

RESPONSE DISTANCE Between TimeTec BLE-2 (Gooseneck Pole) and i-TimeTec App (Smartphone) for Smart Barrier

1.0 • THE OBJECTIVES

This test is to determine:

- The optimum installation distance for TimeTec BLE-2 in relation to the various smartphone brands.
- The best enclosure to house TimeTec BLE-2 for the least communication interference.
- The best unlocking method of the three methods offered by i-TimeTec App when using TimeTec BLE-2 controller in unlocking the barrier gate.

2.0 • TEST SITE

The tests were done at a main entrance installed with a barrier gate at a factory. During the test, the driver was seated inside a tinted car without winding the tinted window as shown in Figure 1.

Tinted Window Film Specification:

Visible Light Transmittance:	73.20%
Visible Light Reflectance:	8.00%
Ultraviolet Radiation Rejection:	99.00%
Shading Coefficient:	0.50
Infrared Heat Rejection:	94.00%
Film Thickness:	4.0 mil or 0.16 mm (1.0 mil = 0.04mm)

Bluetooth Communication Mechanism is explained in Appendix 1. Basically, there are two factors affecting the response distance between the smartphones and TimeTec BLE-2:

- Bluetooth Interference Potential (Appendix 1)
- The brand and the model of the smartphone



3.0 • TEST INSTALLATION

The tests were carried out repeatedly with:

- TimeTec BLE-2 installed on a gooseneck pole in a metal enclosure
- TimeTec BLE-2 installed on a pole in a plastic/pvc enclosure

TimeTec BLE-2 was installed inside a gooseneck pole 2 meters before the barrier gate. It is connected to the barrier gate and shares the power supply from the barrier gate system. The installation was done on the gooseneck pole to ensure that TimeTec BLE-2 achieves an optimize broadcast range.

4.0 • ASSUMPTION BEFORE THE TESTS

Assuming that the enclosure is made of metal; it has the highest Interference Potential (Appendix 2) to Bluetooth Signal (Appendix 1) according to theory.

Therefore, installing TimeTec BLE-2 in a metal enclosure that comes with the pole will shorten the response distance between i-TimeTec App and TimeTec BLE-2.

3 unlock methods were used for this test. The driver did not wind down the car window, or open the car door during the test. All commands were done from inside the car's cabin.

5.0 • TEST RESULTS

• TimeTec BLE-2 in Metal Enclosure

SMARTPHONE BRAND AND MODEL	READING X (METER) DISTANCE DRIVER FROM POLE				
	TEST 1 Voice Command Activated	Gate Open	TEST 2 Auto Unlock Activated	Gate Open	TEST 3 Tap to Unlock
Samsung S8+	3.6	0.0	3.6	0.0	0.0
Samsung J5 Pro	8.0	0.0	8.0	0.0	0.0
Google Pixel 2	6.5	0.0	6.5	0.0	0.0
Mi Redmi	10.0	0.0	10.0	0.0	0.0
Oppo F1s	6.0	0.0	6.0	0.0	0.0
Huawei P9 Lite	8.5	2.7	8.5	2.7	2.7
iPhone 6	10.0	10.0	10.0	10.0	10.0
iPhone 6s	16.0	6.3	16.0	6.3	6.3
iPhone X	10.0	10.0	10.0	10.0	10.0

• TimeTec BLE-2 in Plastic/PVC Enclosure

SMARTPHONE BRAND AND MODEL	READING X (METER) DISTANCE DRIVER FROM POLE				
	TEST 1 Voice Command Activated	Gate Open	TEST 2 Auto Unlock Activated	Gate Open	TEST 3 Tap to Unlock
Samsung S8+	12.0	2.5	12.0	2.5	2.5
Samsung J5 Pro	15.0	6.5	15.0	6.5	6.5
Google Pixel 2	15.0	0.0	15.0	0.0	0.0
Mi Redmi	14.0	5.0	14.0	5.0	5.0
Oppo F1s	15.0	0.0	15.0	0.0	0.0
Huawei P9 Lite	9.5	4.0	9.5	4.0	4.0
iPhone 6	16.0	12.0	16.0	12.0	12.0
iPhone 6s	16.0	11.0	16.0	11.0	11.0
iPhone X	16.0	16.0	16.0	16.0	16.0

6.1 The Response Distance & Type of Enclosure

In all of the tests, the response distance varies based on the smartphone brands and models as well as the type of enclosure being used.

The shortest response distance was recorded by the Samsung Galaxy S8+ at 3.6 meters and the farthest response distance was recorded by the iPhone 6s at 16 meters when TimeTec BLE-2 was installed in a metal housing. On the other hand, the shortest response distance when TimeTec BLE-2 was installed in a plastic/PVC was recorded by Huawei P9 Lite at 9.5 meters and the farthest response distance is recorded by the iPhone 6/6s/X at 16 meters.

Hence, the metal enclosure proved to have greater interference potential when compared to the plastic enclosure. For the same smartphone brands and models, the response varies when different enclosure is in used. To optimize the broadcast range of TimeTec BLE 2, it is recommended that users utilizes the plastic enclosure instead of the metal enclosure.

6.2 The Open Gate Distance & Type of Enclosure

In Test 1 and 2, certain smartphones detected TimeTec BLE-2's broadcast Bluetooth signal at a far distance, i.e Mi-Redmi and Samsung J5 Pro but instead TimeTec BLE-2 failed to receive the auto/voice unlock command. Hence, drivers will have to proceed closer to TimeTec BLE-2 in order for the controller to receive the unlock command. This is due to the distance between "broadcast and listen" being different for Bluetooth chipset, in which the latter is shorter than the former.

To avoid disturbances caused by the failure command, it is advised that users use the Tap to Unlock method.

6.3 The Types of Unlocking Method

The tests were conducted using 3 different unlock methods for all of the smartphones. Users were required to perform the following before using any of the unlock methods:

- Tap to Unlock: Users must unlock the smartphone and launch the App.
- Auto Unlock: Users must unlock the smartphone and run the App in the background.
- Voice Command: Users must unlock the smartphone and run the App in the background.

UNLOCK METHOD	PROS	CONS
Tap to Unlock	The App only sends the unlock command to the dedicated TimeTec BLE-2, and not to any random device installed nearby. Fast "Try Again" mechanism thus allowing users to quickly send another unlock command whenever a "Connection Failed" occurred.	Before using the unlock command, users will need to launch the App first.
Auto Unlock	No distance gap between "broadcast and listen". The Barrier Gates can be unlocked as long as users activate their smartphones, unlock them at all times and have the Mobile App running in the background.	The App will be sending the command to any connected TimeTec BLE-2 within range if multiple BLE-2s are installed. Therefore, there is a possibility that the smartphone is capturing the signal broadcast from other BLE-2s rather than from the intended gate. Slow "Try Again" mechanism thus users will have to wait for the App to restart the process again after initially sending the unlock command.
Voice Command	The Barrier Gates can be unlocked as long as users activate their smartphones, unlock them at all times and have the Mobile App running in the background.	The App will be sending the command to any connected TimeTec BLE-2 within range if multiple BLE-2s are installed. Therefore, there is a possibility that the smartphone is capturing the signal broadcast from other BLE-2s rather than from the intended gate. Slow "Try Again" mechanism thus users will have to wait for the App to restart the process again after initially sending the unlock command.

Tap to Unlock has to be manually operated but it provides accurate response, and users will not unlock the wrong gate when multiple barrier gates are present within range.

Both Voice Command and Auto Unlock provide convenience so long as the users unlock their smartphones before approaching the gate along with the App running in the background. However, the Bluetooth "broadcast and listen" working mechanism could cause the App to send the signal to the wrong gate.

Hence, it is highly recommended to use Tap to Unlock as the default unlocking method because it is the most safe and secure method.

Even though Voice Command and Auto Unlock are convenient in certain ways, users will however need to activate the App and unlock the smartphone first in order to use these methods. This would create inconvenience for users who are not comfortable having their phones unlocked at all times and this will drain the smartphone battery as the App is always running in the background.

7.0 • SUGGESTIONS FOR BEST USER EXPERIENCE:

BEST INSTALLATION DISTANCE

The distance between the gooseneck pole installed with TimeTec BLE-2 and the barrier gate is recommended at 2-3 meters, thus allowing the driver to stop before the barrier gate.



BEST INSTALLATION ENCLOSURE

From the tests, TimeTec BLE-2 has the best response in receiving the unlock command when installed inside a plastic enclosure. Therefore, it is recommended that the plastic enclosure is utilized instead of the metal enclosure.

BEST UNLOCKING METHOD

Based on the tests, it is recommended that Tap to Unlock is the best method overall. However, due to different installation scenarios and smartphones, users can still select their own preferred unlocking methods.

SECURITY MEASURE

Even though there is a loop detector installed to prevent the opening of the barrier gate if no vehicle is detected, it is still recommended that users avoid from initiating the unlocking process at a far distance because this action might allow other vehicles to access the gate, i.e. vehicle in front.

APPENDIX 1 • Bluetooth Communication Mechanism

TimeTec BLE-2 smart door controller is a Bluetooth 4.2 enabled device that broadcasts its unique ID via Bluetooth signal to be detected by smartphones installed with i-TimeTec App. Most smartphones is compatible with Bluetooth 4.2 and certain newer models can even support Bluetooth 5. The table below represents the specifications comparison between different Bluetooth versions:

	BLUETOOTH V2.1	BLUETOOTH 4.0 (LE)	BLUETOOTH 5.0 (LE)
Range	Up to 100m	Up to 100m	Up to 400m
Max range (free field)	Around 100m (Class 2 outdoors)	Around 100m (outdoors)	Around 100m (outdoors)
Frequency	2.402 - 2.481 GHz	2.402 - 2.481 GHz	2.402 - 2.481 GHz
Max data rate	1-3 Mbit/s	1 Mbit/s	2 Mbit/s
Application Troughput	0.7-2.1 Mbit/s	Up to 305 kbit/s	Up to 1,360 kbit/s
Topologies	Point-to-point, scatternet	Point-to-point, mesh network	Point-to-point, mesh network
Network Standard	IEEE 802.15.1	IEEE 802.15.1	IEEE 802.15.1

APPENDIX 2 • Interference Potential

Even though the Bluetooth broadcast range is wide and long, the distance could be affected by the surroundings, especially the building materials (Refer to the table below) since the Bluetooth transmission data can be absorbed or reflected by said materials. Please refer to the table below to learn the types of barrier and the interference potential. The low interference potential indicates that the material has less impact on the Bluetooth transmission distance. As metal has the highest interference potential to radio frequency, it is foreseen that the maximum response distance test with a metal casing shall be shorter than the test without a metal casing.

Radio Frequency (RF) interference potential as shown in the list below:

TYPE OF BARRIER	INTERFERENCE POTENTIAL
Wood	Low
Synthetic material	Low
Glass	Low
Water	Medium
Bricks	Medium
Marble	Medium
Plaster	High
Concrete	High
Bulletproof glass	High
Metal	Very high