Module-1-Embedded System-GPS and Model train

1. GPS interfacing with 8051

Introduction

A GPS (Global Positioning System) module is a device that has become an efficient tool in the field of surveillance, tracking and scientific use. The GPS module is based on satellite navigation technology that provides the information of time and location in all weather conditions anywhere on the earth. The main purpose of the GPS system is to find out the location of a person or vehicle. A GPS receiver affords an exact location of an object in terms of longitude and latitude and also provides timing services, positioning and reliable navigation to the users at anywhere and anytime on the earth.

Global **P**ositioning **S**ystem (GPS) makes use of signals sent by satellites in space and ground stations on Earth to accurately determine their position on Earth.

Radio Frequency signals sent from satellites and ground stations are received by the GPS. GPS makes use of these signals to determine its exact position. The GPS system mainly uses 24-32 satellites to provide the data to the users. This system has become very important for worldwide navigation and it is useful for tracking, surveillance, way and map marking, and much more.

The GPS itself does not need to transmit any information.

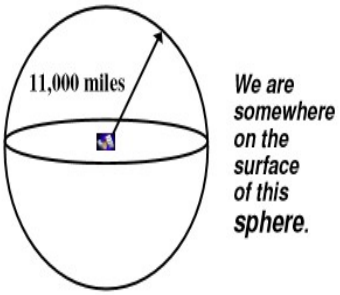
The signals received from the satellites and ground stations contain timestamps of the time when the signals were transmitted. By calculating the time difference between the time the signal was transmitted and the time the signal was received, and using the speed of the signal, the distance between the satellites and the GPS can be determined using a simple formula for distance using speed and time.

Using information from 3 or more satellites, the exact position of the GPS can be triangulated.

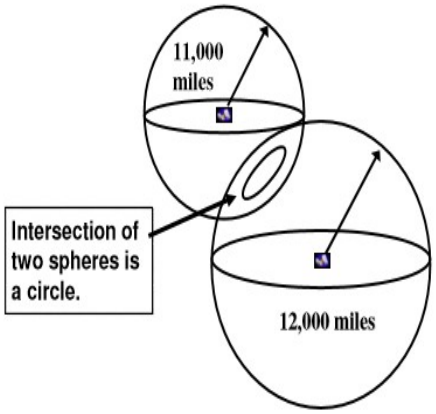
Triangulation

Once both satellite and position are known for at least 4 satellites, the receiver can determine a position by triangulation.

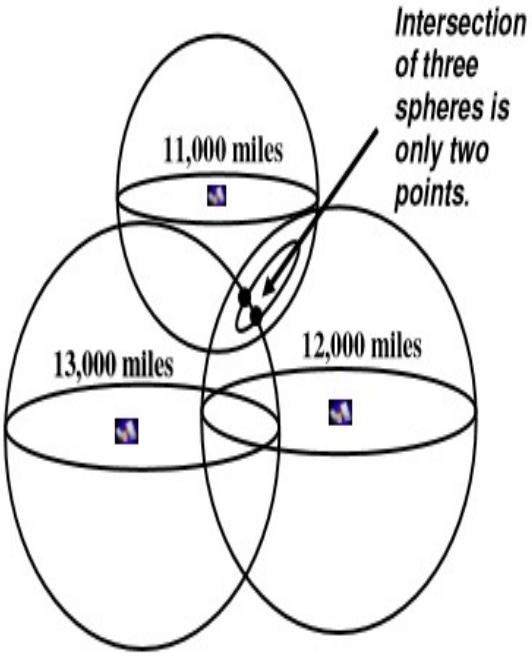
One measurement narrows down our position to the surface of a sphere



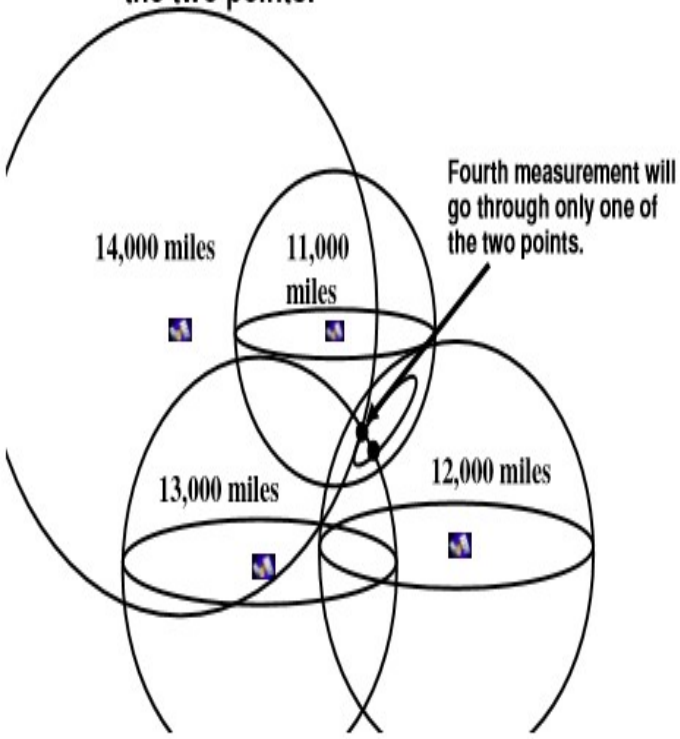
Second measurement narrows it down to the intersection of two spheres.



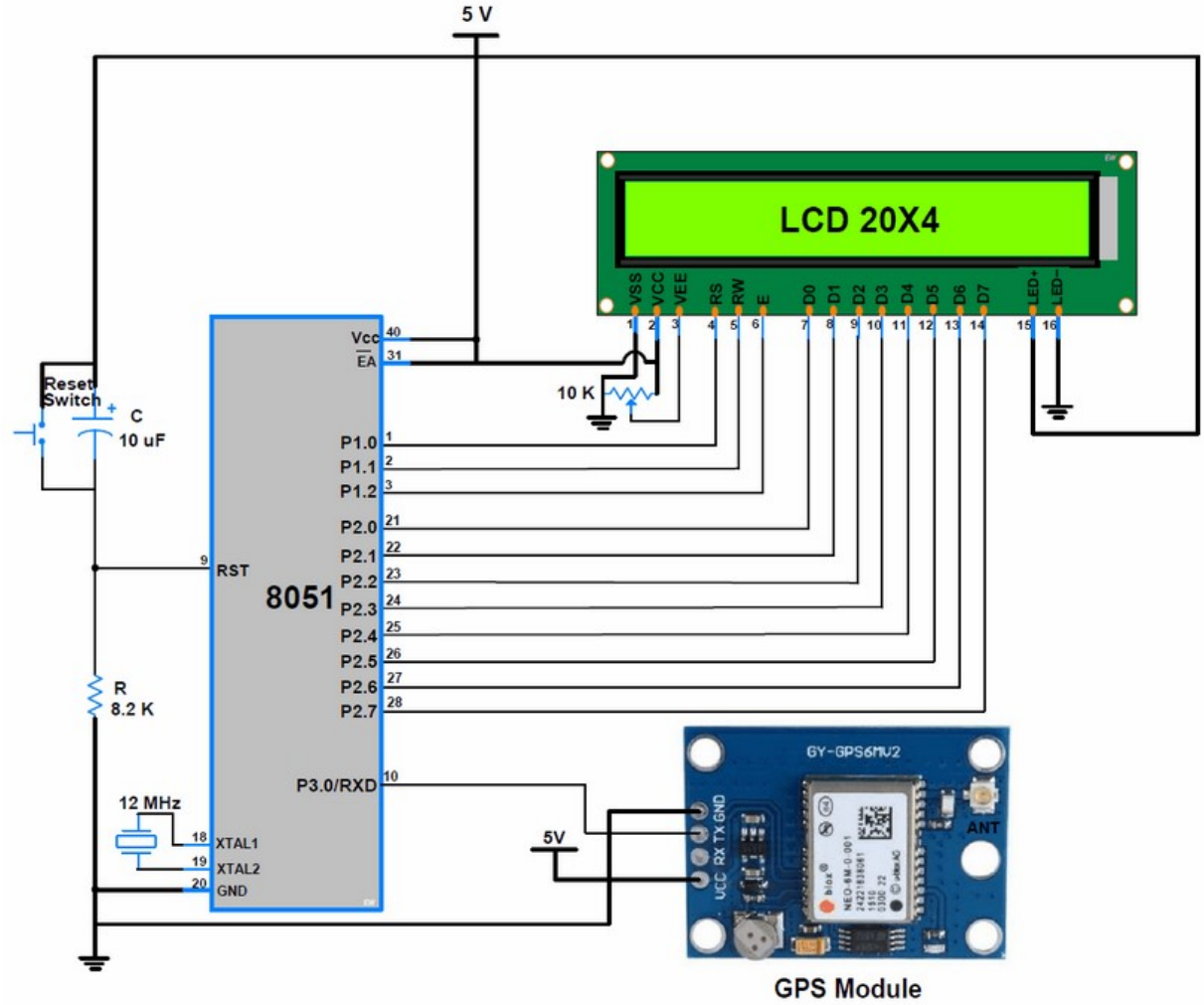
Third measurement narrows to just two points.



Fourth measurement will decide between the two points.



Interfacing Diagram



GPS module interfacing with 8051

Example

The GPS module working principle is, it always transmits serial data in the form of sentences. The longitude and latitude values of the location are contained in the sentence. To communicate over UART you just need three basic signals: TXD, RXD and GND – So that you can interface UART with 8051 microcontroller.

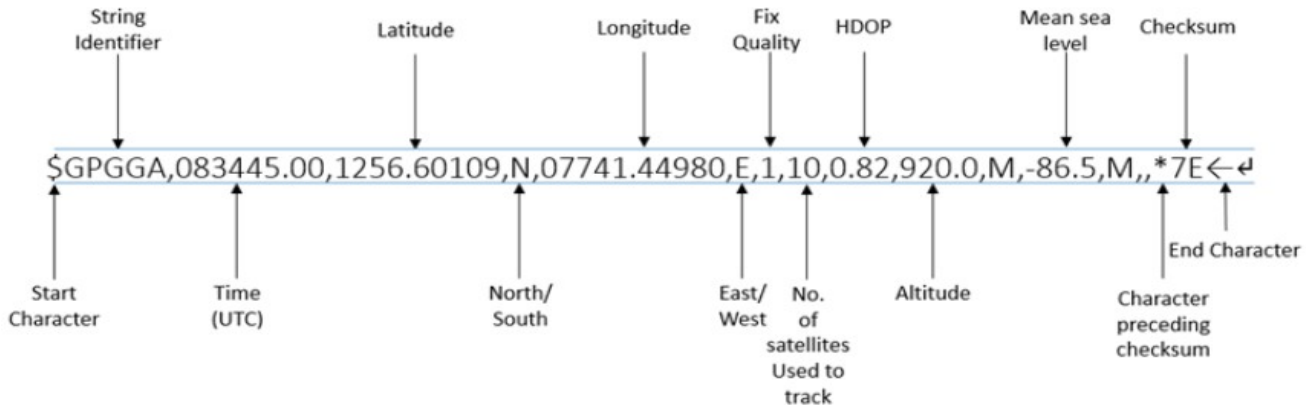
The main intention here is to find the exact location of the GPS receiver in terms of longitude and latitude. The GPS module gives the output data in RS232 logic level format. To convert RS232 format into TTL format, a line- converter MAX232 is used.

It is connected between GPS module and AT89C51 microcontroller. The GPS interfacing with 8051 connection block diagram is shown in the above diagram. The values of the location have been displayed on an LCD which is interfaced to the microcontroller.

Now let's interface the GPS receiver module with 8051 and display the Time, Latitude, and Longitude on the LCD20x4 display. In this interfacing, the AT89S52 microcontroller is used which will read data serially from GPS receiver using USART communication with 9600 bauds.

Then parse the "$GPGGA" string to extract information regarding time, latitude, and longitude.

The Latitude and Longitude displayed on LCD20x4 are in Degree Decimal format.

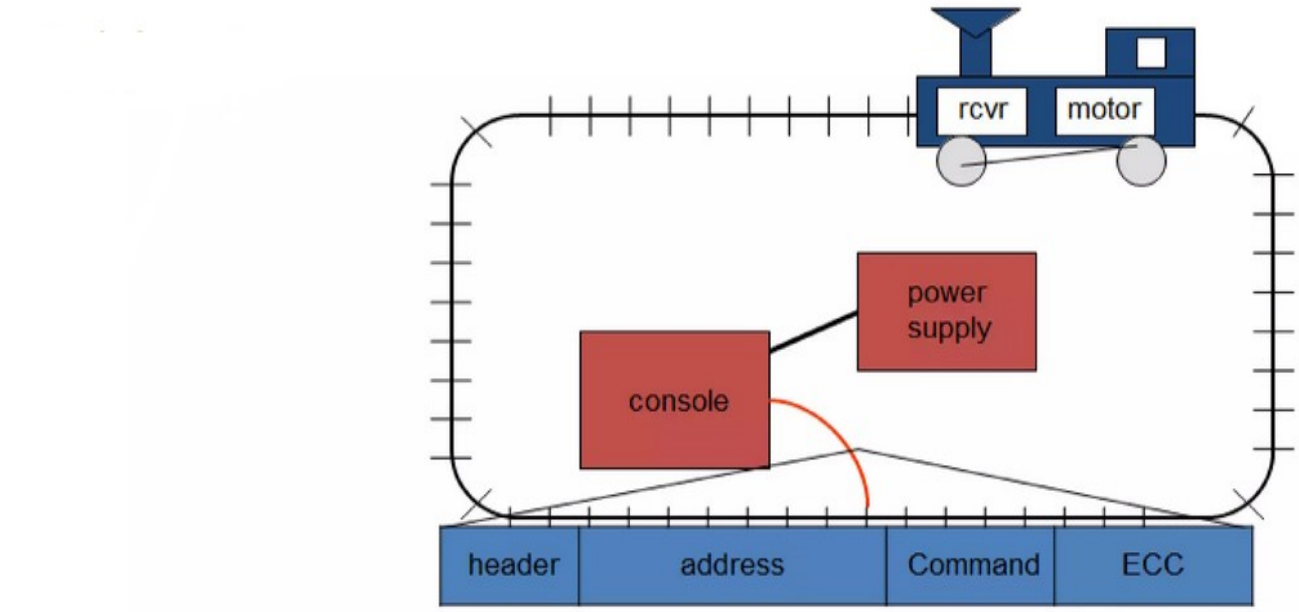


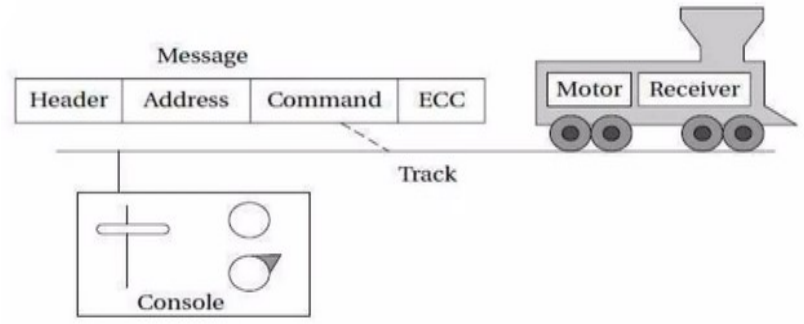
Applications

- **GPS and Satellite Image:** GPS has been widely used to prepare map from Satellite images especially topographic surveys and thematic mapping.
- **Road Traffic Congestion:** A navigation device has a GPRS receiver for receiving real time information about or slow average speed on a stretch of motorway, indicating congestion. The device calculates a new itinerary to avoid the congestion, based on historically record speeds on secondary roads weighed by the current average speed in the congestion area.

- **GPS and Defence:** Corps use GPS as a modern defensive purpose like trending and rescued.
- **Accidental Purpose:** To find and rescue any crashes ship and airplanes, GPS Plays very important role.
- **Tectonics:** GPS enables direct fault motion measurement of earthquake between earthquake GPS can be used to measure crustal motion and deformation to estimate seismic strain build up for creating seismic hazard maps.
- **GPS and Terrorism:** GPS is very important to determine the location of terrorist attacks. For example, on the surgical strike, Indian intelligence agencies had using the GPS and Indian Army carried out surgical strike against terror launch pads on and along the Line of Control (LoC) on 2016.
- **GPS of Mining:** The use of RTK GPS has significantly improved several mining operations such as drilling, shovelling, vehicle tracking and surveying, RTK GPS provides centimetre-level positioning accuracy.
- **GPS and Climatology:** GPS plays very important role to prepare weather map and computerized map.
- **Navigation:** Navigators value digitally precise velocity and orientation measurements. With the help of GPS roads or paths available, traffic congestion and alternative routes, roads or paths that might be taken to get to the destination. If some roads are busy then the best route to take, The location of food, banks, hotels, fuel, airports or other places of interests, the shortest route between the two locations, the different options to drive on highway or back roads etc. are easily getting better result using GPS.
- **Disaster Relief:** GPS gives us the facility to measure the capabilities of earthquake, flood wildfires.
- **Fleet Tracking:** The use of GPS technology to identify, locate and maintain contact reports with one or more fleet vehicles in real time.
- **Robotics:** Self-navigation, autonomous robots using GPS sensors, which calculate Latitude, Longitude, Time, speed and heading.

2. Model train controller





Signaling the train

Requirements

- Console controls up to 8 trains on 1 track.
- Throttle has at least 63 levels.
- Inertia control adjusts responsiveness with at least 8 levels.
- Emergency stop button.
- Error detection scheme on messages.
  - Ignore erroneous messages

Model train controller – WORKING PRINCIPLE

The user sends messages to the train with a control box attached to the tracks. The control box consists of a console, throttle, emergency stop button, and so on.

Since the train receives its electrical power from the two rails of the track, the control box can send signals to the train over the tracks by modulating the power supply voltage.

The control panel sends packets over the tracks to the receiver on the train.

This is a one-way communication system—the model train cannot send commands back to the user.

Requirements Mappings

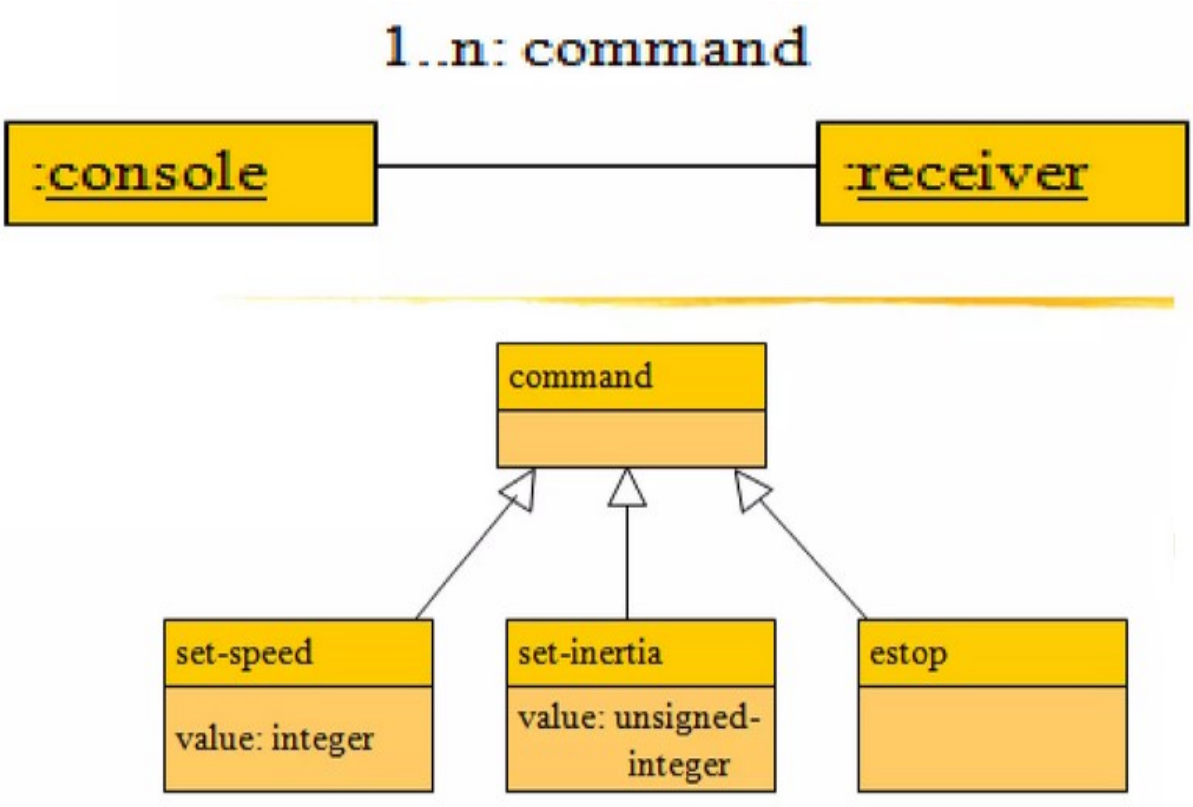
name	model train controller
purpose	control speed of <= 8 model trains throttle,
inputs	inertia, emergency stop, train # train control signals
outputs	set engine speed w. inertia;
functions	emergency stop can update train speed at least 10
performance	times/sec
manufacturing cost	$50
power	wall powered
physical size/weight	console comfortable for 2 hands; < 2 lbs.

Functions

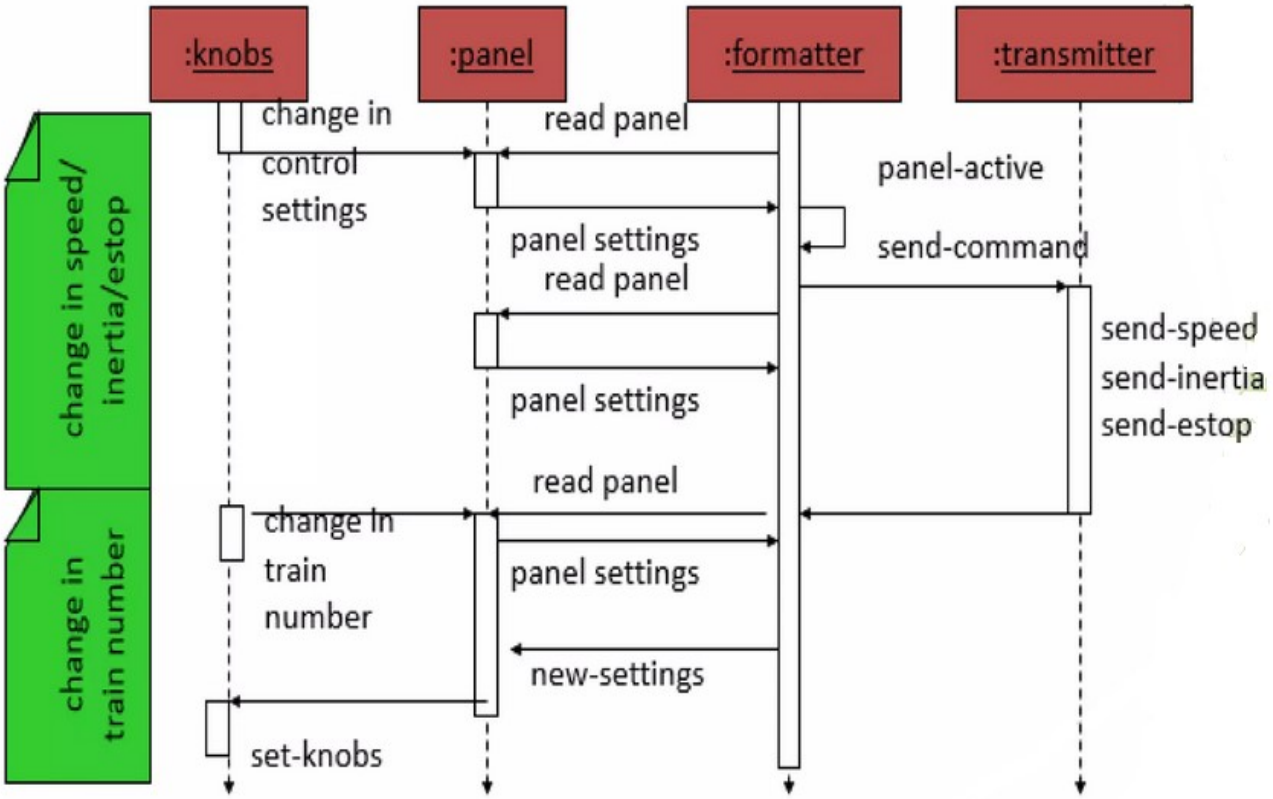
- Console:
  - read state of front panel.
  - format messages.
  - transmit messages.

- Train Receiver:
  - receive message.
  - interpret message.
  - control the train.

Conceptual specifications



Sequence Diagram for transmitting a control input.



Sequence Diagram of set-speed command received by the Train