# IVISTA

# China Intelligent Vehicle Index

## Intelligent Parking Index
## Parking Assist System Rating Protocol

**(Version 2023)**

# Table of Contents

# Parking Assist System Rating Protocol

## 1    Scope

This document specifies the rating methods of IVISTA China Intelligent Vehicle Index - Intelligent Parking Index - Parking Assist System.

## 2    Normative References

The following normative documents contain provisions which, through reference in this text, constitute indispensable provisions of this document. For dated references, only the dated edition applies to this document. For undated references, the latest edition (including all amendments) applies to this document.

GB 34660 Road Vehicles - Requirements and Test Methods of Electromagnetic Compatibility

GB 5768.3 Road Traffic Signs and Markings - Part 3: Road Traffic Markings

GB/T 18385-2005 Electric Vehicles - Power Performance - Test Method

GB/T 34590 Road Vehicles - Functional Safety (All Parts)

GB/T 39263-2020 Road Vehicles - Advanced Driver Assistance Systems - Terms and Definitions

GB/T 40429-2021 Taxonomy of Driving Automation for Vehicles

GB/T 41630-2022 Performance Requirements and Test Methods for Intelligent Parking Assist System

JGJ 100 Code for Design of Parking Garage Building

ISO 16787 Intelligent Transport Systems-Assisted Parking Systems (APS)-Performance Requirements and Test Procedures

## 3    Rating Methods

### 3.1    General

The parking assist system rating items include three parts: parking capability, remote parking assist (RPA), and safety tips review. The full score is 100 points. The final score for the vehicle under test (VUT) is calculated by the score list provided in sections 3.2, 3.3, and 3.4, and rounded to one decimal place. See Annex A, Annex B, and Annex C for specific rating rules.

### 3.2    Parking capability rating

The full score for the parking capability rating is 85 points, and the scores of each scenario and test cycle are as follows. See Annex A for detailed rating methods.

**Table 1  Score Distribution of Parking Capability Rating**

| Rating Section | Score | Type of Parking Space | Score | Test Scenarios | Score | Test Cycle | Score |
|---|---|---|---|---|---|---|---|
| Parking capability rating | 85 points | Parallel parking space | 30 points | Scenario of parallel parking space with two bordering vehicles | 15 points | Parking-in | 12 points |
| | | | | | | Parking-out | 3 points |
| | | | | Scenario of APT walking through parallel parking space with two bordering vehicles at a constant speed along the road edge | 15 points | Parking-in | 12 points |
| | | | | | | Parking-out | 3 points |
| | | Perpendicular parking space | 45 points | Scenario of perpendicular parking space with a pillar and bordering vehicle | 15 points | Parking-in | 15 points |
| | | | | Scenario of perpendicular parking space with markings | 15 points | Parking-in | 15 points |
| | | | | Scenario of CPT walking into the center of perpendicular parking space with two bordering vehicles | 15 points | Parking-in | 15 points |
| | | Diagonal parking space | 10 points | Scenario of diagonal parking space with two bordering vehicles | 10 points | Parking-in | 10 points |

## 3.3  RPA rating

The full score of RPA is 10 points. If the VUT does not have an RPA function, no point will be given for the RPA rating of the VUT. The scores of each item in the **RPA rating** are as follows. See Annex B for the detailed rating method.

**Table 2  Score Distribution of RPA Rating**

| Rating Section | Score | Test Scenarios | Score | Test Cycle | Score |
|---|---|---|---|---|---|
| Remote parking assist | 10 points | Scenario of parallel parking space | 5 points | Parking-in | 3 points |
| | | | | Parking-out | 2 points |
| | | Scenario of perpendicular parking space | 5 points | Parking-in | 3 points |
| | | | | Parking-out | 2 points |

## 3.4  Safety tip review

The full score for the safety tips review is 5 points, and the scores of each item are as follows. See Annex C for detailed rating methods.

**Table 3  Score Distribution of Safety Tips Review**

| Rating Section | Score | Review Contents | Score | Review Items | Score |
|---|---|---|---|---|---|
| Safety tips review | 5 points | Review of user manual | 2 points | Definition of assist functions | 0.5 points |
| | | | | Driver responsibility | 0.5 points |
| | | | | Use conditions of parking function | 0.5 points |
| | | | | Limitations of parking function | 0.5 points |
| | | Review of function prompt | 3 points | Prompt for opening and closing | 1.5 points |
| | | | | Prompt for system failure and functional insufficiency | 1.5 points |

**Annex A**
**Detailed Rules for Parking Capability Rating**

## A.1 Parallel parking space

### A.1.1 Rating of scenario with double-boundary parallel parking spot

A.1.1.1 The full score for the parking-in rating is 12 points, and the rating indicators include "number of kneading", "deflection angle", "distance from curb" and "absolute value of maximum longitudinal acceleration". See Table A.1 for specific scoring methods. After completing the parking-in test, measure the distances Df and Dr between the outer contact points of the front and rear wheels of the VUT and the curb of the target parking space. Take the smaller distance as the "distance to the curb" and calculate the angle α formed between the vehicle body and the parking space boundary using Df and Dr. See Fig. A.1 for the schematic diagram of measurement. If the VUT ends the test ahead of schedule as listed in 5.1.7 of the test procedure, no score will be given under this test cycle.

**Table A.1    Scoring Indicators and Grades for Parking-in Rating**

| Scoring Indicator | Scoring Grade |
|---|---|
| Number of kneading, 7.2 points | ≤4 times, 7.2 points |
| | = 5 times, 6.0 points |
| | = 6 times, 4.8 points |
| | = 7 times, 3.6 points |
| | >7 times, 0 points |
| Deflection angle, 1.2 points | Within -3°~3°, 1.2 points |
| | Out of -3°~3°, 0 point |
| Distance from curb, 1.2 points | [0.30m, inf), 0 point |
| | [0.25m, 0.30m), 0.9 points |
| | [0.10m, 0.25m), 1.2 points |
| | [0.05m, 0.10m), 0.9 points |
| | [0.00m, 0.05m), 0 point |
| Absolute value of maximum longitudinal acceleration, 2.4 points | [0.2g, inf), 0 point |
| | [0.1g, 0.2g), 1.2 points |
| | [0.0g, 0.1g), 2.4 points |

Note 1:   If the parking-in duration exceeds 90s, the scoring indicator "absolute value of maximum longitudinal acceleration" is 0 point.

Note 2:   The starting point for measuring the parking-in duration is when the VUT first switches from forward gear to reverse gear during the initial kneading. The endpoint for measuring the parking-in duration is when the VUT smoothly parks in the target parking space and the system signals the completion of the parking-in.
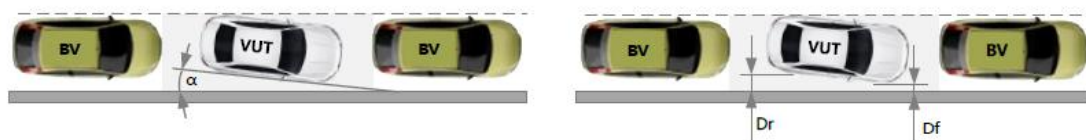


**Fig. A.1 Schematic Diagram of Measurement of Deflection Angle (Left) and Distance from Curb (Right)**

A.1.1.2 The full score for the parking-out rating is 3 points, and the rating indicator is "whether the VUT can park out". If the VUT parks out successfully, the VUT scores 3 points under this test cycle. Different vehicle types may have different parking-out technical routes. The two final forms of

parking-out shown in Fig. A.2 can be considered normal and successful parking-out. If the VUT ends the test ahead of schedule as listed in 5.1.7 of the test procedure, no score will be given under this test cycle.
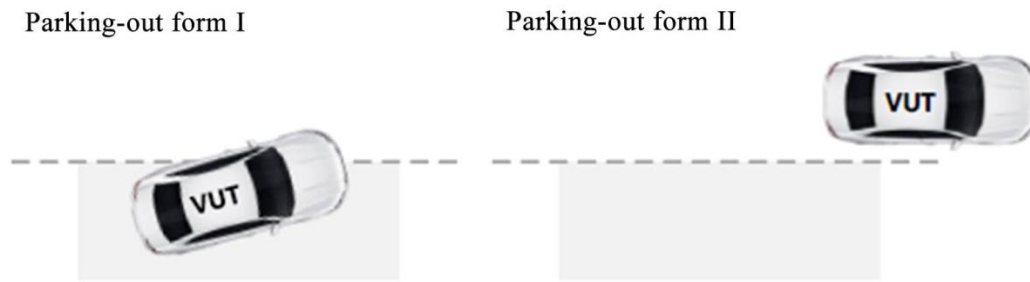


**Fig. A.2 Two Parking-out Forms in Parallel Parking Space**

A.1.2    Rating of the scenario in which APT walks through a double-boundary parallel parking space at a constant speed along the road edge

A.1.2.1   The parking-in rating has a maximum score of 12 points. The score is based on the actual performance of the VUT under the test cycle according to the specified completion conditions in A.1.2.2 of the test cycle. Scenarios a, b, and c correspond to scores of 12, 6, and 0 points respectively.

A.1.2.2   The parking-out rating has a maximum score of 3 points. The score is based on the actual performance of the VUT under the test cycle according to the specified completion conditions in A.1.2.2 of the test protocol. Scenarios a, b, and c correspond to scores of 3, 1.5, and 0 points respectively.

**Table A.2    Scoring of Scenario in which APT Walks through a Double-boundary Parallel Parking Space at a Constant Speed along the Road Edge**

| Test Cycle | | Test Result | Score |
|---|---|---|---|
| Parking-in rating | Scenario a | Successful collision avoidance and parking in the parking space | 12 points |
| | Scenario b | Only successful collision avoidance | 6 points |
| | Scenario c | Collision | 0 points |
| Parking-out rating | Scenario a | Successful collision avoidance and parking out the parking space | 3 points |
| | Scenario b | Only successful collision avoidance | 1.5 points |
| | Scenario c | Collision | 0 points |

**A.2 Perpendicular parking space**

**A.2.1    Rating of the scenario of perpendicular parking space with a pillar and bordering vehicle**

The full score for the parking-in rating is 15 points, and the rating indicator includes "number of kneading", "deflection angle", "whether the VUT is in the target area" and "absolute value of maximum longitudinal acceleration". See Table A.3 for specific scoring methods. After completing the parking-in test, measure the distances between the outer contact points of the front and rear wheels of the VUT and the inner edge of the target parking space. Judge whether the VUT is parked in the target area, and calculate the included angle β between the vehicle body and the parking space boundary. See Fig. A.3 for the schematic diagram of measurement. The target area refers to the rectangular area in which the distance between the VUT and the left and right edge lines of the target parking space is Δd, and the value of Δd is 0.1 m. If the VUT ends the test ahead of schedule as listed in 5.1.7 of the test procedure, no score will be given under this test cycle.

**Table A.3　Scoring Indicators and Grades for Parking-in Rating**

| Scoring Indicator | Scoring Grade | |
|---|---|---|
| Number of kneading, 9.0 points | Length of VUT <5m | ≤3 times, 9.0 points |
| | | = 4 times, 7.5 points |
| | | = 5 times, 6.0 points |
| | | = 6 times, 4.5 points |
| | | >6 times, 0 points |
| | Length of VUT ≥5m | ≤4 times, 9.0 points |
| | | = 5 times, 7.5 points |
| | | = 6 times, 6.0 points |
| | | =7 times, 4.5 points |
| | | >7 times, 0 points |
| Deflection angle, 1.5 points | Within -3°~3°, 1.5 points | |
| | Out of -3°~3°, 0 point | |
| Whether it is in the target area, 1.5 points | Yes, 1.5 points | |
| | No, 0 points | |
| Absolute value of maximum longitudinal acceleration, 3.0 points | [0.2g, inf), 0 point | |
| | [0.1g, 0.2g), 1.5 points | |
| | [0.0g, 0.1g], 3 points | |

**Note 1:** If the parking-in duration exceeds 90s, the scoring indicator "absolute value of maximum longitudinal acceleration" is 0 point.

**Note 2:** The starting point for measuring the parking-in duration is when the VUT first switches from forward gear to reverse gear during the initial kneading. The endpoint for measuring the parking-in duration is when the VUT smoothly parks in the target parking space and the system signals the completion of the parking-in.
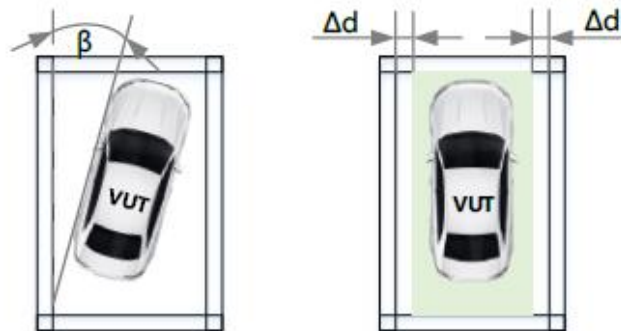


**Fig. A.3 Schematic Diagram of Measurement of Deflection Angle (Left) and Target Area (Right)**

**A.2.2　Rating of scenario of perpendicular parking space with markings**

Same as A.2.1.

**A.2.3　Rating of scenario in which CPT walks into the center of perpendicular parking space with a pillar and bordering vehicle**

The full score for the parking-in rating is 15 points, and the rating indicator is "whether there is a collision". If the VUT is able to detect the CPT and stop safely, the VUT scores 15 points under this test cycle; otherwise, 0 points will be scored.

**A.3　Diagonal parking space**

The full score for the parking-in rating is 10 points, and the rating indicator includes "number of kneading", "deflection angle", "whether the VUT is in the target area" and "absolute value of maximum longitudinal acceleration". SeeTable A.4 for specific rating methods. After completing the parking-in test, measure the distance between the outer contact points of the front and rear wheels of the VUT and the outer edge of the bordering vehicle. Judge whether the VUT is parked in the target area, and calculate the included angle β between the vehicle body and the parking space boundary. SeeFig. A.4 for the schematic diagram of measurement. The target area refers to the rectangular area in which the distance between the VUT and the bordering vehicle on each side is Δd, and the value of Δd is 0.1 m. If the VUT ends the test ahead of schedule as listed in 5.1.7 of the test procedure, no score will be given under this test cycle.

**Table A.4    Scoring Indicators and Grades for Parking-in Rating**

| Scoring Indicator | Scoring Grade | | |
|---|---|---|---|
| Number of kneading, 6 points | Length of VUT <5m | ≤3 times, 6 points | |
| | | =4 times, 5 points | |
| | | =5 times, 4 points | |
| | | = 6 times, 3 points | |
| | | >6 times, 0 points | |
| | Length of VUT ≥5m | ≤4 times, 6 points | |
| | | =5 times, 5 points | |
| | | =6 times, 4 points | |
| | | = 7 times, 3 points | |
| | | >7 times, 0 points | |
| Deflection angle, 1 point | Within -3°~3°, 1 point | | |
| | Out of -3°~3°, 0 point | | |
| Whether it is in the target area, 1 point | Yes, 1 point | | |
| | No, 0 points | | |
| Absolute value of maximum longitudinal acceleration, 2 points | [0.2g, inf), 0 point | | |
| | [0.1g, 0.2g), 1 point | | |
| | [0.0g, 0.1g), 2 points | | |

**Note 1:** If the parking-in duration exceeds 90s, the scoring indicator "absolute value of maximum longitudinal acceleration" is 0 point.

**Note 2:** The starting point for measuring the parking-in duration is when the VUT first switches from forward gear to reverse gear during the initial kneading. The endpoint for measuring the parking-in duration is when the VUT smoothly parks in the target parking space and the system signals the completion of the parking-in.
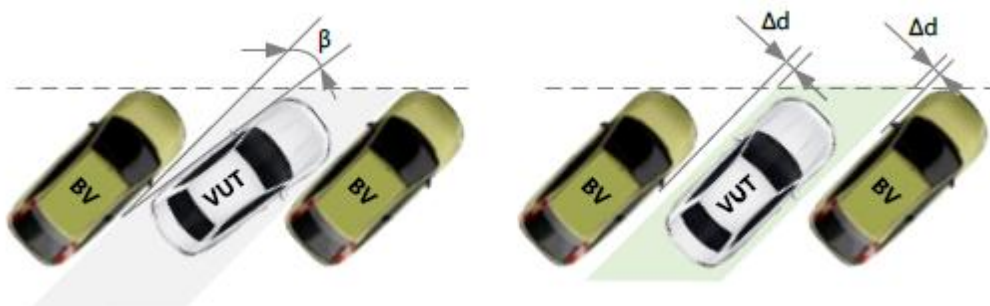


**Fig. A.4 Schematic Diagram of Measurement of Deflection Angle (Left) and Target Area (Right)**

**Annex B**

# Detailed Rules for RPA Rating

## B.1 Rating of scenario with parallel parking spot

B.1.1    The full score for the parking-in rating is 3 points, and the rating indicators include "number of kneading", "deflection angle", "distance from curb" and "absolute value of maximum longitudinal acceleration". See Table B.1 for specific scoring methods. After completing the parking-in test, measure the distances Df and Dr between the outer contact points of the front and rear wheels of the VUT and the curb of the target parking space. Take the smaller distance as the "distance to the curb" and calculate the angle α formed between the vehicle body and the parking space boundary using Df and Dr. See Fig. B.1 for the schematic diagram of measurement. If the VUT ends the test ahead of schedule as listed in 5.1.7 of the test procedure, no score will be given under this test cycle.

### TableB.1    Scoring Indicators and Grades for Parking-in Rating

| Scoring Indicator | Scoring Grade |
|---|---|
| Number of kneading, 1.8 points | ≤4 times, 1.8 points |
| | = 5 times, 1.5 points |
| | = 6 times, 1.2 points |
| | = 7 times, 0.9 points |
| | >7 times, 0 points |
| Deflection angle, 0.3 points | Within -3°~3°, 0.3 points |
| | Out of -3°~3°, 0 point |
| Distance from curb, 0.3 points | [0.30m, inf), 0 point |
| | [0.25m, 0.30m), 0.225 points |
| | [0.10m, 0.25m), 0.3 points |
| | [0.05m, 0.10m), 0.225 points |
| | [0.00m, 0.05m), 0 point |
| Absolute value of maximum longitudinal acceleration, 0.6 points | [0.2g, inf), 0 point |
| | [0.1g, 0.2g), 0.3 points |
| | [0.0g, 0.1g), 0.6 points |

**Note 1:**    If the parking-in duration exceeds 90s, the scoring indicator "absolute value of maximum longitudinal acceleration" is 0 point.

**Note 2:**    The starting point for measuring the parking-in duration is when the VUT first switches from forward gear to reverse gear during the initial kneading. The endpoint for measuring the parking-in duration is when the VUT smoothly parks in the target parking space and the system signals the completion of the parking-in.



**Fig. B.1 Schematic Diagram of Measurement of Deflection Angle (Left) and Distance from Curb (Right)**

B.1.2    The full score for the parking-out rating is 2 points, and the rating indicator is "whether the VUT can park out". If the VUT parks out successfully, the VUT scores 2 points under this test cycle. Different vehicle types may have different parking-out technical routes. The two final forms of parking-out shown in Fig. B.2 can be considered normal and successful parking-out. If the VUT ends the test ahead of schedule as listed in 5.1.7 of the test procedure, no score will be given under this test cycle.

Parking-out form I        Parking-out form II



**Fig. B.2 Two Parking-out Forms in Parallel Parking Space**

## B.2 Rating of scenario of perpendicular parking space

B.2.1    The full score for the parking-in rating is 3 points, and the rating indicator includes "number of kneading", "deflection angle", "whether the VUT is in the target area" and "absolute value of maximum longitudinal acceleration". See Table B.2 for specific scoring methods. After completing the parking-in test, measure the distances between the outer contact points of the front and rear wheels of the VUT and the inner edge of the target parking space. Judge whether the VUT is parked in the target area, and calculate the included angle β between the vehicle body and the parking space boundary. See Fig. B.3 for the schematic diagram of measurement. The target area refers to the rectangular area in which the distance between the VUT and the left and right edge lines of the target parking space is Δd, and the value of Δd is 0.1 m. If the VUT ends the test ahead of schedule as listed in 5.1.7 of the test procedure, no score will be given under this test cycle.

**Table B.2     Scoring Indicators and Grades for Parking-in Rating**

| Scoring Indicator | Scoring Grade | | |
|---|---|---|---|
| Number of kneading, 1.8 points | Length of VUT <5m | ≤3 times, 1.8 points | |
| | | = 4 times, 1.5 points | |
| | | = 5 times, 1.2 points | |
| | | =6 times, 0.9 points | |
| | | >6 times, 0 points | |
| | Length of VUT ≥5m | ≤4 times, 1.8 points | |
| | | = 5 times, 1.5 points | |
| | | = 6 times, 1.2 points | |
| | | = 7 times, 0.9 points | |
| | | >7 times, 0 points | |
| Deflection angle, 0.3 points | Within -3°~3°, 0.3 points | | |
| | Out of -3°~3°, 0 point | | |
| Whether the VUT is parked in the target area, 0.3 points | Yes, 0.3 points | | |
| | No, 0 points | | |
| Absolute value of maximum longitudinal acceleration, 0.6 points | [0.2g, inf), 0 point | | |
| | [0.1g, 0.2g), 0.3 points | | |
| | [0.0g, 0.1g), 0.6 points | | |

**Note 1:**    If the parking-in duration exceeds 90s, the scoring indicator "absolute value of maximum longitudinal acceleration" is 0 point.

**Note 2:**    The starting point for measuring the parking-in duration is when the VUT first switches from forward gear to reverse gear during the initial kneading. The endpoint for measuring the parking-in duration is when the VUT smoothly parks in the target parking space and the system signals the completion of the parking-in.
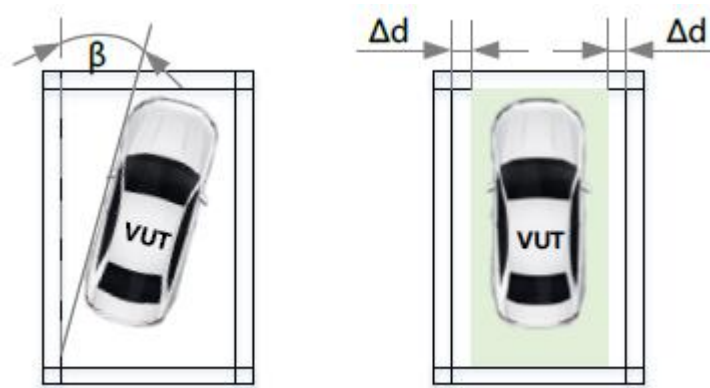
**Fig. B.3 Schematic Diagram of Measurement of Deflection Angle (Left) and Target Area (Right)**

B.2.2    The full score for the parking-out rating is 2 points, and the rating indicator is "whether the VUT can park out". If the VUT parks out successfully, the VUT scores 2 points under this test cycle. Otherwise, the score is 0 points, and the test is carried out once. Different vehicle types may have different parking-out technical routes. The following two final forms of parking-out can be considered normal and successful parking-out. If the VUT ends the test ahead of schedule as listed in 5.1.7 of the test procedure, no score will be given under this test cycle.
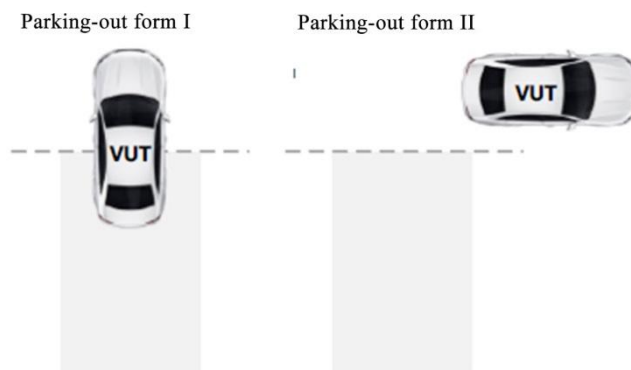


**Fig. B.4 Two Parking-out Forms in Vertical Parking Space**

**Annex C**
**Detailed Rules for Safety Tips Review**

## C.1 Review of user manual

The full score for a user manual review is 2 points, and the specific review terms and scoring methods are as follows:

**Table C.1    Scoring Terms and Methods for User Manual Review**

| S/N | Scoring Term | Scoring method |
|---|---|---|
| 1 | Definition of assist functions | If the user manual specifies that the system is "assisted driving", 0.5 points will be scored; otherwise, no point will be scored |
| 2 | Driver responsibility | If the user manual specifies that the driver needs to be fully responsible for the driving results, 0.5 points will be scored; otherwise, no point will be scored |
| 3 | Use conditions of parking function | If the user manual clearly specifies the use conditions of the parking function, 0.5 points will be scored; otherwise, no point will be scored |
| 4 | Limitations of parking function | If the user manual clearly lists conditions where the parking function is not applicable, 0.5 points will be scored; otherwise, no point will be scored |

## C.2 Review of function prompt

The full score for the review of the function prompt is 3 points, and the rating items include "prompt for enabling and disabling" and "prompt for system failure and functional insufficiency". Specific scoring methods are as follows:

a)    Enable the parking-in and parking-out functions of the VUT, and observe whether there are sound and image prompts when the relevant functions are enabled and disabled. If the VUT is able to prompt the driver that the parking function is enabled and disabled by sound or image or both, 1.5 points will be scored. Otherwise, no points will be scored.

b)    During parking-in and parking-out of the VUT, set functional insufficiency and fault problems by means such as blocking the sensor or powering off, and observe whether there are prompts for system failure and functional insufficiency. If the VUT is able to alert the driver to system failures or functional insufficiencies in the parking function through sound, image, or both, 1.5 points will be awarded. Otherwise, no points will be given.