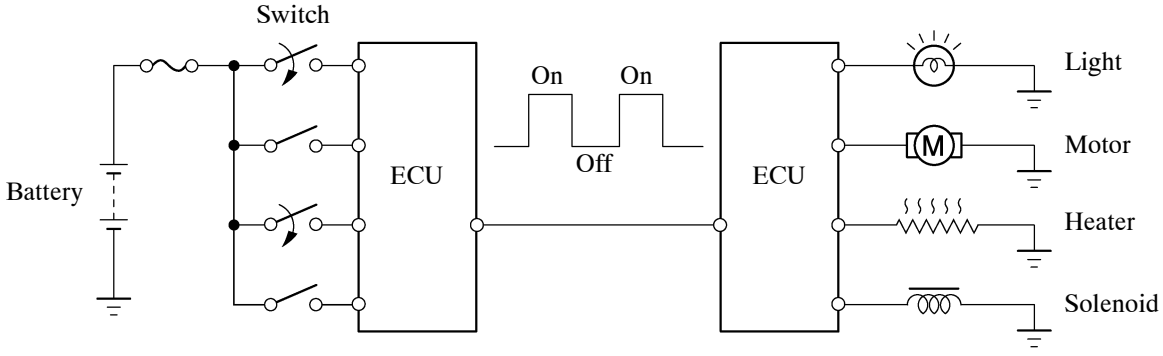
■ BASICS OF MULTIPLEX COMMUNICATION

1. General

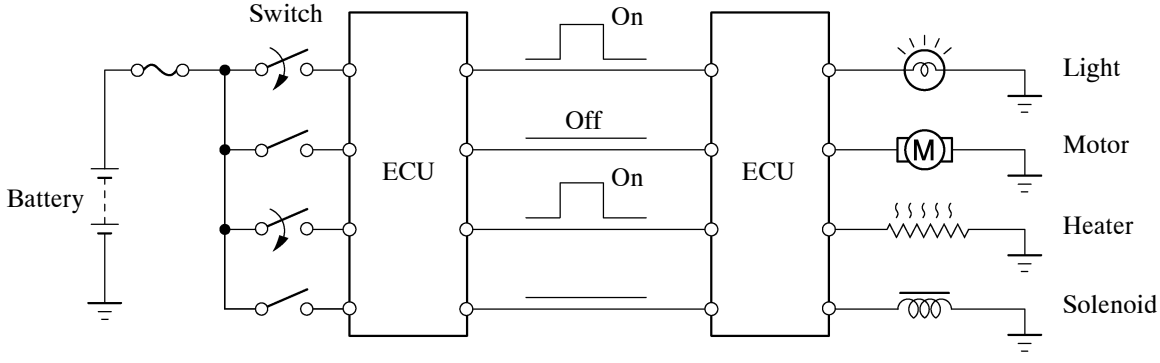
In a conventional system, parallel communication is used on exchange information between ECUs. To transmit four pieces of information, parallel communication requires four communication wires. In contrast, multiplex communication uses serial communication, which converts multiple pieces of information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

▶ Conceptual Drawing ◀



Serial Communication

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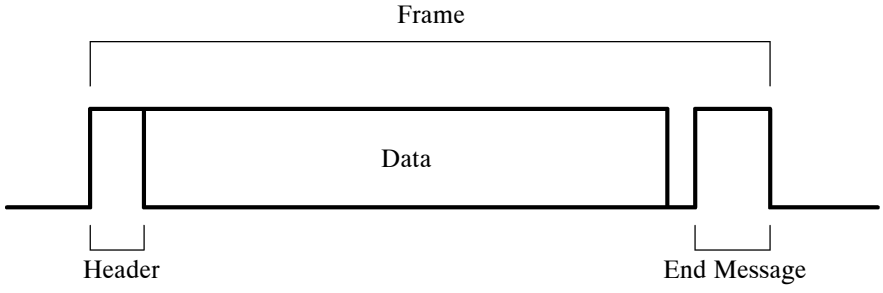


Parallel Communication

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2. Frame

Serial communication data consists of bits and frames. A bit is the basic unit that represents the smallest 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.

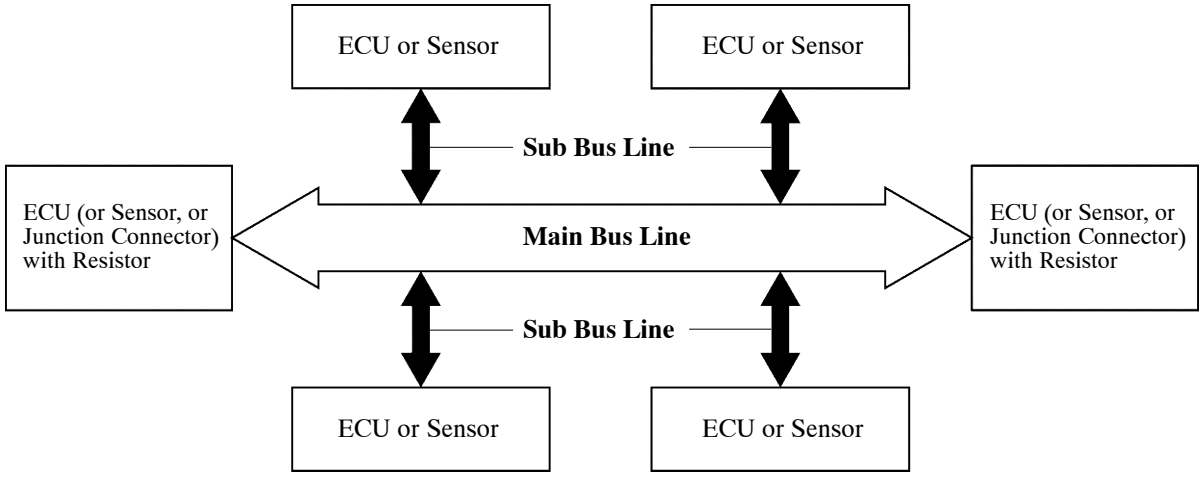


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3. Network Style

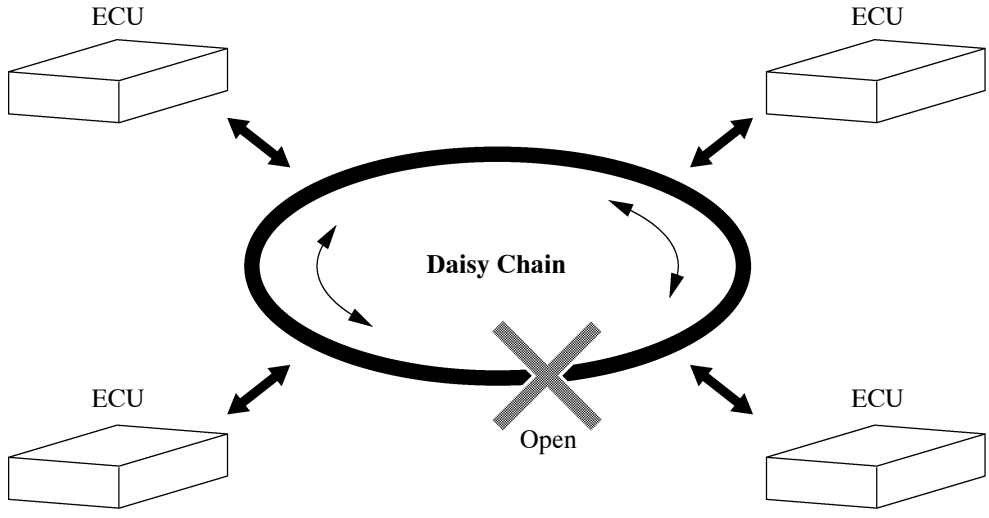
- A multi-star style CAN communication network is used. This style of network consists of a main bus line that has either ECUs, sensors or junction connectors that contain terminating resistors, and sub bus line(s) that are connected to the main bus lines. These sub bus lines have ECUs and or sensors connected to them. This style of network allows communication among all the ECUs connected to the network.

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- BEAN uses a ring and bus style of network to connect the ECUs. This type 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.



4. Difference Between CAN and BEAN

The protocols, which are the rules for establishing data communication, differ between CAN and BEAN. 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.

Protocol	CAN	BEAN
Communication Speed	500 k bps* (Max. 1 M bps)	Max. 10 k bps*
Communication Wire	Twisted-pair Wire	AV Single Wire
Drive Type	Differential Voltage Drive	Single Wire Voltage Drive
Data Length	1-8 Byte (Variable)	1-11 Byte (Variable)

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

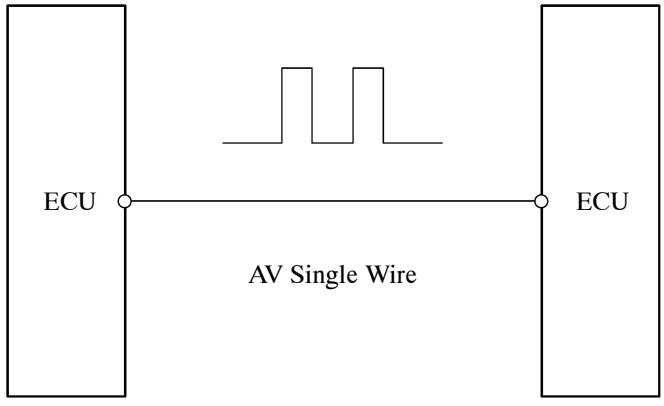
- CAN communication speed is much faster than BEAN.
- If the chassis control system used BEAN (which have a slower communication speed) instead of CAN, the slower communication speed would mean that system control could be delayed.
- For this reason, the chassis control system uses CAN, which has a fast communication speed and can send and receive a large quantity of data in a short amount of time.

5. Communication Wire

A single, AV (Automobile Vinyl) wire is used for BEAN communication. A twisted-pair wire is used for CAN communication.

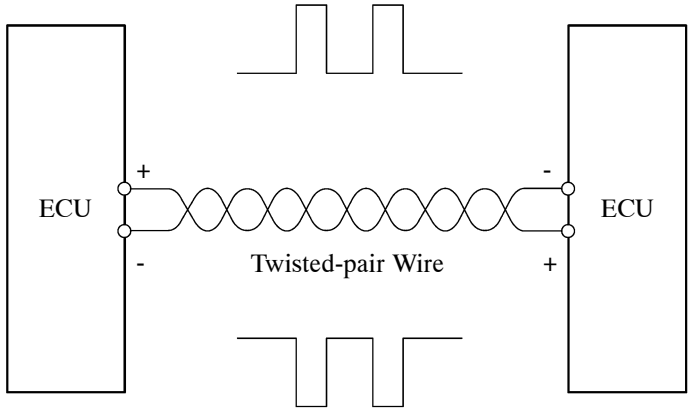
Communication Wire	Outline
AV Single Wire 240BE09	This is a lightweight single communication wire that consists of a single core line surrounded by insulation. Voltage is applied to this line in order to drive communication, and this system is called a “Single Wire Voltage Drive”.
Twisted-pair Wire for CAN  241BE168	In this communication wire, a pair of lines are twisted together and covered with insulation. Communication is driven by applying positive (+) and negative (-) voltage to the two lines in order to send a single signal. This system, which is called a “Differential Voltage Drive”, can reduce noise.

▶ Single Wire Voltage Drive ◀



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▶ Differential Voltage Drive ◀



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