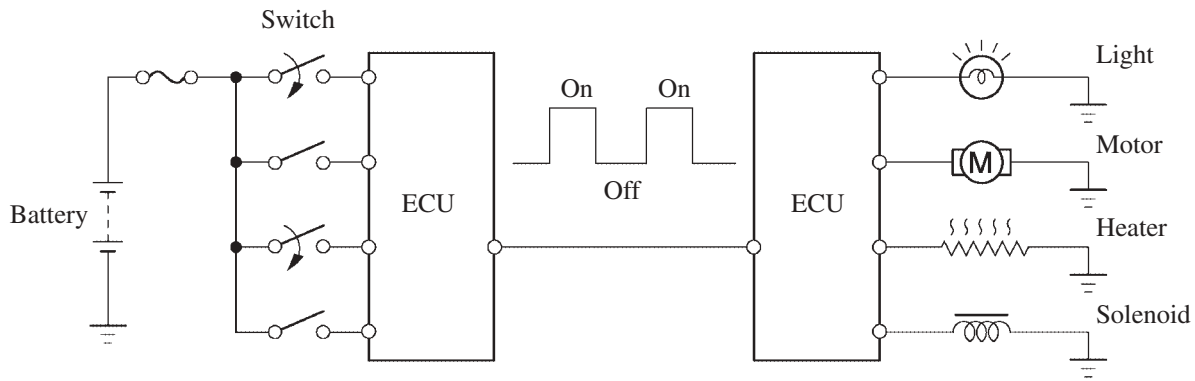


3. Basic of MPX

General

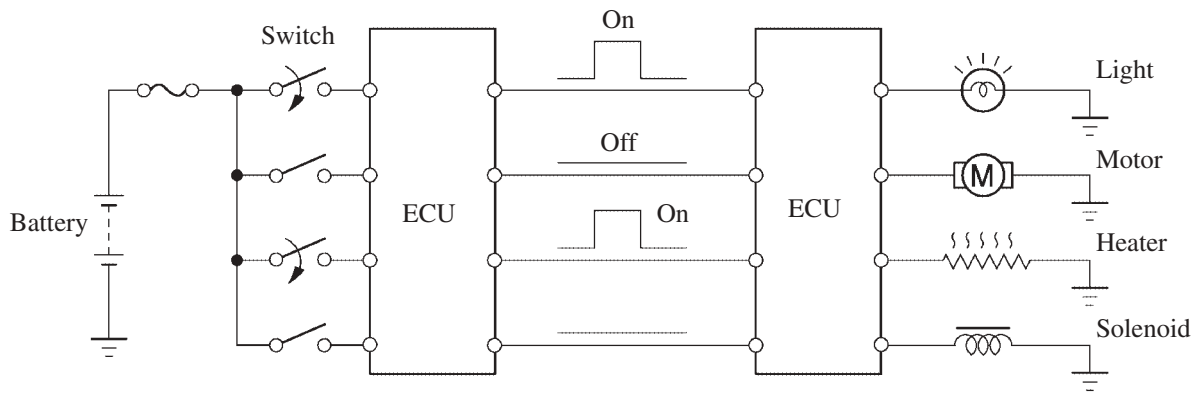
In the without multiplex communication system, parallel communication is used to exchange information between ECUs. To transmit four pieces of information, for example, parallel communication requires four communication wires. In contrast, multiplex communication is used on serial communication, which converts multiple pieces of information into serial communication data. Thus, they can be transmitted through a single communication wire.

► Conceptual Drawing ◀



240BE03

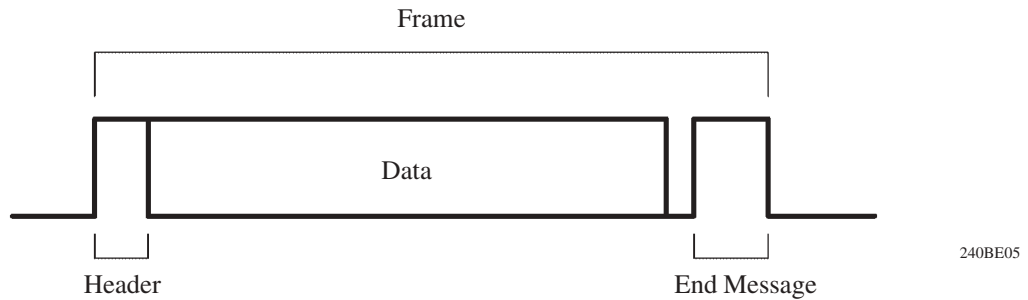
Serial Communication



240BE04

Parallel Communication

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.



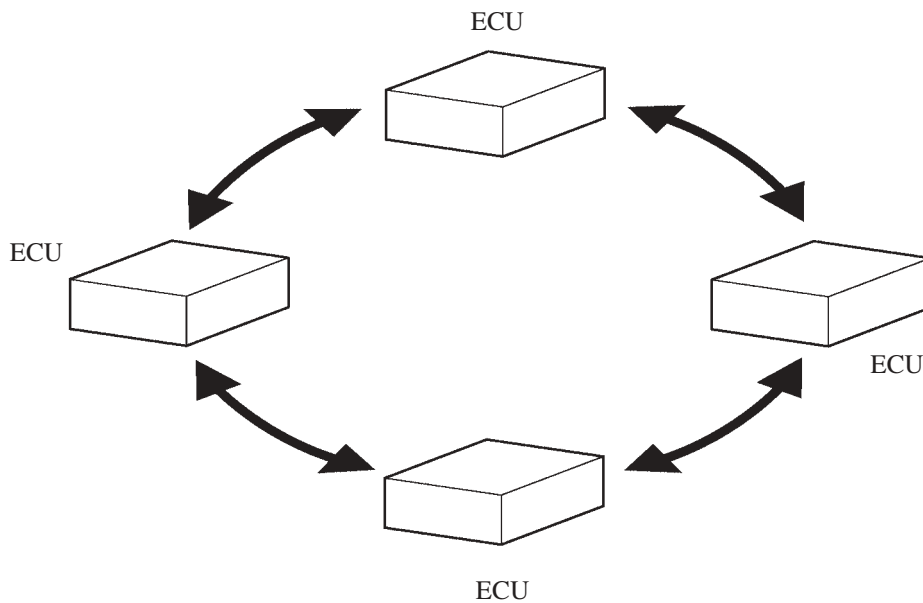
Network Style

1) 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.

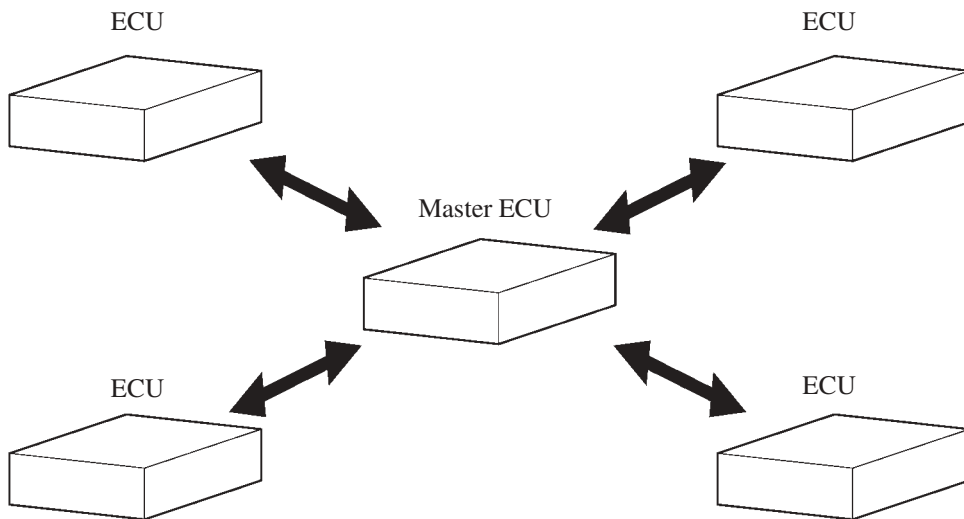
2) Ring Style

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



3) Star Style

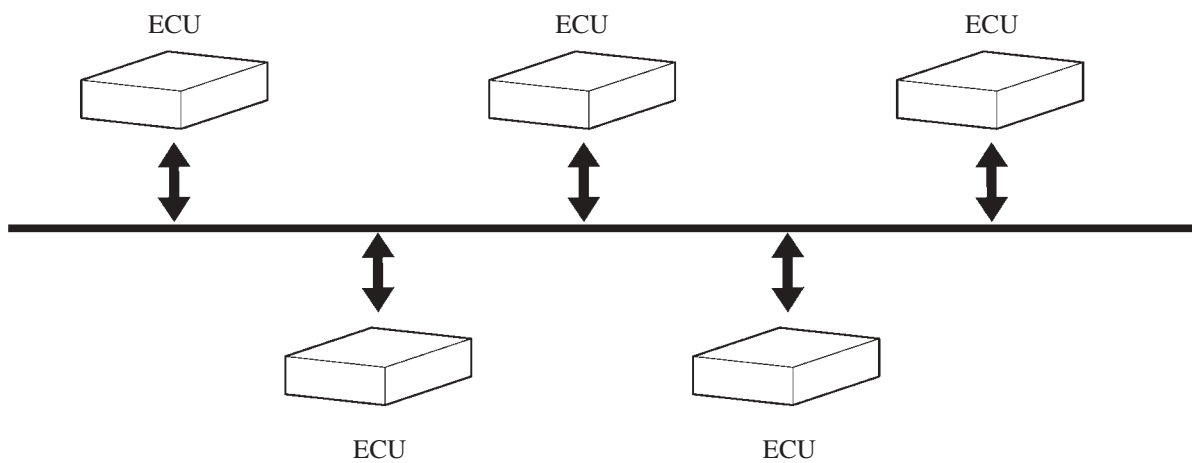
This style is centered on a master ECU, which holds a central control function. The ECUs are connected in a star shape. The ECUs cannot establish communication with other ECUs without passing through the master ECU.



240BE07

4) Bus Style

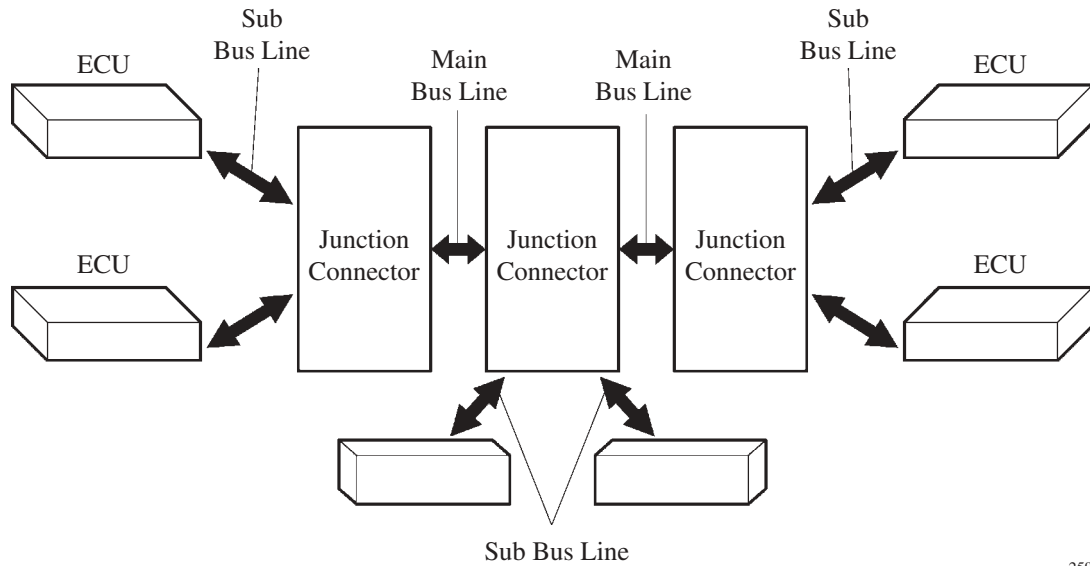
In this style of network, all ECUs are connected to a single common communication wire. The transmitting ECUs output signals through a common communication wire and the receiving ECUs input data through a common communication wire.



240BE08

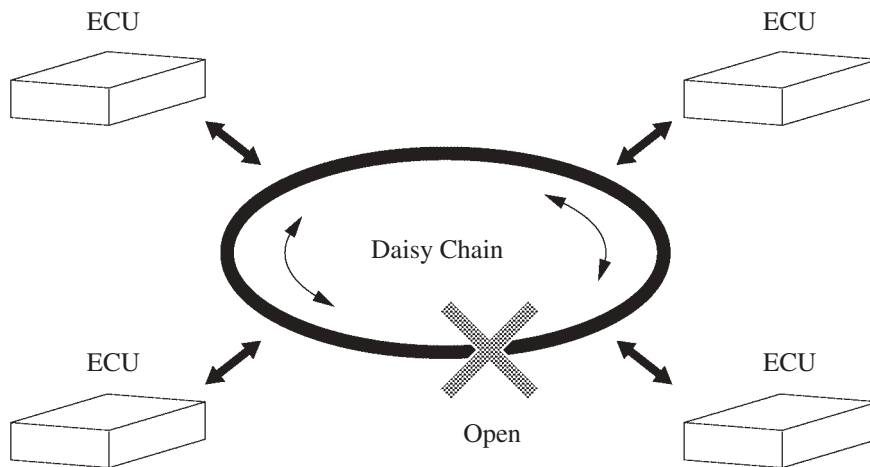
— REFERENCE —

- The CAN uses the multi star style bus connection. The three junction connectors are connected with a main bus line. The junction connector extend sub bus line, and enables communication between all the connected ECUs.



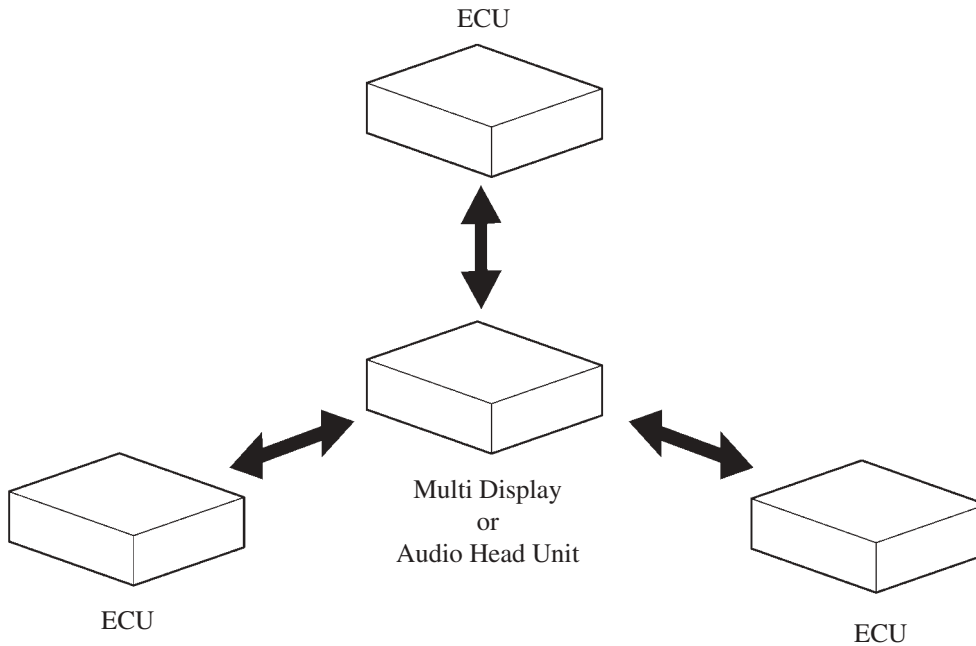
259L.SI29

- The BEAN 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 uses a star style, which is centered on the multi display or audio head unit.



240BE77

Difference of CAN, BEAN and AVC-LAN

1) General


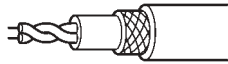

The protocols, which are the rules for establishing data communication, differ between the CAN, BEAN and the AVC-LAN. If ECUs use different types of data such as communication speed, communication wire, and signals, they will be unable to understand each other. Therefore, protocols (rules) must be established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

Control	Driving Control System		Body Electrical Control System	
Protocol	CAN (ISO Standard)		BEAN (TOYOTA Original)	AVC-LAN (TOYOTA Original)
Communication Speed	500 k bps* (Max. 1M 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)

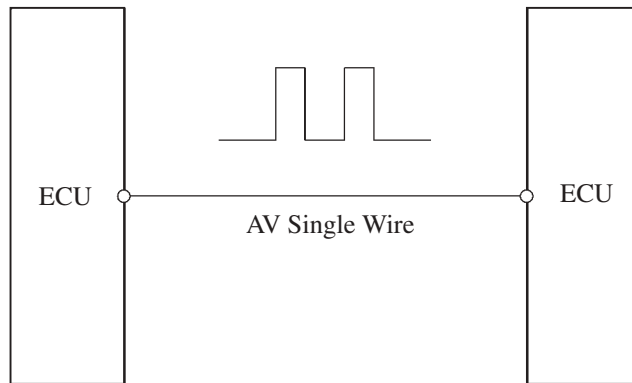
*: bps: abbreviation for “Bits Per Second”, indicating the number of bits that can be transmitted per second.

2) Communication Wire

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

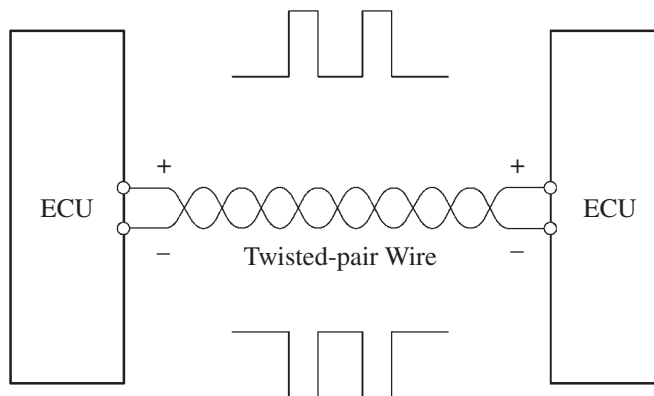
Communication Wire	Outline
<p>AV Single Wire</p>  <p>240BE09</p>	<p>This is a lightweight single communication wire that consists of a single core line surrounded by insulation. Voltage is applied to this line in order to drive communication, and this system is called a “Single Wire Voltage Drive”.</p>
<p>Twisted-pair Wire for AVC-LAN</p>  <p>240BE10</p>	<p>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.</p>
<p>Twisted-pair Wire for CAN</p>  <p>241BE168</p>	

► Single Wire Voltage Drive ◀



240BE11

► Differential Voltage Drive ◀



240BE12