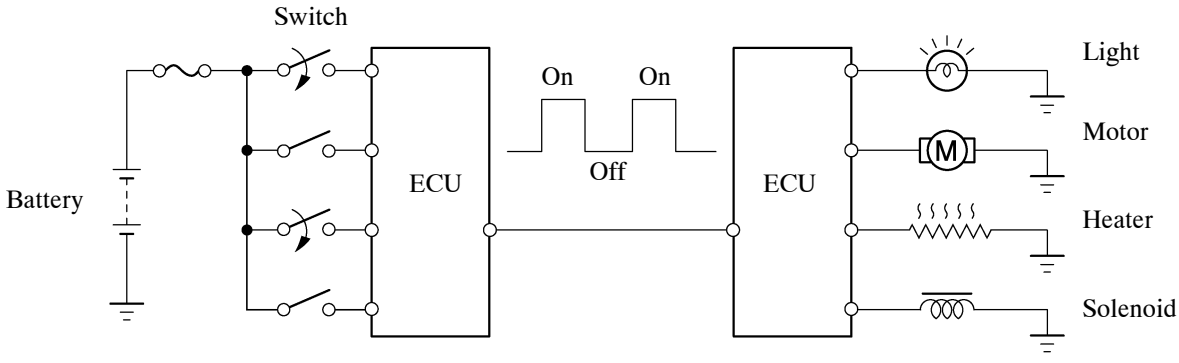
■ BASIC OF MPX

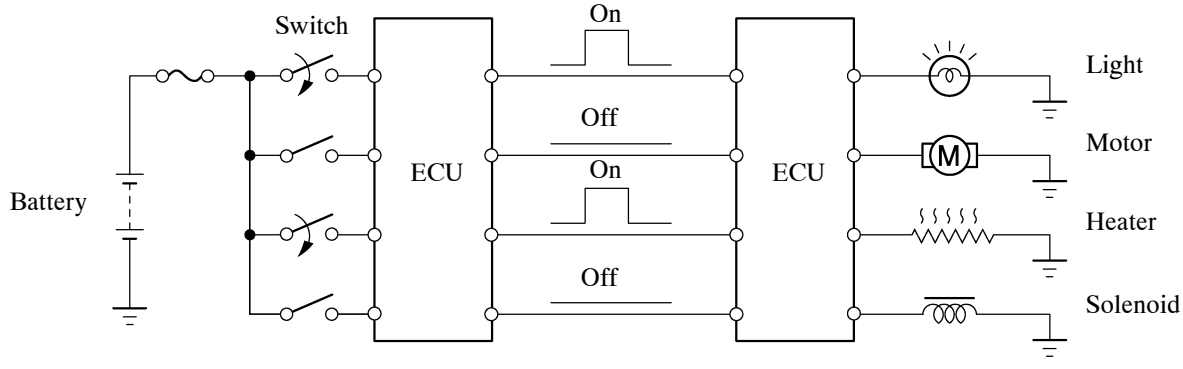
1. General

- 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 ◀

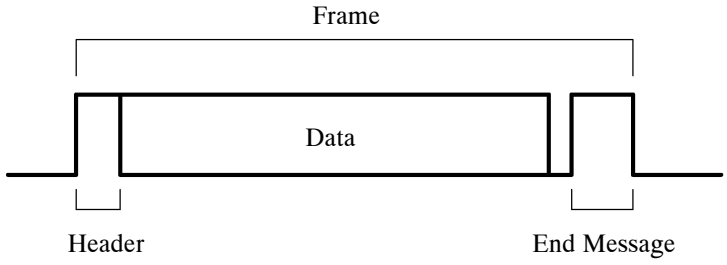


Serial Communication 240BE03



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.



240BE05

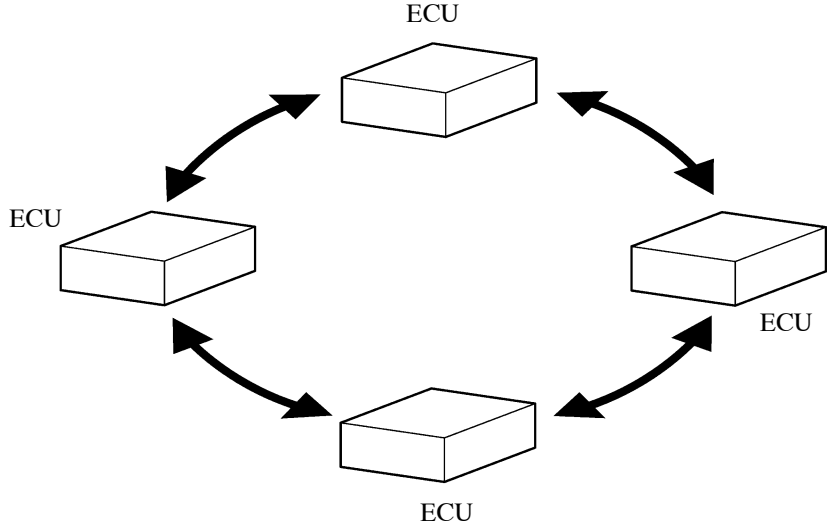
2. Network Style

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

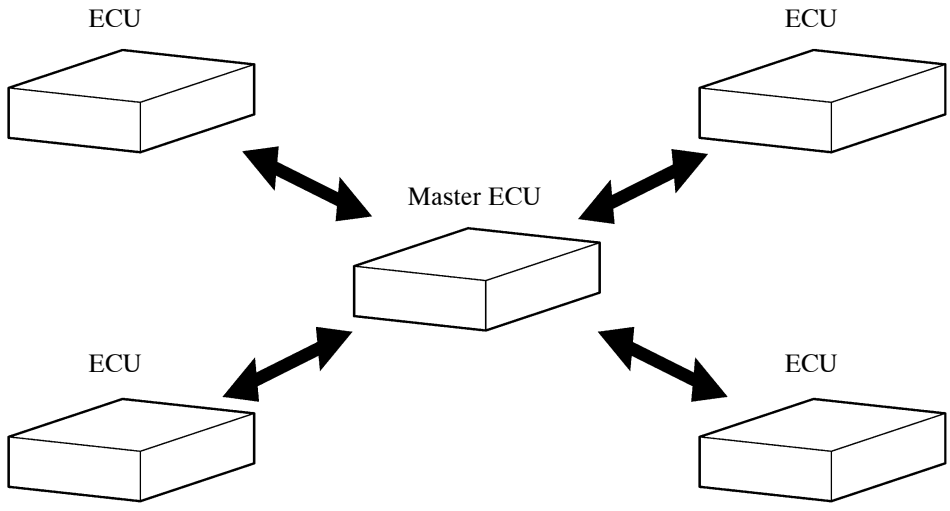
In this style of network, the ECUs are connected in a ring form. A feature of this style is that a signal that is output by a transmitting ECU circles the ring and returns to its original ECU.



240BE06

Star Style

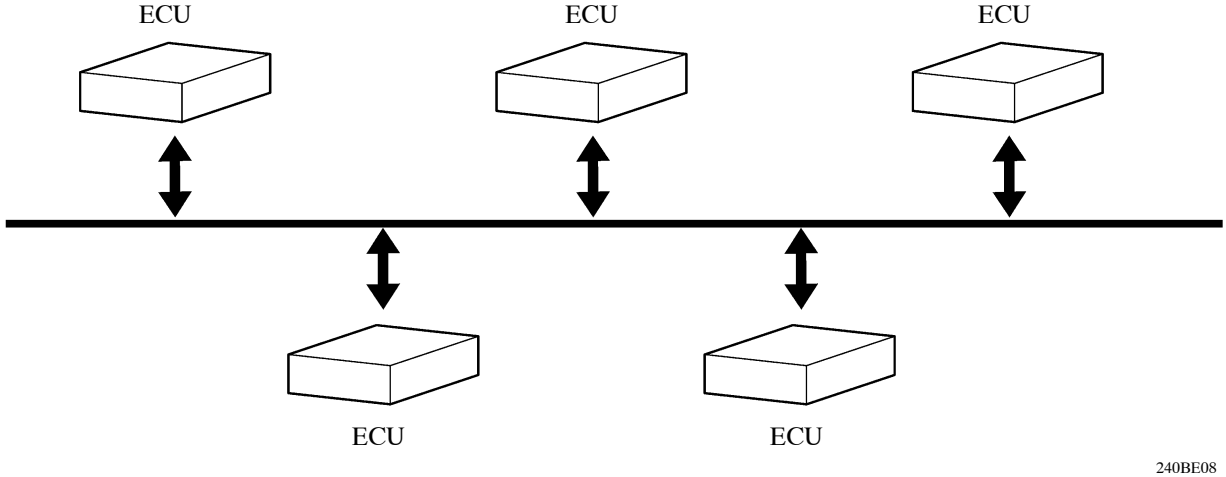
This style is centered on a master ECU, which holds a central control function. The ECUs are connected in a star shape. The ECUs cannot establish communication with other ECUs without passing through the master ECU.



240BE07

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.

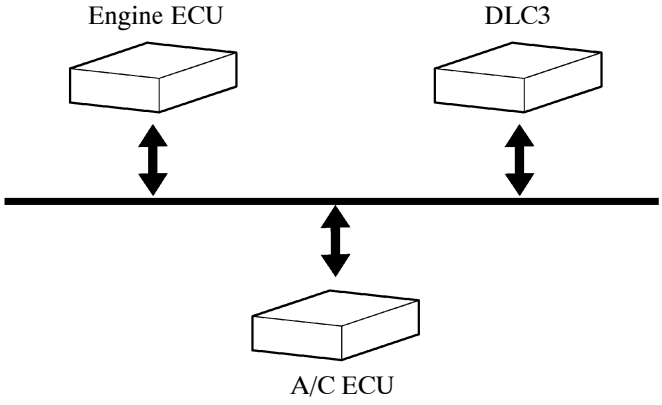


240BE08

— REFERENCE —

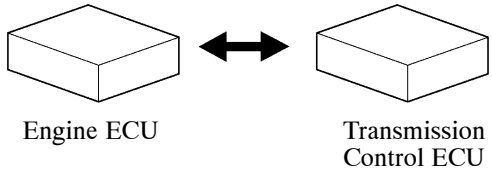
The vehicle-bus CAN system on the new model uses the bus style bus connection. The ECUs are connected to a single common communication wire.

In the power train-bus CAN system, there is one-to-one communication between the engine ECU and the transmission control ECU. This is the minimum arrangement bus style connection.



Vehicle-bus CAN System

286BE41



Power Train-bus CAN System

263BE152

BE

3. Differences of CAN and Other Communication Systems

- Currently, Toyota vehicles use three types of multiplex communication systems: the CAN (Controller Area Network), BEAN (Body Electronics Area Network), and AVC-LAN (Audio Visual Communication-Local Area Network).
- 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.

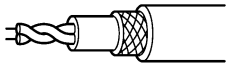
Control	Vehicle Electrical System Control	Body Electrical System Control	
Protocol	CAN (ISO Standard)	BEAN (TOYOTA Original)	AVC-LAN (TOYOTA Original)
Communication Speed	500 k bps* (Max. 1 M bps)	Max. 10 k bps*	Max. 17.8 k bps*
Communication Wire	Twisted-pair Wire	AV Single Wire	Twisted-pair Wire
Drive 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.

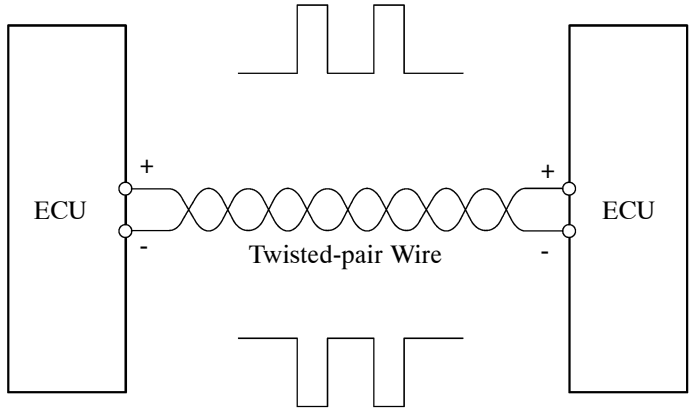
- Although BEAN and AVC-LAN have almost the same communication speed, the CAN communication speed is much faster than BEAN and AVC-LAN. When the vehicle control system uses BEAN and AVC-LAN with a slower communication speed than CAN, the slower communication speed means that the system control could possibly be delayed. For this reason, the vehicle control system uses CAN, which has a fast communication speed and can send and receive a large quantity of data at one time.

4. Communication Wire

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

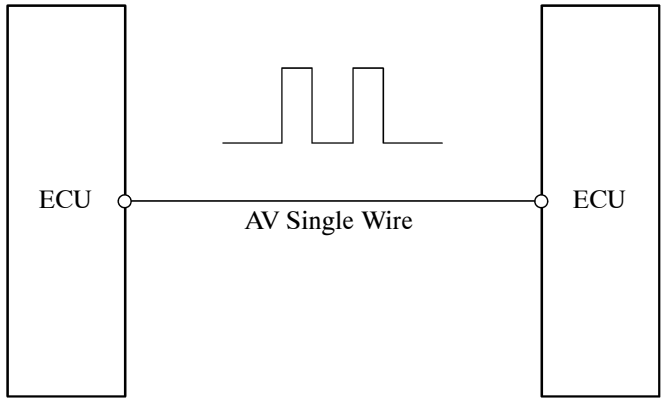
Communication Wire	Outline
Twisted-pair Wire for CAN  241BE168	In this communication wire, a pair of lines are twisted together and covered with insulation. Communication is driven by applying positive (+) and negative (-) voltage to the two lines in order to send a single signal. This system, which is called a “Differential Voltage Drive”, can reduce noise.
Twisted-pair Wire for AVC-LAN  240BE10	
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”.

▶ Differential Voltage Drive ◀



240BE12

▶ Single Wire Voltage Drive ◀



240BE11