
CLEARANCE SONAR SYSTEM PARK ASSIST / MONITORING

General

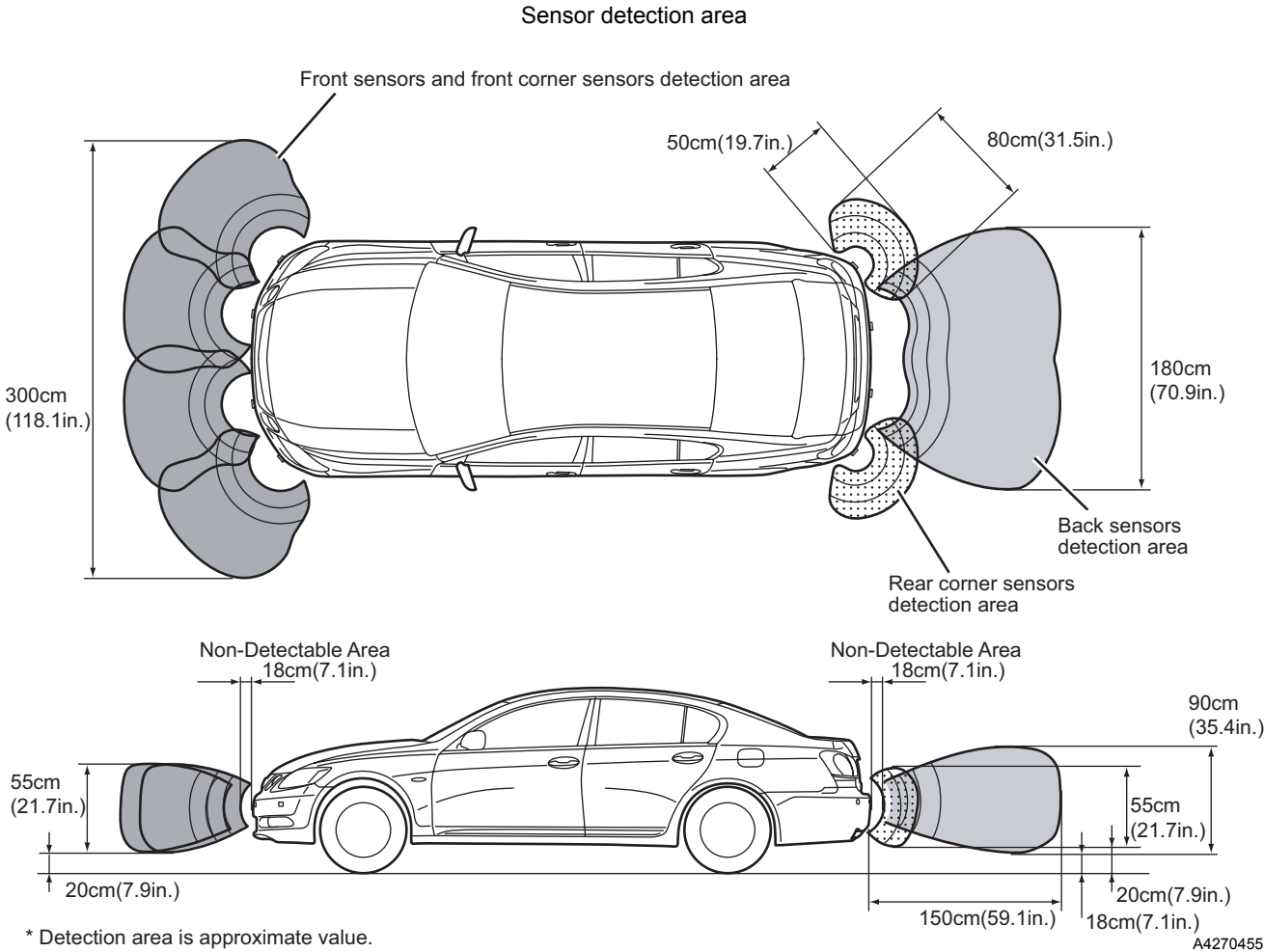
- A Lexus Parking Assist-sensor(Steering-guided) is available on all models as optional equipment. Using ultrasonic sensors to detect the presence of obstacles in the vicinity of the front and rear bumpers as well as their distance, this system assists the driver during a turnaround in a tight space or to park the vehicle in a garage.
- This system uses the multi-information display and the screen and a buzzer to inform the driver of the obstacle data detected by the sensors.
- The following ultrasonic sensors are provided to detect obstacles: one sensor each at the right and left corners of the front and rear bumpers, two in the center of the front bumper, and two in the center of the rear bumper. The sensors are painted with the same color as the outer panels to ensure the proper appearance.
- The sound volume of the buzzer and whether to turn the display ON or OFF can be adjusted through the customizable function. In addition, the sound volume of the buzzer can be adjusted by operating the clearance sonar setting screen on the display.

Function

- The ultrasonic waves that are output by a sensor bounce off an obstacle, back to the sensor. The length of time this process takes is used for estimating the distance between the sensor and the obstacle. Thus, the system is able to inform the driver of the distance of the obstacle through a graphic display and sounding a buzzer.

Detection Range

- The front sensors and the front corner sensors detect obstacles in an area within approximately 100cm(39.4in.). The rear corner sensors detect within approximately 50cm(19.7in.), and the back sensors within approximately 150cm(59.1in). There are some areas in which the sensors cannot detect obstacles if they are too close to the bumpers.



- The system switches from the "steering guidance mode" to the "normal clearance sonar mode" if any one of the conditions listed below is met. The sensor detection area during the "normal clearance sonar mode" differs from the sensor detection area during the "steering guidance mode".

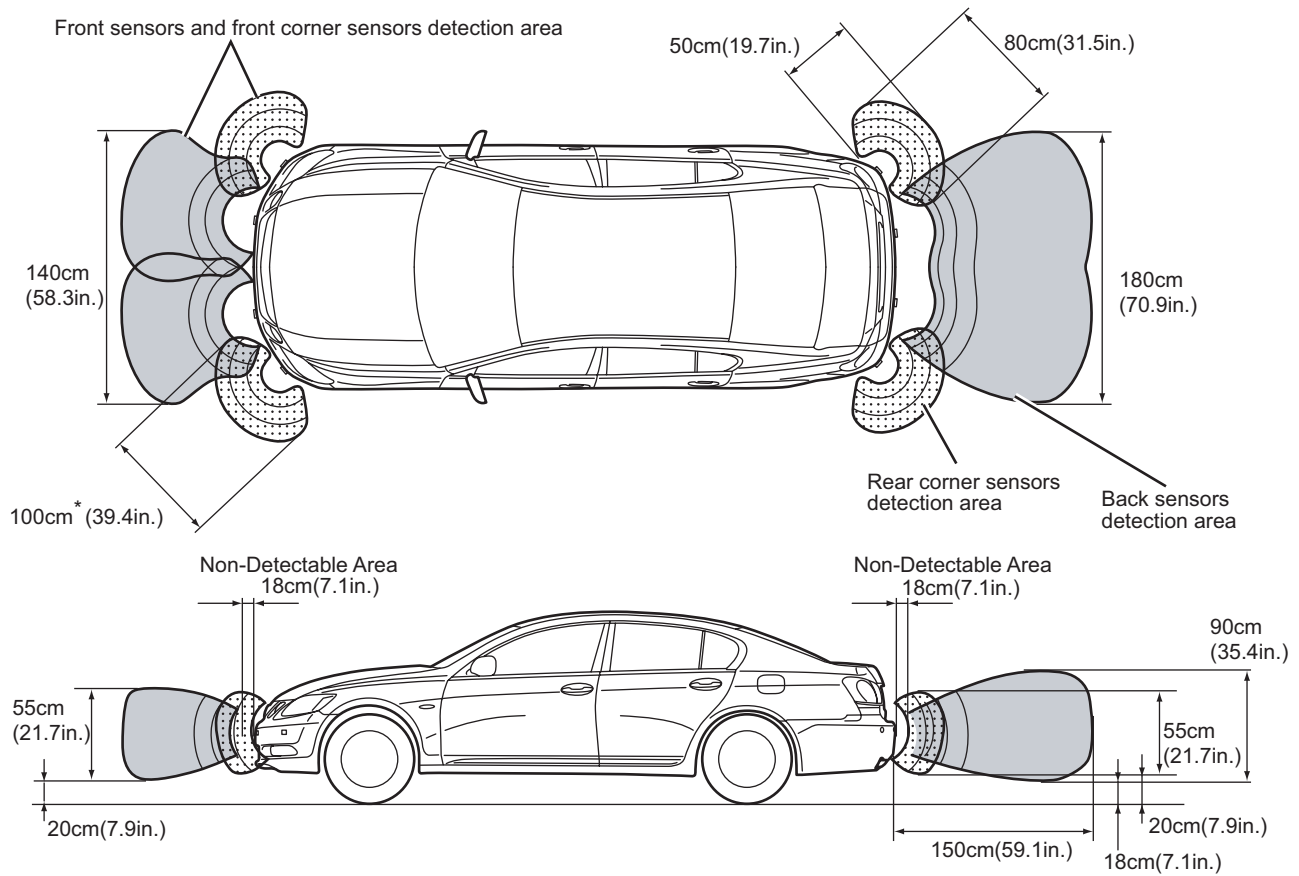
Changes conditions to normal clearance sonar mode

"Normal clearance sonar mode" is selected through the customizable function
A failure is detected in any one of the sensors
The input of a steering angle signal or VGRS signal is disrupted
Neutral point learning mode*

❖REFERENCE❖

- * : If the system voltage drops momentarily to an abnormal level(When ECU is exchanged etc.), the system will transfer to the neutral point learning mode. Then, a steering mark will illuminate in the multi-information display and the screen.In that case,make sure to perform the neutral mode learning mode and the maximum steering angle learning mode by turning the steering wheel lock-to-lock. Otherwise, the system may not be able to make a proper contact/avoidance judgment.

Sensor detection area(Normal clearance sonar mode)

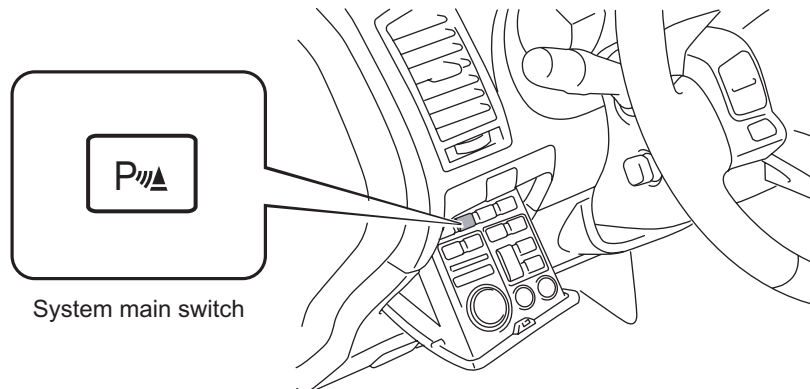


*:Detection area is approximate value.

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Detection Activation

- The clearance sonar main switch is located in the switch module area on the left side of the driver. This switch turns the power to the LEXUS Parking Assist-sensor(steering-guided) ON and OFF.



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- The system starts the obstacle detection operation when all the conditions listed in the table below have been met.

Sonar operation conditions

Dual sonar(front & front corner)	Rear corner sonar	Back sonar
• IG ON • Clearance sonar main switch ON • Shift lever is in a position other than "P" (Only front cornersensor detect an obstacle while the shift lever is in the "R" range) • Less than about 10 km/h(5.9m/h)	• IG ON • Clearance sonar main switch ON • Shift lever is in the "R" range • Less than about 10 km/h(5.9m/h)	• IG ON • Clearance sonar main switch ON • Shift lever is in the "R" range

- After the driver turns the ignition ON and the clearance sonar main switch ON, the system will perform a system check operation for approximately 0.8 seconds, in order to check the sensors for an open circuit or other failures. At the same time, the system sounds the buzzer and flashes the LEDs on the multi-information display.

Contact/Avoidance Judgment(Judgment Line)

- Based on a value obtained from the steering sensor signal and the relative angle of the VGRS (Variable Gear Ratio Steering), the system selects a judgment line that is preset in the clearance warning ECU, and effects a three-stage contact/avoidance judgment in accordance with the position of the obstacle.

Contact/Avoidance judgment

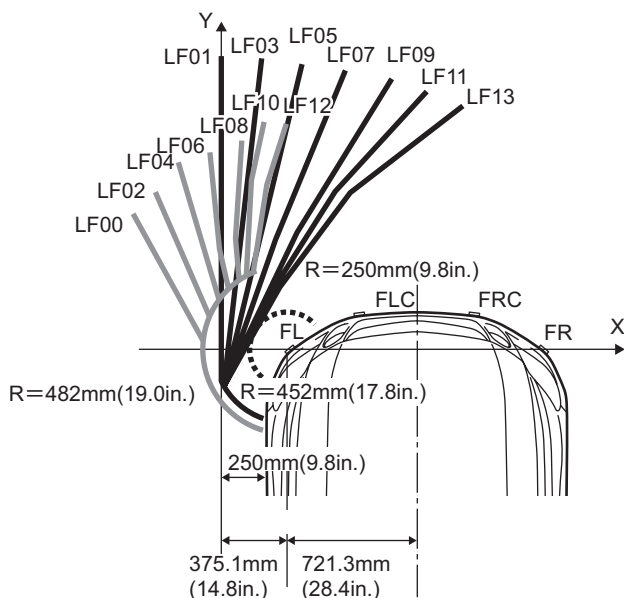
	State
Contact Judgment(Collision will be unavoidable)	State in which the obstacle cannot be avoided even if the driver fully turns the steering wheel.
Avoidance Judgment(Collision will be avoided by changing the steering)	State in which the vehicle will contact the obstacle at the present steering angle, but will be able to avoid contact with the obstacle by turning the steering.
Absolute Avoidance Judgment(Collision will be avoided with the present steering angle)	State in which the vehicle will not contact the obstacle even at the present state of steering.

Judgment Line Except in the P or R Position

- The judgment lines from LF00 to LF13 correspond to the turning angle of the steering wheel. If there is an obstacle in the area on the vehicle side of the LF13 judgment line, there is a risk of the vehicle approaching within 25cm(9.8in) of the obstacle, regardless the steering maneuver that the driver may make. To counter the obstacle that is present within the sensor detection area, the clearance warning ECU makes an avoidance judgment by using a judgment line (odd number from LF01 to LF13) in accordance with the amount of effort that is applied to the steering wheel. (It illuminates the steering assist mark to urge the driver to avoid the obstacle through a steering maneuver.) The even-numbered judgment lines from LF00 to LF12 are the hystereses that correspond to the odd-numbered judgment lines from LF01 to LF13. They are used for making absolute avoidance judgments in the following combinations: LF00 and LF01, LF02 and LF03, up to LF12 and LF13. For example, the system will reach an absolute avoidance judgment if an obstacle that is detected at the LF13 judgment line moves outward of the vehicle, away from the LF12 judgment line, due to a steering maneuver.
- The system issues a contact judgment, avoidance judgment, or absolute avoidance judgment report by illuminating or blinking the (front) indicator light in the clearance warning indicator assembly, and sounding the buzzer. In addition, the steering assist mark illuminates during an avoidance judgment.

❖ REFERENCE ❖

- :Function of multi-information display only
- :Buzzer sounds only upon contact judgment and avoidance judgment

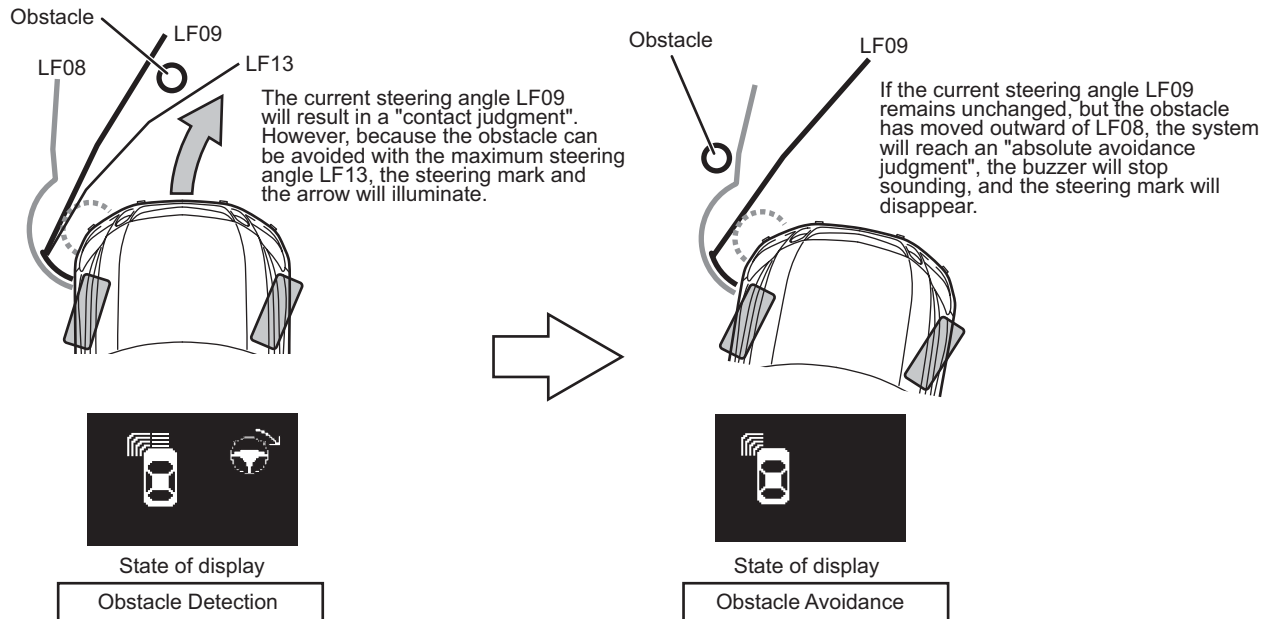


Note: The illustration shows the vehicle making a right turn. In the case of a left turn, the system selects the judgment lines that are formed in a laterally symmetrical manner.

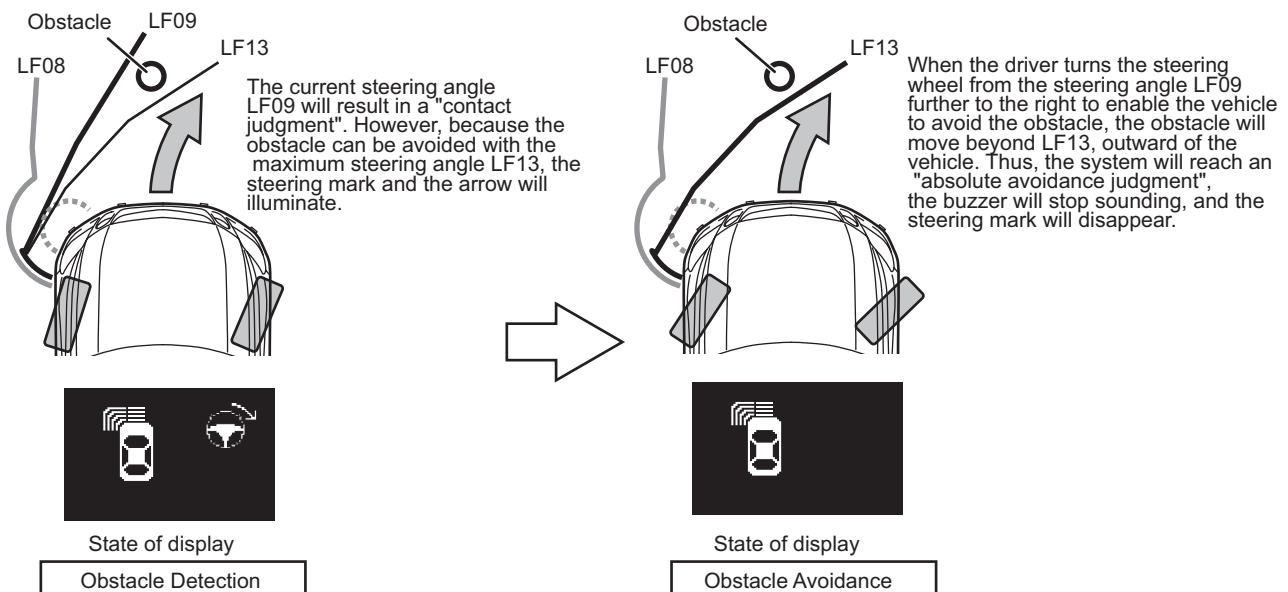
States and Indication Examples (Except in the P or R Position)

- If an obstacle is detected at the LF09 judgment line, and the obstacle can be avoided through a steering maneuver, a steering guide mark will appear and the buzzer will sound. (The sounding intervals of the buzzer vary by the distance between the sensor and the obstacle.) Thus, the driver will be able to avoid the obstacle by performing a steering maneuver in accordance with the steering guide mark. (The obstacle will move outward of the vehicle, away from the LF08 judgment line.) The combination of the judgment lines changes continuously with the turning angle of the steering wheel.

- (1) If, once the system has made an avoidance judgment on an obstacle, the vehicle continues to approach the obstacle without changing its steering angle, or the obstacle has moved, causing the system to change to an "absolute avoidance judgment":

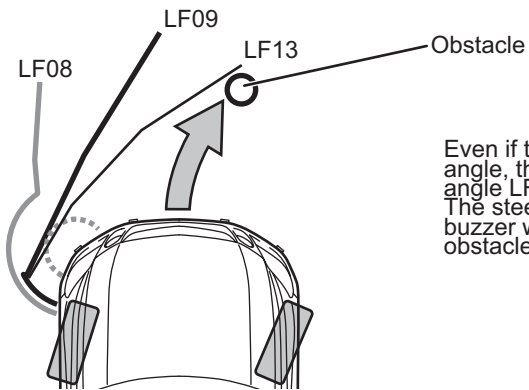


- (2) If, once the system has made an avoidance judgment on an obstacle, the driver performs a steering maneuver to the extent that the vehicle can avoid the obstacle:



* This illustration is a typical example.

(3) If an obstacle is detected inward of the vehicle from the maximum steering angle LF13:



Even if the driver turns the steering wheel to its maximum angle, the object will remain inward of the maximum steering angle LF13. Thus, the system will reach a "contact judgment". The steering mark and the arrow will not illuminate, and the buzzer will sound in accordance with the distance to the obstacle.



State of display

Obstacle Detection

* This illustration is a typical example.

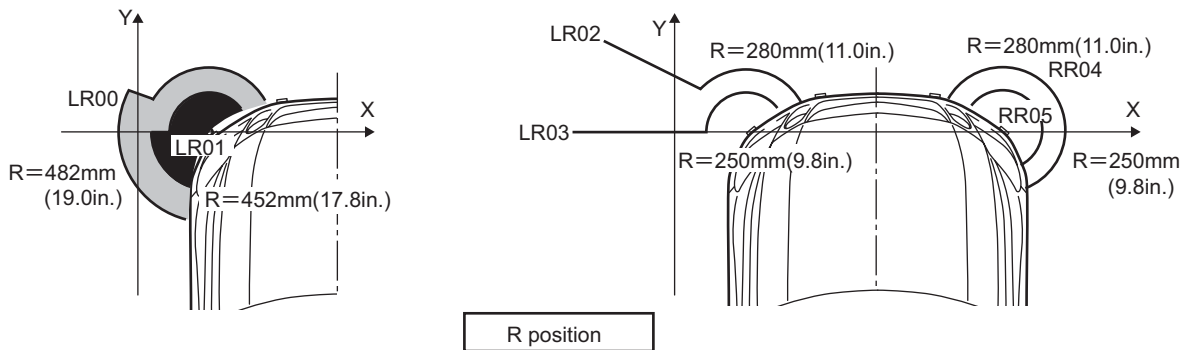
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Judgment Line in the R Position

- The judgment lines LR00 and LR01 are present when the steering turning angle is below 90 degrees. The judgment lines LR02 to RR05 are present when the steering turning angle is over 90 degrees. When an obstacle is present within the area of the judgment line LR03, the system determines that the obstacle can be avoided, provided that there are no obstacles within the LR01 and RR05 areas. (The steering assist mark will illuminate to urge the driver to avoid the obstacle through a steering maneuver.) The even-numbered judgment lines LR00, LR02, and RR04 are hystereses that correspond to the odd-numbered judgment lines LR01, LR03, and RR05. If the driver continues to operate the vehicle with the current steering angle unchanged, or if the driver operates the vehicle by turning the steering wheel to the extent that does not cause the judgment lines to change, these judgment lines will cause the system to reach an "absolute avoidance judgment". If the driver turns the steering wheel until the judgment lines change, the system will make an contact/avoidance judgment based on a newly selected judgment line.
- The system issues an contact judgment, avoidance judgment, or absolute avoidance judgment report by illuminating or blinking the (front) indicator light in the clearance warning indicator assembly, and sounding• the buzzer. In addition, the steering assist mark illuminates during an avoidance judgment.

❖ REFERENCE ❖

- :Buzzer sounds only upon contact judgment and avoidance judgment

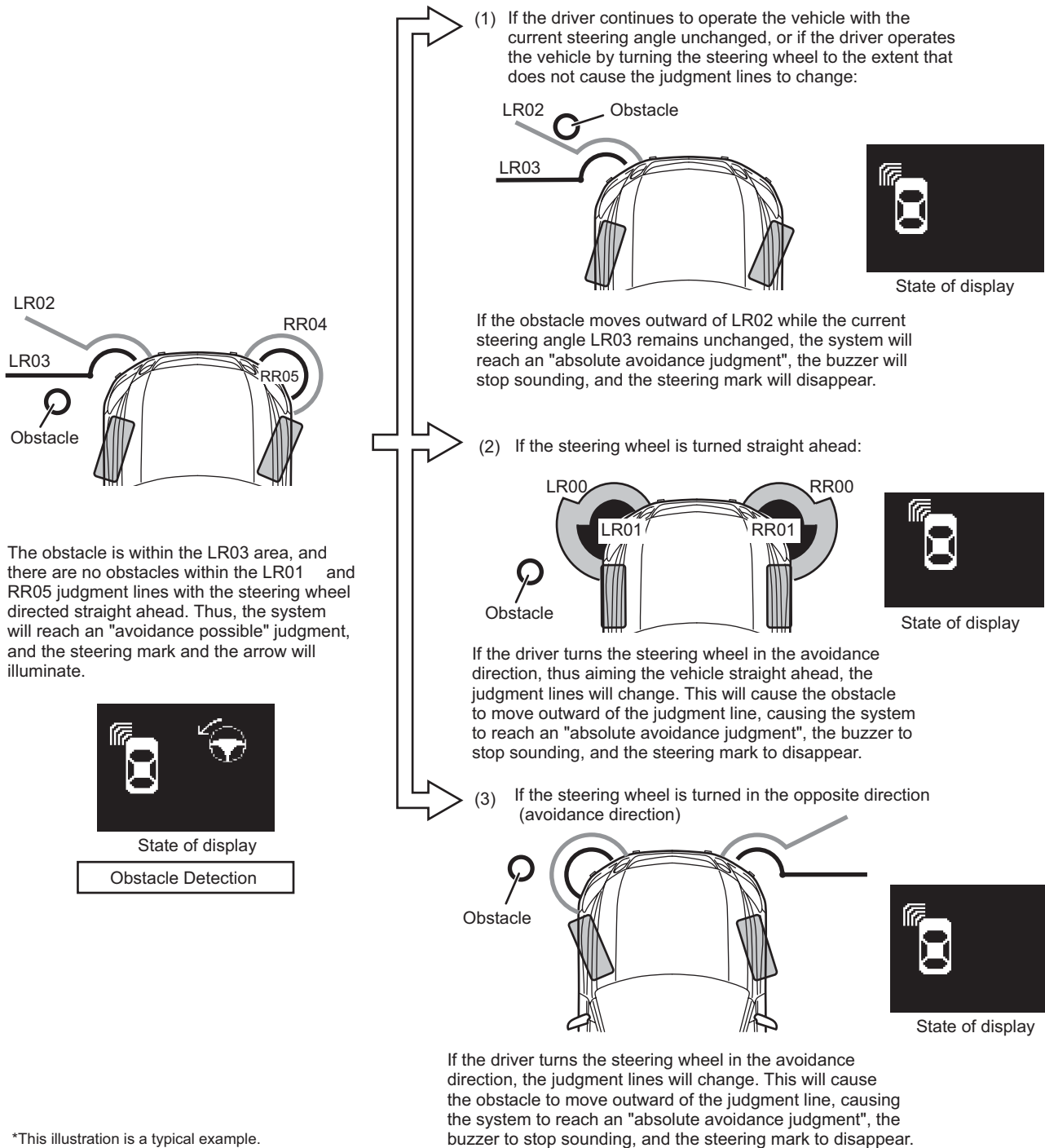


Note: The illustration shows the front left state. In the case of the front right state, the system selects the judgment lines that are formed in a laterally symmetrical manner.

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States and Indication Examples (in the R Position)

- If an obstacle is detected at the LR03 judgment line, and the obstacle can be avoided through a steering maneuver, a steering guide mark will appear and the buzzer will sound. (The sounding intervals of the buzzer vary by the distance between the sensor and the obstacle.) Thus, the driver will be able to avoid the obstacle by performing a steering maneuver in accordance with the steering guide mark. (The obstacle will move outward of the vehicle, away from the LR02 judgment line.) The combination of the judgment lines changes continuously with the turning angle of the steering wheel.



*This illustration is a typical example.