

# **GTI Test Solution for MIoT Terminal: Vehicle Detector in Intelligent Parking System**

The logo consists of the letters 'GTI' in a bold, white, sans-serif font, centered on a dark blue background. The background features a glowing blue grid pattern that recedes into a bright light source, creating a tunnel-like effect. There are also some circular light artifacts on the left side.

**GTI**

<http://www.gtigroup.org>

**GTI Test Solution for MIoT Terminal:  
Vehicle Detector in Intelligent Parking System**



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### Document History

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## 1 Scope

This document defines the function and performance test solution for Vehicle Detector in Intelligent Parking System.

## 2 References

[1] GTI NB-IoT Terminal OTA Test Specification, 2018.10

## 3 Definitions, Symbols and Abbreviations

Abbreviation	Definitions
NB-IoT	Narrow Band Internet of Things
RSRP	Reference Signal Received Power
SINR	Signal to Interference plus Noise Ratio
OTA	Over The Air
TRP	Total Radiated Power
TIS	Total Istropic Sensitivity

## 4 Test Environment



Figure 4-1 logic networking diagram for Test

	Item	Function	Amount	Note
1	steel plate	Car simulator	1	12cm*12c*3mm
2	Strong magnet	To simulate the change of magnetic field	1	Rb magnet
3	Tinfoil	Obstacle simulator	1	
4	TIN can	Obstacle simulator	1	

Figure 4-2 Test Tool

5 Test Case

5.1 Service Test

5.1.1 Heartbeat Interactive Test

TC NO.	错误!未找到引用源。↓
Test Case	Heartbeat Interactive Test
Test Purpose	Check whether the heartbeat interaction interface between the vehicle detector and the platform is normal, and whether the device works normally.
Initial configuration	1. Put the vehicle detector in a stable position; 2. Install the SIM card and register to the network;
Test procedure	1. Configuration of a 10-minute heartbeat cycle on the parking management platform 2. Observe two heartbeat cycles. 3. Adjust the heartbeat cycle to 15 minutes and 20 minutes diversely; repeat steps 1~3. 4. Record test results.
Check Point / Data Record	1. With three heartbeat cycle configurations, heartbeat messages could be received on service platform side. 2. The deviation between the actual heartbeat interval and configured interval is <25 seconds
Reference flow	

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5.1.2 Car In-out Reporting Test

TC NO.	错误!未找到引用源。↓
Test Case	Car in-out reporting test
Test Purpose	To Verify whether the vehicle detector reports the data according to the specified rules when the state of parking space changes.
Initial configuration	1. Put the vehicle detector in a stable position; 2. Install the SIM card and register to the network; 3. Register the vehicle detector to the business platform; 4. Complete device initialization; set the heartbeat time to 15 minutes;
Test procedure	1. The steel plate is placed directly above the vehicle detector to simulate the status of the vehicle entries and keep for 2 minutes. 2. Remove the steel plate from the top of the vehicle detector to simulate the status of the vehicle leaves and keep for 2 minutes. 3. Repeat steps 1-2 4. Record test results.
Check Point / Data Record	1. Test Step 1, after parking is stable, the vehicle log will be displayed within 25 seconds 2. Test step 2, after parking is stable, the vehicle-free log is displayed within 25 seconds

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Note	
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**5.1.3 Neighboring Vehicle Misjudgment Test**

TC NO.	5.1.3
Test Case	Neighboring Vehicle Misjudgment Test
Test Purpose	Verify whether the simulated in-and-out vehicles will produce interference to the adjacent parking spaces; Verify the interference of vehicles driving in the surrounding environment (5cm away from the standard parking space) and vehicles crossing the parking space area quickly (overtaking in passing) to the vehicle detector
Initial configuration	<ol style="list-style-type: none"> <li>Put the vehicle detector in a stable position;</li> <li>Install the SIM card and register to the network;</li> <li>Add the vehicle detector to the business platform;</li> <li>Complete device initialization;</li> <li>A vehicle or no vehicle in the parking area;</li> <li>Set the heartbeat time to 15 minutes;</li> </ol>
Test procedure	<ol style="list-style-type: none"> <li>Scenario1: Steel plate passes slowly over the oblique top of the vehicle detector, do not cover the vehicle detector above directly, simulate the vehicle passing near the parking space and observe the change of the parking space.</li> <li>Scenario2: The steel plate is placed on the oblique top of the vehicle detector, do not cover the right top of the vehicle detector, test at 5 cm around the vehicle detector, simulating the parking of adjacent parking spaces for 2 minutes, and observing the change of parking spaces.</li> <li>Scenario3: The steel plate passes through the vehicle detector quickly, simulating the vehicle crossing the parking space quickly and observing the change of parking space.</li> <li>50 tests for each of the three scenarios.</li> <li>Record test results.</li> </ol>
Check Point / Data Record	<ol style="list-style-type: none"> <li>The parking area maintained its original shape without any reported state change.</li> <li>The Misjudgments rate is less than 1%.</li> </ol>
Note	

**5.1.4 Strong Magnetic Interference Test**

TC NO.	<del>错误!未找到引用源。</del>
Test Case	Strong magnetic interference test
Test Purpose	After strong magnetic interference, geomagnetism can work normally without manual intervention.
Initial configuration	<ol style="list-style-type: none"> <li>Put the vehicle detector in a stable position;</li> <li>Install the SIM card and register to the network;</li> <li>Add the vehicle detector to the business platform;</li> <li>Complete device initialization;</li> <li>Set the heartbeat time to 15 minutes;</li> </ol>

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Test procedure	<ol style="list-style-type: none"> <li>1. Strong magnetic (100mGs) is sucked under the steel plate and placed directly above the vehicle detector, simulate an inbound vehicle with strong magnetic force and stay for 2 minutes.</li> <li>2. The steel plate strengthened magnetic (100mGs) is removed from the front of the vehicle detector; simulate an inbound vehicle with strong magnetic force and stay for 2 minutes.</li> <li>3. Put the steel plate directly above the vehicle detector without strong magnetic force, simulate the normal inbound vehicle and stay for 2 minutes.</li> <li>4. Remove the steel plate from the top of the vehicle detector to simulate the status of the vehicle leaves and keep for 2 minutes.</li> <li>5. Repeat steps 1-4.</li> <li>6. Record test results.</li> </ol>
Check Point / Data Record	<ol style="list-style-type: none"> <li>1. Test step 1, display vehicle logs within 25 seconds.</li> <li>2. Test step 2, display vehicle-free logs within 25 seconds.</li> <li>3. Test step 3, display vehicle logs within 25 seconds.</li> <li>4. Test step 4, display vehicle-free logs within 25 seconds.</li> </ol>
Note	

5.1.5 Obstacle Test

TC NO.	错误!未找到引用源。5
Test Case	Obstacle test
Test Purpose	Verify the interference of obstacles on vehicle detector
Initial configuration	<ol style="list-style-type: none"> <li>1. Put the vehicle detector in a stable position;</li> <li>2. Install the SIM card and register to the network;</li> <li>3. Add the vehicle detector to the business platform;</li> <li>4. Complete device initialization;</li> <li>5. Set the heartbeat time to 15 minutes;</li> <li>6. Put a tinfoil and a TIN can on the surface of the vehicle detector, respectively.</li> </ol>
Test procedure	<ol style="list-style-type: none"> <li>1. Put 2 sheets of A4 paper on the surface of the vehicle detector.</li> <li>2. Put the steel plate directly above the vehicle detector to simulate the status of the vehicle entries and keep for 2 minutes.</li> <li>3. Remove the steel plate from the top of the vehicle detector to simulate the status of the vehicle leaves and keep for 2 minutes.</li> <li>4. Repeat steps 1-2.</li> <li>5. Put tinfoil on the vehicle detector.</li> <li>6. Put the steel plate directly above the vehicle detector to simulate the status of the vehicle entries and keep for 2 minutes.</li> <li>7. Remove the steel plate from the top of the vehicle detector to simulate the status of the vehicle leaves and keep for 2 minutes.</li> <li>8. Repeat step 5~7 for 3 times.</li> <li>9. Put cans on vehicle detector.</li> <li>10. Put the steel plate directly above the vehicle detector to simulate the status of the vehicle entries and keep for 2 minutes.</li> <li>11. Remove the steel plate from the top of the vehicle detector to simulate the status of the vehicle leaves and keep for 2 minutes.</li> <li>12. Repeat step 9~11 for 3 times.</li> </ol>
Check Point / Data Record	<ol style="list-style-type: none"> <li>1. Test step 1: the parking area maintained its original shape without any reported state change.</li> <li>2. Test step 2, display vehicle logs within 25 seconds.</li> <li>3. Test step 3, display vehicle-free logs within 25 seconds.</li> </ol>

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	<ol style="list-style-type: none"> <li>4. Test Step 5, the parking area maintained its original shape without any reported state change.</li> <li>5. Test step 6: display vehicle logs within 25 seconds.</li> <li>6. Test steps 7: display vehicle-free logs within 25 seconds.</li> <li>7. Test Step 9: the parking area maintained its original shape without any reported state change.</li> <li>8. Test step 10: display vehicle logs within 25 seconds.</li> <li>9. Test steps 11: display vehicle-free logs within 25 seconds.</li> </ol>
Note	

### 5.1.6 Remote Upgrade

TC NO.	错误!未找到引用源。6
Test Case	Remote upgrade
Test Purpose	Remote Upgrade Scheme of Test Terminal.
Initial configuration	<ol style="list-style-type: none"> <li>1. Put the vehicle detector in a stable position;</li> <li>2. Install the SIM card and register to the network;</li> <li>3. Add the vehicle detector to the business platform;</li> <li>4. Complete device initialization, set the heartbeat time to 15 minutes;</li> </ol>
Test procedure	<ol style="list-style-type: none"> <li>1. Platform Push Equipment Upgrade Software.</li> <li>2. Record test results.</li> </ol>
Check Point / Data Record	<ol style="list-style-type: none"> <li>1. Platform message logs can reflect new versions.</li> </ol>
Note	

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### 5.2 Stability Test

TC NO.	5.2
Test Case	Reliability Test 错误!未找到引用源。
Test Purpose	Verify whether the vehicle detector can work stably in the long running process.
Initial configuration	<ol style="list-style-type: none"> <li>1. Put the vehicle detector in a stable position;</li> <li>2. Install the SIM card and register to the network;</li> <li>3. Add the vehicle detector to the business platform;</li> <li>4. Set the heartbeat time to 15 minutes</li> <li>5. Complete device initialization,;</li> </ol>
Test procedure	<ol style="list-style-type: none"> <li>1. Use steel plate to simulate the vehicle moving over the vehicle detector for 45 minutes once and standing for 2 minutes before leaving. Simulate the scene of vehicle entering and leaving.</li> <li>2. 10 random tests within 72 hours.</li> <li>3. Record test results.</li> </ol>

Check Point / Data Record	<ol style="list-style-type: none"> <li>1. There is no log outage in the log.</li> <li>2. There is no vehicle change reporting in the log..</li> <li>3. There is no software abnormal restart in the log.</li> <li>4. There is no time ahead or severely delayed server time in the log.</li> <li>5. Message loss rate &lt; 1%.</li> </ol>
Note	

**5.3 Reliability Test**

**5.3.1 Abnormal scenario Test**

TC NO.	5.3.1
Test Case	Abnormal scenario <u>错误!未找到引用源。</u>
Test Purpose	Verify whether the vehicle detector can recover normally in case of disconnection.
Initial configuration	<ol style="list-style-type: none"> <li>1. Put the vehicle detector in a stable position;</li> <li>2. Install the SIM card and register to the network;</li> <li>3. Heartbeat time set to 5 minutes;</li> <li>4. Connect the vehicle detector with the platform so that the platform can view the log information of the vehicle detector.</li> </ol>
Test procedure	<ol style="list-style-type: none"> <li>1. Put the vehicle detector into the shield box to simulate the environment without NB-IoT network signal.</li> <li>2. Continuous observation of 2 heartbeat cycles.</li> <li>3. Remove the vehicle detector from the shield box and restore the NB-IoT signal.</li> <li>4. Waiting for heartbeat to report automatically.</li> <li>5. Repeat the test 3 times.</li> <li>6. Observe the log records on the terminal side and the management platform side</li> </ol>
Check Point / Data Record	<ol style="list-style-type: none"> <li>1. Step 2: No log messages on the platform during network disconnection.</li> <li>2. Step 4: After the recovery of disconnection and the arrival of heartbeat time, we can re-register to the network and send log messages.</li> </ol>
Note	

**5.3.2 Equipment Switch On/off Test**

TC NO.	5.3.2
Test Case	Reliability Test <u>错误!未找到引用源。</u>
Test Purpose	Verify the rate of success test of switching machine.
Initial configuration	<ol style="list-style-type: none"> <li>1. The vehicle detector is placed in a stable position</li> <li>2. SIM card installed and registered to the network</li> <li>3. Heartbeat time set to 5 minutes;</li> <li>4. Connect the vehicle detector with the platform so that the platform can view the log information of the vehicle detector;</li> </ol>

Test procedure	<ol style="list-style-type: none"> <li>1. Device shutdown</li> <li>2. Wait for 5 minutes, check the heartbeat information and confirm the shutdown was successful</li> <li>3. Open the vehicle detector. Check the device's boot message after the boot is successful, wait for 5 minutes, then, check the platform's heartbeat message.</li> </ol>
Check Point / Data Record	<ol style="list-style-type: none"> <li>1. When closing, no packets will be reported after the heartbeat time reaches</li> <li>2. After startup, the startup message and heartbeat message can be seen through the platform.</li> </ol>
Note	

## 5.4 Accuracy Test

TC NO.	5.4
Test Case	Accuracy Test <u>错误!未找到引用源。</u>
Test Purpose	Verify the accuracy rate of the inbound and outbound geomagnetic vehicle accuracy.
Initial configuration	<ol style="list-style-type: none"> <li>1. Put the vehicle detector in a stable position;</li> <li>2. Install the SIM card and register to the network;</li> <li>3. Initialize the vehicle detector.</li> <li>4. Set the heartbeat time to 15 minutes</li> </ol>
Test procedure	<ol style="list-style-type: none"> <li>1. The steel plate is used to simulate the vehicle, move over the vehicle detector every 30 seconds and leaving after 30 seconds to simulate the scene of vehicle entering and leaving.</li> <li>2. Repeated trials 100 times.</li> <li>3. Record test results.</li> </ol>
Check Point / Data Record	<ol style="list-style-type: none"> <li>1. If the reported status of parking space after each entry/exit is consistent with the actual status, it is considered that the operation of entry and exit of the vehicle is accurate.</li> <li>2. The Misjudgments rate is less than 1%.</li> </ol>
Note	

## 5.5 Power Consumption Test

TC NO.	5.5
Test Case	Power Consumption Test <u>错误!未找到引用源。</u>

Test Purpose	Verify the power consumption of terminal in use.
Initial configuration	<ol style="list-style-type: none"> <li>1. Add external leads of power supply port for vehicle detector</li> <li>2. Install SIM card and register to the network;</li> <li>3. Set heartbeat time to 15 minutes;</li> </ol>
Test procedure	<ol style="list-style-type: none"> <li>1. Use an ammeter to power the device</li> <li>2. Record the average current and duration respectively, in power-on, heartbeat, inbound and outbound vehicles and idle.</li> </ol>
Check Point / Data Record	Under the business model, 10 entries and 10 exits per day, the terminal battery life is not less than 3 years.
Note	<p>Calculation scheme:</p> <ol style="list-style-type: none"> <li>1. Record the battery capacity of DUT as , the unit is <i>mAh</i></li> <li>2. Record the frequency of Periodic Status Report as <math>f_{PSR}</math>, which means times per Day.</li> <li>3. Estimate the frequency of car in-out Report as , which means the report frequency is <math>2 \times f_{car}</math> times per Day.</li> <li>4. Estimate the times of starting up per day as <math>f_{SwitchOn}</math> which may be Decimals less than 1.</li> <li>5. Calculate the Battery life according to following formula:</li> </ol> $Battery\ life = C / C_{Day}$ <p>Where</p> $C_{Day} = f_{PSR} I_{PSR} T_{PSR} + 2 \times f_{car} I_{car} T_{car} + f_{StartUp} I_{SwitchOn} T_{SwitchOn} + I_{Standby} T_{Standby}$ $I_{Standby} = 24\ hours - (f_{PSR} T_{PSR} + 2 \times f_{car} T_{car} + f_{SwitchOn} T_{SwitchOn})$

带格式的: 突出显示

删除的内容: of 15 minutes of heartbeat,

## 5.6 OTA Performance

### 5.6.1 TRP

Refer to TC 5.2 in GTI NB-IoT Terminal OTA Test Specification

### 5.6.2 TRS

Refer to TC 5.4 in GTI NB-IoT Terminal OTA Test Specification

### 5.6.3 OTA Criteria

Measurement Items	Criteria	
	Avg	Min

## GTI

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TRP	17.5 dBm	16.5dBm
	Avg	Max
TRS*	-102 dBm	-101dBm
*: TRS is the cell power without repetition		