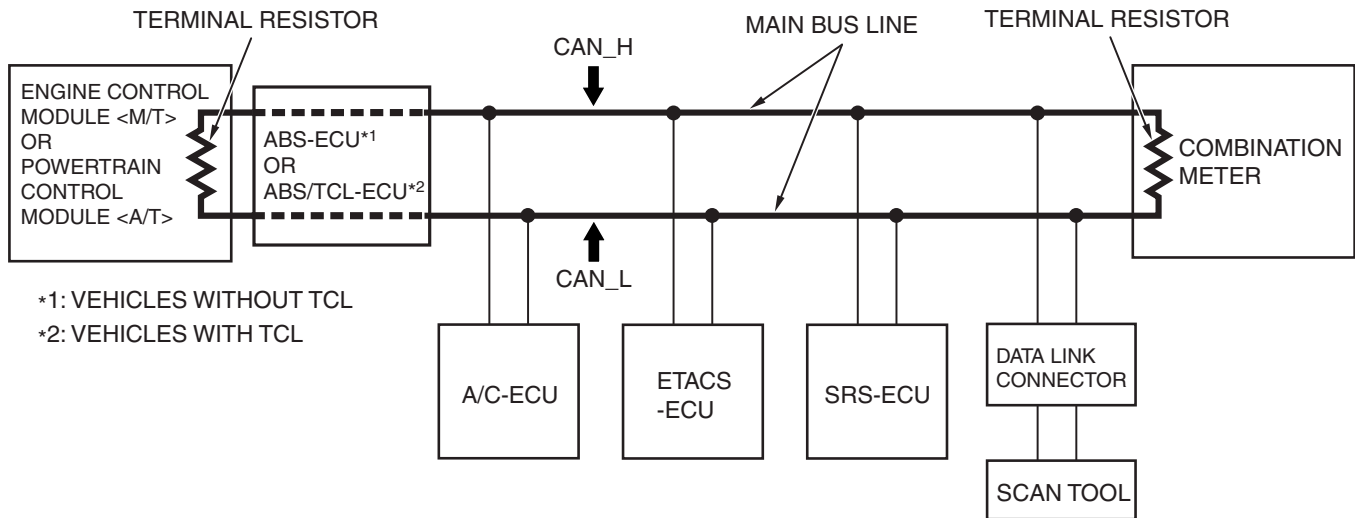


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STRUCTURE



*1: VEHICLES WITHOUT TCL
*2: VEHICLES WITH TCL

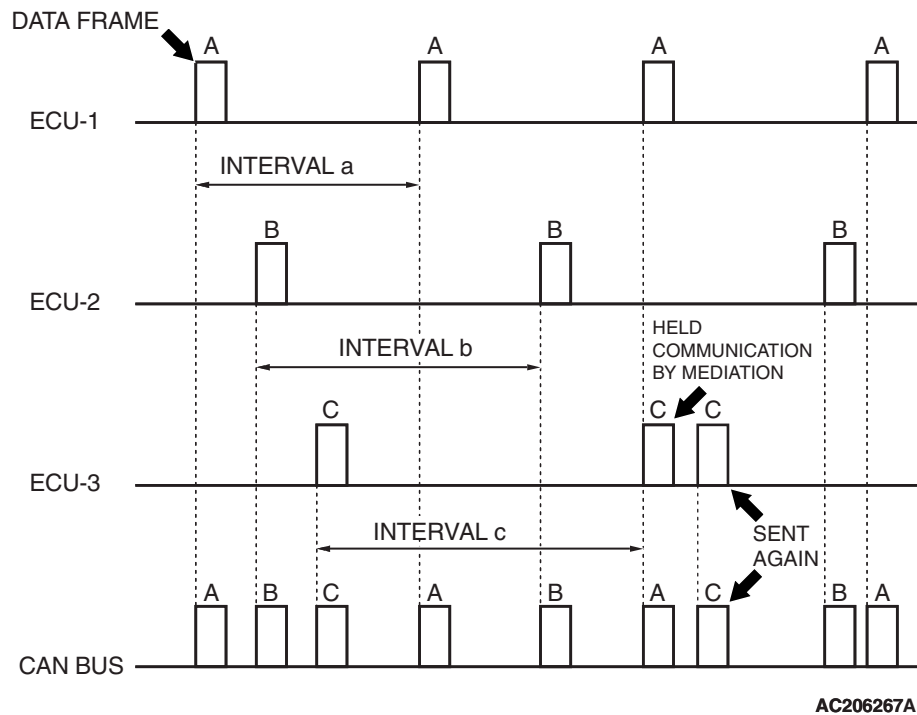
—: INDICATES MAIN BUS LINE
—: INDICATES SUB BUS LINE

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- The CAN bus line consists of two lines, CAN_L and CAN_H (CAN Low and CAN High, respectively), as well as two terminal resistors. (A twisted-pair cable, highly resistant to noise, is used for the communications line.)
- The CAN bus line connecting the two terminal resistors is the main bus line, and the CAN bus line connecting each ECU is the sub-bus line.
- The terminal resistors are installed in the engine control module (ECM) <M/T> or powertrain control module (PCM) <A/T> and connection meter to stabilize communication signals. (Each terminal resistance is set at approximately 120 ohms.)
- The ABS-ECU <vehicles without TCL> or ABS/TCL-ECU <vehicles with TCL> is branched internally, with one line connected to the ABS-ECU <vehicles without TCL> or ABS/TCL-ECU <vehicles with TCL> and the other connected to the ECM <M/T> or PCM <A/T>.
- Seven ECUs are connected in the Eclipse CAN bus line as follows.
 - ECM <M/T> or PCM <A/T>
 - ABS-ECU <vehicles without TCL> or ABS/TCL-ECU <vehicles with TCL>
 - A/C-ECU
 - ETACS-ECU
 - SRS-ECU
 - Combination meter

OPERATION

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The CAN communication system is described below.

- Data from each sensor is transmitted periodically as data frames over the CAN bus (periodically sent data). For further details, consult the Data Frame section on [P.54C-11](#).
- The multiple ECUs requiring data over the CAN bus simultaneously receive data.
- Transmission intervals from 10 to 1,000 msec can be set, depending on the necessity of the data sent.

NOTE: In the figure above, the data frame A is transmitted in "a" intervals, while the data frames B and C are transmitted at intervals "b" and "c," respectively.

- A single ECU transmits multiple data frames.
- In the case of data collision (if multiple ECUs transmit at roughly the same moment), mediation occurs so that multiple data frames are not transmitted simultaneously. For further details, consult the Mediation section on [P.54C-10](#).
- Transmission is performed on the basis of electric potential difference, not through voltage as in conventional systems. For further details, consult the section on CAN bus voltage transformation on [P.54C-10](#).
- Various kinds of error detection and recovery processing are performed to secure a greater level of reliability. For further details, consult the sections on error detection and system recovery on [P.54C-11](#).

- For further details on the main communication signals, consult the table on [P.54C-13](#).

MEDIATION

Because each ECU transmits data independently over the CAN bus, there are cases of data collision when multiple data frames that ECUs attempt to transmit simultaneously (if multiple ECUs transmit at roughly the same moment). When this happens, processing of the ECUs attempting transmission is prioritized as follows:

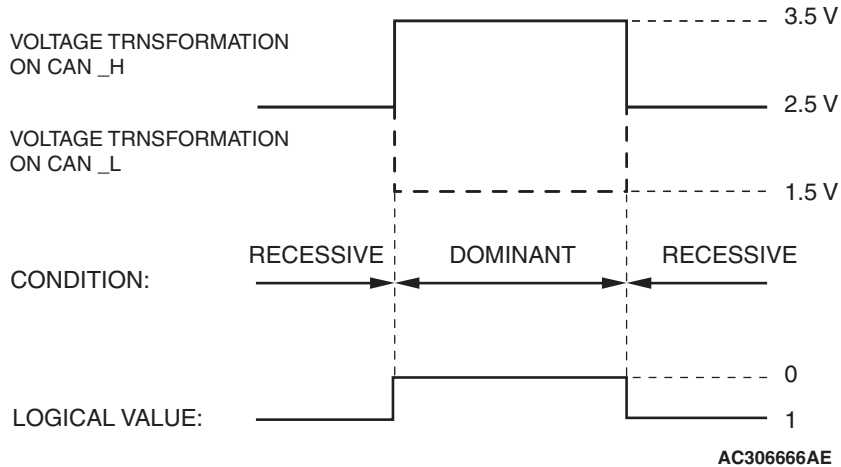
1. Data frames with high-priority ID codes are granted transmission priority.
2. Transmission of low-priority data is held at the issuing ECUs until the bus clears (when no transmission data exists on the CAN bus).

NOTE: In the holding state, new data (as the data frame content) will be sent after refreshing at fixed periods.

3. When the bus clears, the data frames are sent again.

NOTE: Because there is ample leeway on the CAN bus, there is no instance when data frames cannot be sent.

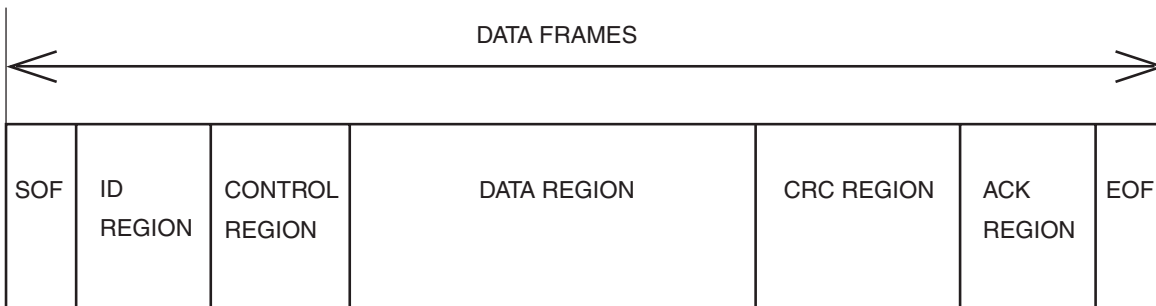
VOLTAGE TRANSFORMATION ON THE CAN BUS



Data frame transmission over the CAN bus line involves voltage transformation (for output signals) in the distinctive CAN profile shown in the figure below. The ECU transmitting over the CAN_H and CAN_L bus lines sends 2.5 – 3.5 V signals to the CAN_H side and 2.5 – 1.5 V signals to the CAN_L side. The receiving ECU reads the data from the CAN_H and CAN_L potential difference. Both CAN_H and CAN_L call 2.5 V states recessive. CAN_H calls 3.5

V states dominant while CAN_L calls 1.5 V states dominant. By transformation mainly to 2.5 V, even in cases when voltage is rendered 0 from faulty grounding or the like (causing a problem of an approximate 0.5 voltage increase on the communications line), communication is uninterrupted. By incorporating dual communication lines, reliability in the presence of noise is greatly improved.

DATA FRAMES



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SOF (Start of Frame)

- Indicates the start of the frame

ID (Identifier) region

- Specifies priority rank in case of mediation

Control region

- Specifies the frame type, data length, etc.

Data region

- Values used for data control, etc.

Cyclic Redundancy Check (CRC) region

- Region for checking for errors in error content. The transmitter ECU calculates the value between SOF and data region by applying prescribed operations and maintains the results. The receiving ECU detects erroneous communication by comparing the CRC region with the data region.

ACK (Acknowledge) region

- Region for signal reception confirmation

EOF (End of Frame)

- Indicates the end of the frame

ERROR DETECTION AND RECOVERY

The CAN protocol ensures communication reliability through the CRC that appears in data frames and through various error detection and recovery functions (designed for recovery by retransmission, etc.). If an error is detected but it is not resolved even after recovery, communication is stopped. This state is called "Bus Off."

SELF-DIAGNOSIS

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- CAN self-diagnosis is performed by each ECU connected to the CAN bus.
- Diagnostic trouble codes related to communication are named with the capital letter U, and are called "U-codes."
- A summary of the CAN self-diagnosis system is presented below. For further details on each diagnostic trouble code stored by the ECUs, consult the U-Code Diagnostic Trouble Code List on [P.54C-15](#).

TIME-OUT

Each ECU transmits data frames periodically. If the data frame is not received within the specified period, the intended receiving ECU transmits a diagnostic trouble code indicating communication time-out for the ECU that failed to transmit.

BUS OFF

Related to a communication error that persists even after the transmitting ECU attempts recovery for a specified number of attempts or that persists for a specified period after recovery. Communication is stopped and this diagnostic code is issued.

FAILURE DATA

When the transmitting ECU detects failure of a sensor directly connected to it, this is the pertinent data used to inform the ECU.

DATA LENGTH ERROR

When the number of data bytes received is different from the prescribed number of bytes, this diagnostic trouble code is issued.

DYNAMIC RANGE ERROR

When the data received exceeds or is less than the prescribed range, this diagnostic trouble code is issued.

CAN BUS DIAGNOSTICS

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Because each ECU is interconnected through the CAN bus (where the MUT-III is also connected), the CAN bus must be diagnosed during inspection. Simply by performing MUT-III screen operations, the following inspections can be performed automatically, and the result can be used to verify the CAN bus status.

- Voltage measurement between the CAN_L and CAN_H and the body grounding terminal
- Resistance measurement between the CAN_L and CAN_H
- Confirmation of communication of all ECUs

CAN COMMUNICATION SIGNAL TABLE

M2542000600217

SIGNAL	TRANSMITTER ECU	RECEIVER ECU					
		ECM <M/T> OR PCM <A/T>	ABS-ECU OR ABS/TCL-ECU	COMBINATION METER	A/C-ECU	ETACS-ECU	SRS-ECU
Engine speed signal	ECM <M/T> OR PCM <A/T>	—	•	•	•	•	—
A/C information signal		—	—	—	•	—	—
Vehicle speed signal		—	—	•	•	—	—
Vehicle stop signal		—	—	•	—	•	—
Malfunction indicator lamp request signal		—	—	•	—	—	—
Auto-cruise control indicator lamp signal		—	—	•	—	—	—
Engine coolant temperature signal		—	—	•	•	—	—
Selector position signal		—	•	•	—	•	—
ABS warning light request signal	ABS-ECU OR ABS/TCL-ECU	—	—	•	—	—	—
SRS warning light request signal	SRS-ECU	—	—	•	—	—	—
Communication continuation request signal	Combination meter	—	—	—	—	•	—
Vehicle speed signal		—	—	—	—	•	•
Ignition switch (IG1) signal		—	—	—	—	•	—
Seat belt signal		—	—	—	—	•	—
Fuel information signal		•	—	—	—	—	—
Brake lamp signal		—	•	—	—	—	—
Communication continuation request signal	A/C-ECU	—	—	—	—	•	—

SIGNAL	TRANSMITTER ECU	RECEIVER ECU					
		ECM <M/T> OR PCM <A/T>	ABS-ECU OR ABS/ TCL-ECU	COMBINATION METER	A/C-ECU	ETACS- ECU	SRS-ECU
Communication standby signal	ETACS-ECU	–	–	•	–	–	–
Ignition switch (ACC) signal		–	–	•	•	–	–
Ignition switch (IG1) signal		–	–	•	–	–	–
High-beam indicator request signal		–	–	•	–	–	–
Turn-signal indicator request signal		–	–	•	–	–	–
Fog light indicator request signal		–	–	•	–	–	–
Illumination signal		–	–	•	–	–	–
Door "open" signals		–	–	•	–	–	–
Interior light shut-off signal		–	–	•	–	–	–

NOTE: "•" indicates the applicable points.

CAN COMMUNICATION-RELATED DTC CODE (U CODE) TABLE

M2542000700195

CODE NO.	DIAGNOSTIC ITEM	OUTPUT ECU	ACTION	
U1073	Bus Off	ECM <M/T> or PCM <A/T>, SRS-ECU, ABS-ECU <vehicles without traction control system>, ABS/TCL-ECU <vehicles with traction control system>, Combination meter, ETACS-ECU, A/C-ECU	CAN main bus line diagnostics	
U1100	ECM <M/T> or PCM <A/T> time-out (related to engine)	ABS/TCL-ECU <vehicles with traction control system>, Combination meter, ETACS-ECU, A/C-ECU		
U1101	ECM <M/T> or PCM <A/T> time-out (related to automatic transaxle)	ABS/TCL-ECU <vehicles with traction control system>, Combination meter, ETACS-ECU		
U1102	ABS-ECU time-out	ECM <M/T> or PCM <A/T>, Combination meter		
U1108	Combination meter time-out	ECM <M/T> or PCM <A/T>, ETACS-ECU		
U1109	ETACS-ECU time-out	ECM <M/T> or PCM <A/T>, Combination meter		
U1110	A/C-ECU time-out	ECM <M/T> or PCM <A/T>, ETACS-ECU		
U1111*	Multi-center display unit (middle-grade type) time-out	ETACS-ECU, A/C-ECU		
U1112	SRS-ECU time-out	Combination meter		
U1114*	TPMS-ECU time-out			
U1117	Immobilizer-ECU time-out	ECM <M/T> or PCM <A/T>		
U1120	Failure information on ECM <M/T> or PCM <A/T> (related to engine)	ABS/TCL-ECU <vehicles with traction control system>, Combination meter, A/C-ECU		Diagnose CAN main bus lines and confirm input signals.
U1128	Failure information on combination meter	ETACS-ECU		
U1434*	Failure information on TPMS-ECU	Combination meter		

NOTE: *: This diagnostic trouble code will be set even if the system is normal.

NOTES