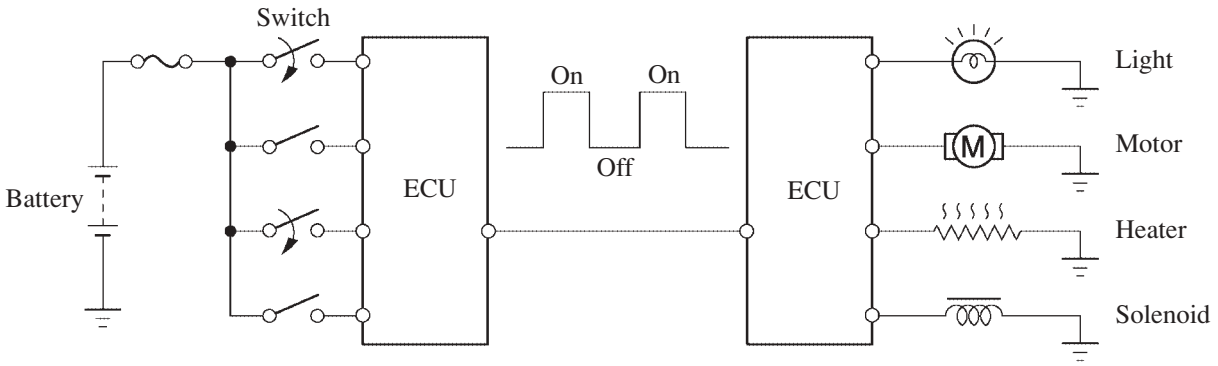
■ BASIC OF MULTIPLEX COMMUNICATION SYSTEM

1. General

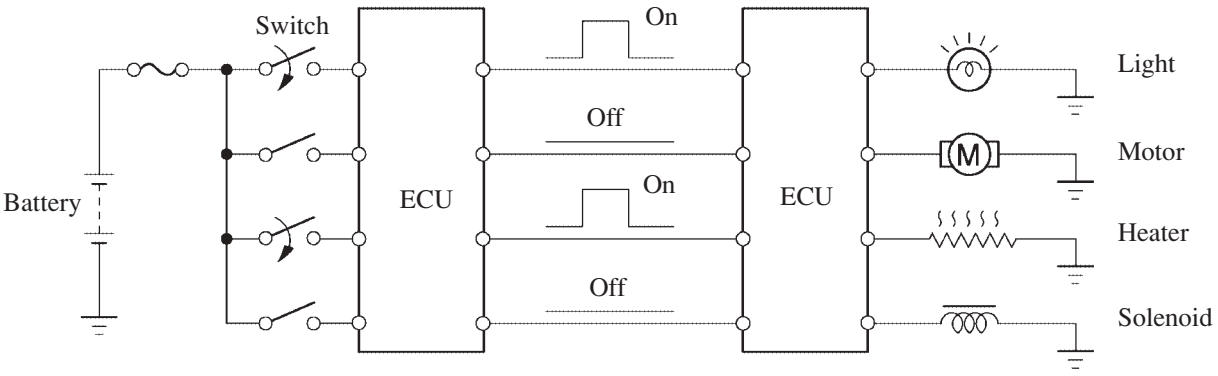
In the conventional system, parallel communication is used to exchange information between ECUs. To transmit four pieces of information, for example, parallel communication requires four communication wires. In contrast, multiplex communication is used on serial communication, which converts multiple pieces of information into serial communication data. Thus, they can be transmitted through a single communication wire.

▶ Conceptual Drawing ◀



Serial Communication

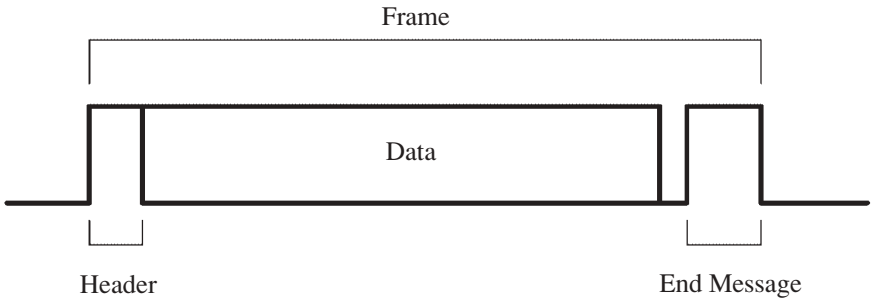
240BE03



Parallel Communication

240BE04

- Serial communication data consists of bits and frames. A bit is the basic unit that represents the amount of information. A bit is represented by binary values "0" or "1". A frame is a body of data that is transmitted together. A frame contains a header that indicates the beginning, and an end message that indicates the end.



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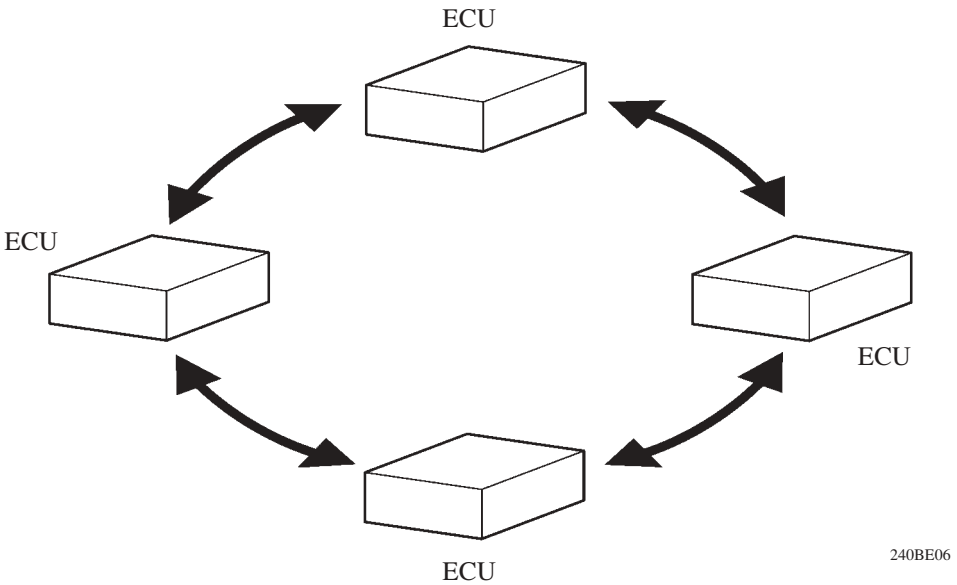
2. Network Style

General

Based on serial communication, various ECUs are connected on a network to exchange various pieces of information. Such a system is called "Multiplex Communication". There are three styles of networks: ring, star, and bus.

Ring Style

In this style of network, the ECUs are connected in a ring form. A feature of this style is that a signal that is output by a transmitting ECU circles the ring and returns to its original ECU.

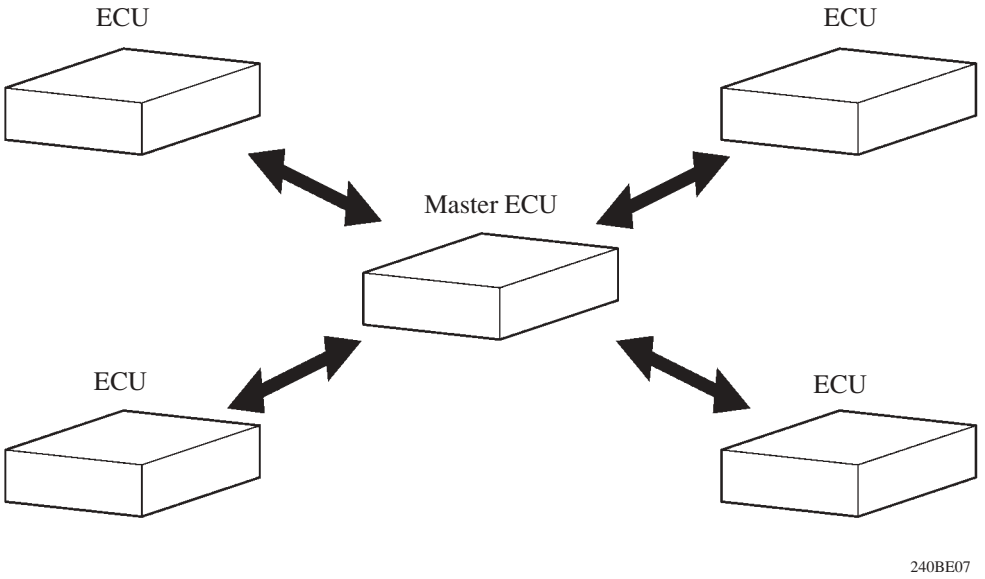


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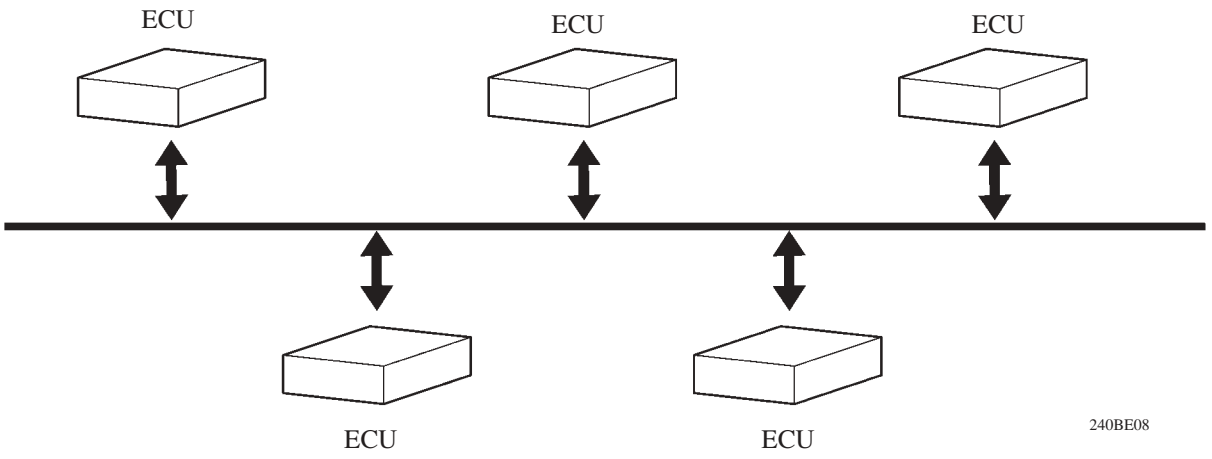
Star Style

This style is centered on a master ECU, which holds a central control function. The ECUs are connected in a star shape. The ECUs cannot establish communication with other ECUs without passing through the master ECU.



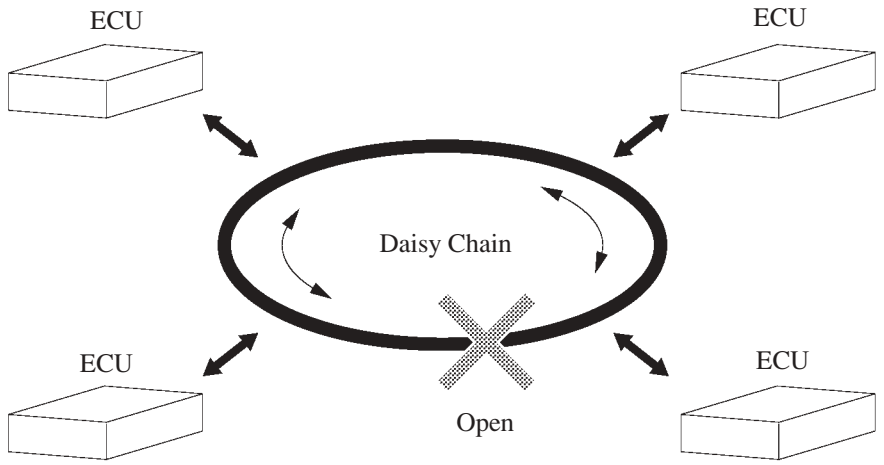
Bus Style

In this style of network, all ECUs are connected to a single common communication wire. The transmitting ECUs output signals through a common communication wire and the receiving ECUs input data through a common communication wire.



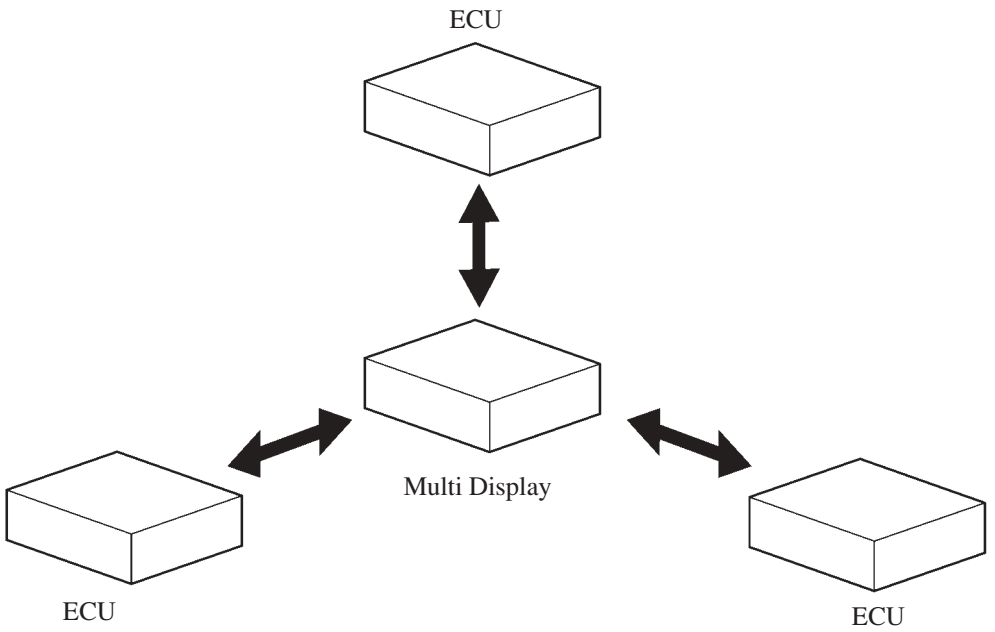
—REFERENCE—

- *The BEAN on the new Kluger uses the ring and bus styles of networks to connect ECUs. This style of connection method is called a "Daisy Chain". In a daisy chain, communication can be maintained even if there is an area that has an open circuit.*



241BE06

- *The AVC-LAN in the model with multi display uses a star style, which is centered on the multi display.*



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3. Difference of CAN, BEAN and AVC-LAN

- The protocols, which are the rules for establishing data communication, differ between the CAN, BEAN and the AVC-LAN. If ECUs use different types of data such as communication speed, communication wire, and signals, they will be unable to understand each other. Therefore, protocols (rules) must be established among them.

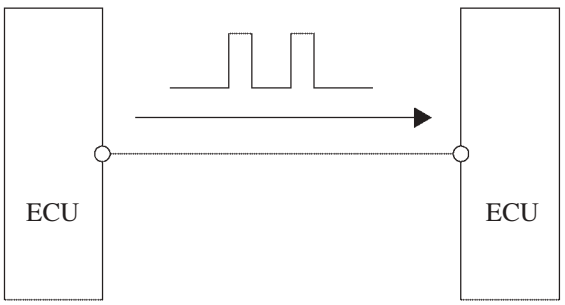
Control	Chassis Electrical System Control	Body Electrical System Control	
Protocol	CAN (ISO Standard)	BEAN (TOYOTA Original)	AVC-LAN (TOYOTA Original)
Communication Speed	500 k bps* (Max. 1 M bps)	Max. 10 k bps*	Max. 17.8 k bps*
Communication Wire	Twisted-pair Wire	AV Single Wire	Twisted-pair Wire
Drive Type	Differential Voltage Drive	Single Wire Voltage Drive	Differential Voltage Drive
Data Length	1-8 Byte (Variable)	1-11 Byte (Variable)	0-32 Byte (Variable)

*: bps: abbreviation for "Bits Per Second", indicating the number of bits that can be transmitted per second.

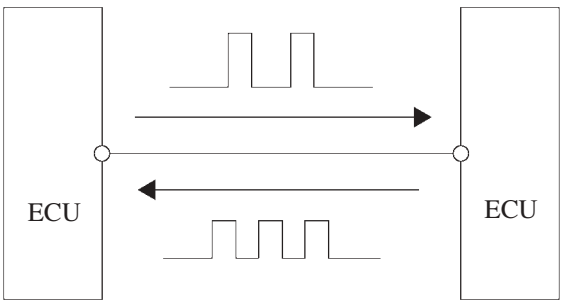
- Although BEAN and AVC-LAN have almost the same communication speed, the CAN communication speed is much faster than BEAN and AVC-LAN. When the chassis control system uses BEAN and AVC-LAN with a slower communication speed than CAN, the slower communication speed means that system control could possibly be delayed. For this reason, the chassis control system uses CAN, which has a fast communication speed and can send and receive a large quantity of data at one time.
- The communication between the control signals related to the audio and visual systems and the gateway ECU is established via the AVC-LAN. The transmission of the signals exchanged between BEAN and AVC-LAN is carried out by the gateway function of the gateway ECU.

—REFERENCE—

There are two types of BEAN communication methods: the one-way type and the two-way type. The new Kluger uses the two-way type, which is currently in the main stream.



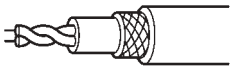
One-way Type 240BE13



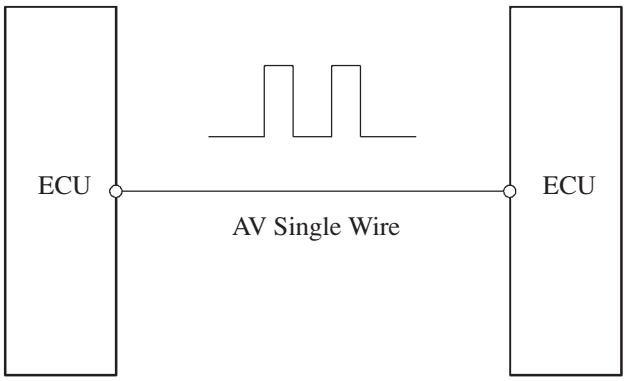
Two-way Type 240BE14

4. Communication Wire

BEAN uses a single, AV (Automobile Vinyl) wire for communication. CAN and AVC-LAN use twist pair wires for communication.

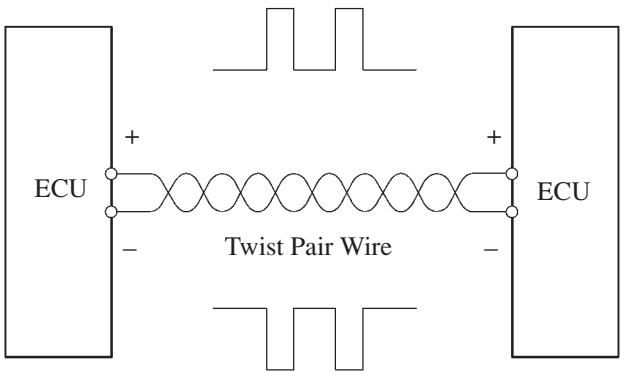
Communication Wire	Outline
AV Single Wire  240BE09	Because this communication wire consists of a single wire that is covered with an insulator, it is lightweight. To drive communication, the system applies voltage to the wire, a method known as signal-wire voltage drive.
Twist Pair Wire for AVC-LAN  240BE10	This communication line consists of two wires that are covered with insulators and twisted together. Two wires are used for transmitting a single signal. Voltages of positive (+) and negative (-) for AVC-LAN or voltages of CAN High and CAN Low for CAN are applied to the respective wires to drive the communication, a method known as differential voltage drive. This method helps reduce noise.
Twist Pair Wire for CAN  241BE168	

▶ Single Wire Voltage Drive ◀



240BE11

▶ Differential Voltage Drive ◀



240BE12

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