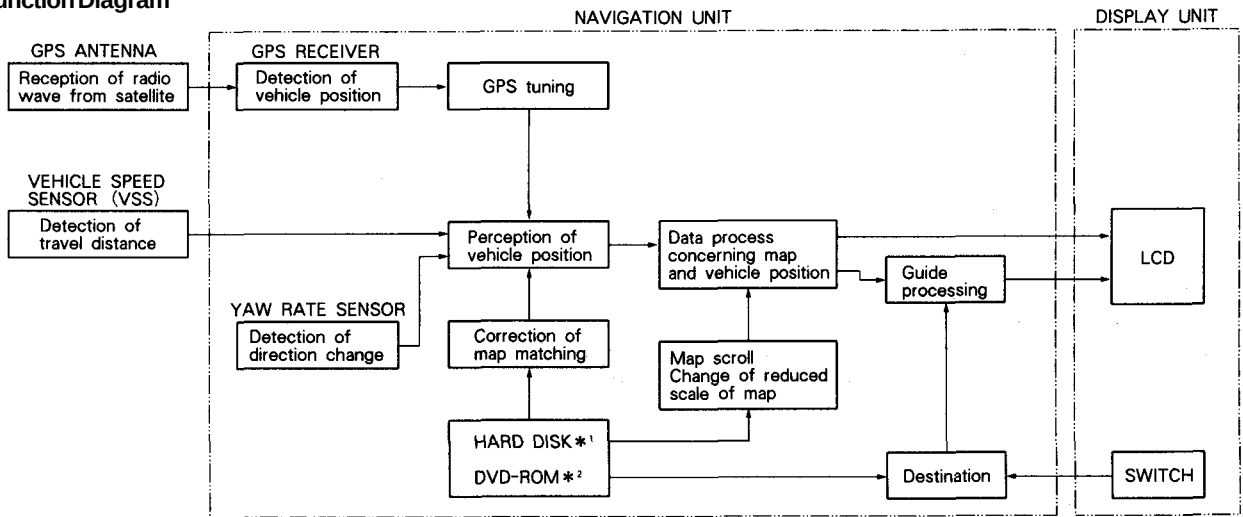


Navigation Function

The navigation system is composed of the navigation unit, the vehicle speed sensor, the GPS antenna, and the display unit.

Function Diagram

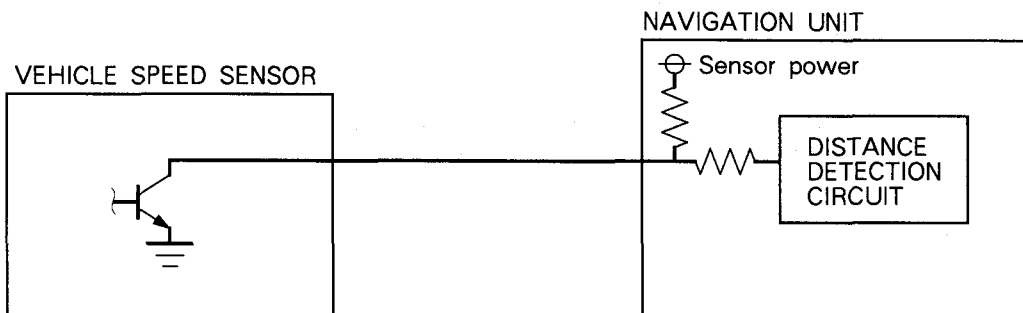


*1: '97 - 99 models

*2: '00 - 01 models

Vehicle Speed Sensor (VSS)

The vehicle speed sensor (VSS) is driven by the differential gear. For every revolution of the sensor, a four-pulse signal is sent to the navigation unit. The VSS outputs the distance signal by turning the navigation unit's sensor power on and off.



(cont'd)

Description

Navigation Function (cont'd)

Yaw Rate Sensor

The yaw rate sensor detects the direction change (angular speed) of the vehicle. The sensor is an oscillation gyro built into the navigation unit.

Sensor Element Structure

The sensor element is shaped like a tuning fork, and it consists of the piezoelectric parts, the metal block, and the support pin. There are four piezoelectric parts: one to drive the oscillators, one for monitoring that maintains the oscillation at a regular frequency, and two to detect angular velocity. The two oscillators have a 90 degree twist in the center, are connected at the bottom by the metal block, and supported by the support pin. A detection piezoelectric part is attached to the top of each oscillator. The driving piezoelectric part is attached to the bottom of one oscillator, and the monitoring piezoelectric part is attached to the bottom of the other oscillator.

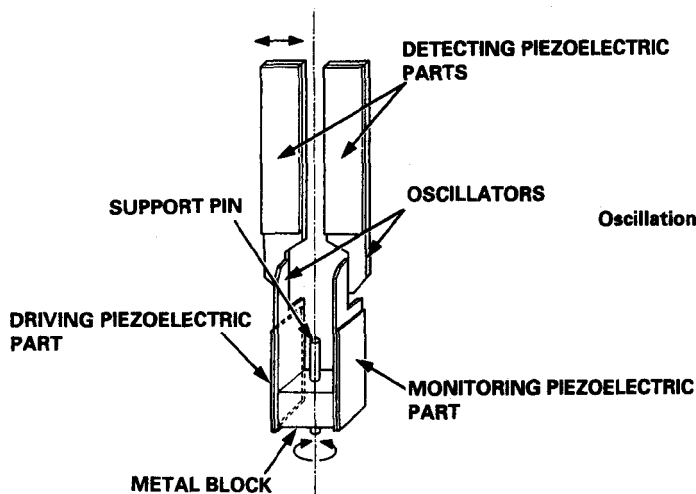
Oscillation Gyro Principles

The piezoelectric parts have "electric/mechanical transfer characteristics." The piezoelectric parts bend vertically when voltage is applied to both sides of the parts, and voltage is generated between both sides of the piezoelectric parts when they are bent by an external force. The oscillation gyro functions by utilizing this characteristic of the piezoelectric parts and "Coriolis force." (Coriolis force deflects moving objects as a result of the earth's rotation.) In the oscillation gyro, this force moves the sensor element when angular velocity is applied.

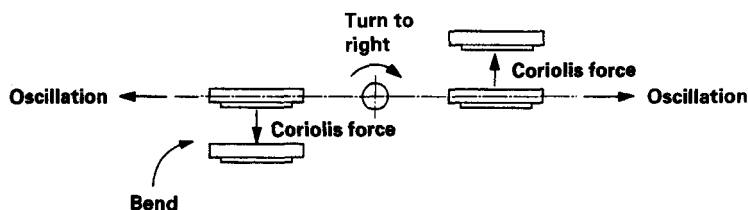
Operation

1. The driving piezoelectric part oscillates the oscillator by repeatedly bending and returning when an AC voltage at 6 kHz is applied to the part. The monitoring-side oscillator resonates because it is connected to the driving-side oscillator by the metal block.
2. The monitoring piezoelectric parts bends in proportion to the oscillation and outputs voltage (the monitor signal). The navigation unit control circuit controls the drive signal to stabilize the monitor signal.
3. When the vehicle is stopped, the detecting piezoelectric parts oscillate right and left with the oscillators, but no signal is output because the parts are not bent (no angular force).
4. When the vehicle turns to the right, the sensor element moves in a circular motion with the right oscillator bending forward and the left oscillator bending rearward. The amount of forward/rearward bend varies according to the angular velocity of the vehicle.
5. The detecting piezoelectric parts output voltage (the yaw rate signal) according to the amount of bend. The amount of vehicle direction change is determined by measuring this voltage.

Enlarged view of sensor element



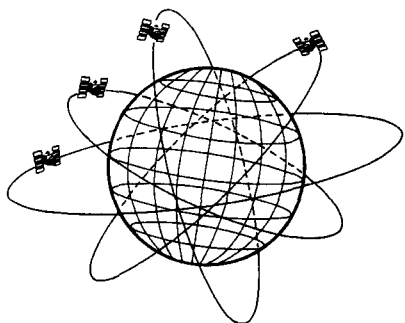
Sensor element top view



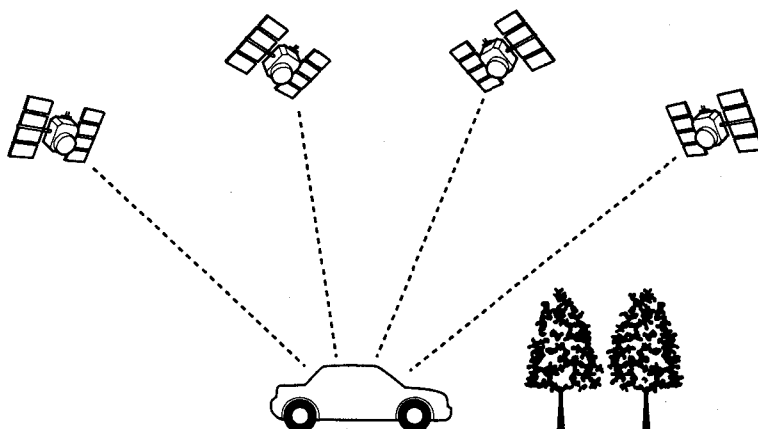
Global Positioning System (GPS)

The Global Positioning System (GPS) enables the navigation system to determine the current position of the vehicle by using the electric waves transmitted from the satellites in orbit around the earth. The satellites transmit the satellite identification signal, orbit information, transmission time signal, and other information. When the GPS receiver receives the electric waves from three or more satellites simultaneously, it calculates the current position of the vehicle based on the distance to each satellite and the satellite positions on their respective orbits.

Position detection Image with GPS satellite



NOTE: Four satellites on each of six orbits.



Precision of GPS

The precision of the GPS varies according to the number of satellites from which electric waves are received and the control condition. The precision is indicated by the GPS mark shown on the upper left of the display.

GPS MARK	No. of SATELLITES	CONDITION	DESCRIPTION
No satellite mark → 	Two or less	Impossible to detect vehicle position	GPS function is normal. The satellite electric waves received by the GPS are too few to detect the vehicle position.
Yellow satellite mark → 	Three	Vehicle position detectable in two dimensions	The longitude and latitude of the vehicle position can be detected. (Less precise than detection in three dimensions)
Green satellite mark → 	Four or more	Vehicle position detectable in three dimensions	The longitude, latitude and the altitude of the vehicle position can be detected. (More precise than detection in two dimensions)
Not indicated	—	Faulty	The GPS can't be used due to a faulty GPS receiver, open in the wire, or other fault.

GPS Antenna

Receiving the electric waves from the satellites, the GPS antenna amplifies and transmits them to the GPS receiver.

GPS Receiver

The GPS receiver is built in the navigation unit. It calculates the vehicle position by receiving the signal from the GPS antenna. The vehicle position and signal reception condition is transmitted from the GPS receiver to the navigation control unit to adjust vehicle position.

(cont'd)

Description

Navigation Function (cont'd)

Navigation Unit

The navigation unit calculates the vehicle position and guides you to the destination. The unit performs map matching correction, GPS correction, and distance tuning. It also controls the menu functions and the DVD-ROM drive (hard disk drive '96 - 99 models). With control of all these items, the navigation unit makes the navigation picture signal, then it transmits the signal to the display unit and audio driving instructions to the audio unit.

Calculation of Vehicle Position

The navigation unit calculates the vehicle position (the driving direction and the current position) by receiving the directional change signals from the yaw rate sensor and the travel distance signals from the vehicle speed sensor (VSS).

Map Matching Tuning

The map matching tuning is accomplished by indicating the vehicle position on the roads on the map. The map data transmitted from the DVD-ROM (hard disk '96 - 99 models) is checked against the vehicle position data, and the vehicle position is indicated on the nearest road. Map matching tuning does not occur when the vehicle travels on a road not shown on the map or when the vehicle position is far away from a road on the map.

GPSTuning

The GPS tuning is accomplished by indicating the vehicle position as the GPS's vehicle position. The navigation unit compares its calculated vehicle position data with the GPS vehicle position data. If there is large difference between the two, the indicated vehicle position is adjusted to the GPS vehicle position.

Distance Tuning

The distance tuning reduces the difference between the travel distance signal from the VSS and the distance data on the map. The navigation unit compares its calculated vehicle position data with the GPS vehicle position data. The navigation unit then decreases the tuning value when the vehicle position is ahead of the GPS vehicle position, and it increases the tuning value when the vehicle position is behind the GPS vehicle position.

RouteGuidance

The navigation unit can calculate different routes to a selected destination. You have four options:

- Direct Route — Calculate a route that is the most direct and will take the least time.
- Easy Route — Calculate a route that minimizes the number of turns needed.
- Minimize Freeways — Calculate a route that avoids freeway travel. If that is not possible, keep the amount of freeway travel to a minimum.
- Minimize Toll Roads — Calculate a route that avoids or minimizes travel on toll roads

AudioGuidance

The navigation unit transmits audio driving instructions before entering an intersection or passing a junction.

The audio instructions come through audio unit and the front speakers.

DVD-ROM ('00 - 01 models). Hard Disk ('96 - 99 models)

The map data (including all scale rates) is stored in the DVD-ROM/Hard Disk. The map data includes:

- Road distances, road widths, speed limits, traffic regulations, passing time at junction, distances to junctions, and the driving instructions for audio guidance.
- Latitude and longitude for GPS.

Audio Unit

The audio unit receives the audio driving instructions from the navigation unit and transmits the instructions through the front speakers even when the audio system is in use.

Display Unit

'96 - 99 models

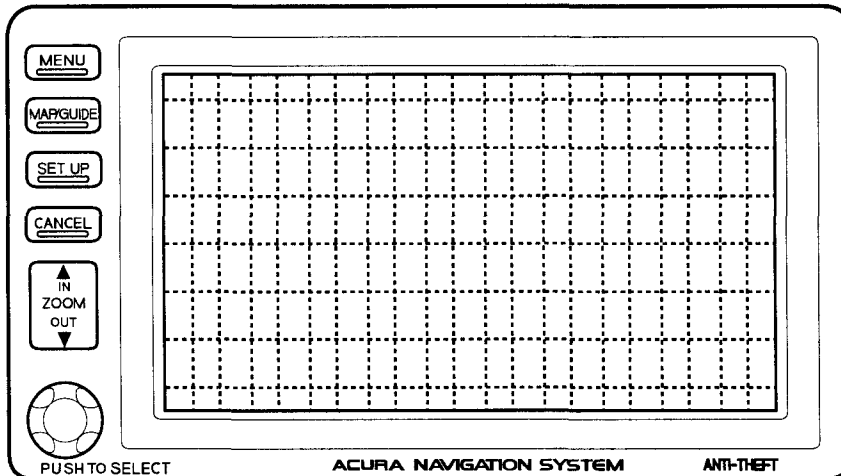
The display unit uses liquid crystal display (LCD). The LCD is a 6-inch-wide, Thin Film Transistor (TFT), stripe type with 220,000 picture elements. The color film and fluorescent light are laid out on the back of the liquid crystal film. The touch sensor on the front of the LCD is an infrared type with nine vertical and nine horizontal infrared rays to produce 81 sensing points. The display unit transmits the signal from each operation key and the touch switches the navigation unit.

'00 - 01 models

The display unit uses liquid crystal display (LCD). The LCD is a seven-inch-wide, Thin Film Transistor (TFT), stripe type with 280,800 picture elements. The color film and fluorescent light are laid out on the back of the liquid crystal film. The touch sensor on the front of the LCD is an infrared type with twenty vertical and seven horizontal infrared rays to produce 140 sensing points. The display unit transmits the signal from each operation key and the touch switches the navigation unit.

Infrared rays

The illustration shows '00 - 01 models.



-----: Infrared for touch switch