Test Report:

TeraRanger Duo Performance on Glass Window Surfaces

Prepared by
Greg watts

Terabee is an official CERN Technology Partner:

Proprietary & Confidential

Phone: +33 (0)6 81 28 70 24

Email: info@terabee.com

Web: www.terabee.com
www.teraranger.com

Address:

Terabee, Technoparc
90 Rue Henri Fabre
01630 Saint-Genis-Pouilly
France

Document version: 1.0

Test Report: TeraRanger Duo Performance on Glass Window Surfaces

1. Introduction

There is a growing demand to apply distance sensing in conditions where glass is often part of the environment. For light emitting sensors, this particular surface can be a challenge to “detect” or measure, for instance, when approaching at angles other than 90 degrees or working under strong ambient light conditions. In some cases, the signal can go straight through the transparent glass material, or be reflected away, failing to give accurate readings.

TeraRanger Duo is specifically designed to solve the problem of measuring “difficult surfaces”. TeraRanger Duo is a hybrid sensor of two technologies: (1) infrared Time-of-Flight (ToF) as found in the TeraRanger One sensor, and (2) high performance ultrasound (sonar). ToF copes very well with various material surfaces (and as the report shows, this can often include glass surfaces), with ultrasound providing a redundancy measure for the rare situations in which ToF might be suboptimal.

This report demonstrates the performance of both the optical Time-of-Flight and ultrasound components of TeraRanger Duo when detecting glass surfaces. The purpose of this test is to show in which conditions, and how well, Terabee technology works in “detecting” difficult surfaces such as plate glass. These tests were performed using a randomly selected TeraRanger Duo* from stock. All ToF distance measurements were made in the ‘default/precise’ (rather than the ‘fast’) mode.

* Please note; TeraRanger Duo uses TeraRanger One Type A sensor technology for its Time-of-Flight component and is not optimised for use outdoors or in bright sunlight in the same way that a TeraRanger One Type B sensor is.

2. Test Materials

Two glass surfaces were tested:

1. Terabee control window
2. Metallic coated (tinted) window

The control window is a standard double-glazed unit consisting of two glass panes separated by a hermetically sealed insulating air space.

The tinted window is an ordinary double-pane float-glass window with metallic coating, designed to reduce solar heat. This coating also produces a mirror effect.

Picture 2.1 Terabee control window (left): Metallic coated window (right)

Terabee
90 Rue Henri Fabre
01630 Saint-Genis-Pouilly

Website: www.teraranger.com
Commercial: teraranger@terabee.com

3. Test Setup

The TeraRanger Duo sensor was used to measure the distance to windows in outdoor, sunny conditions with an extremely high ambient light level (115 000 lux), and at an ambient temperature of 28°C. This implies that data collected during the test is highly representative of many real-life outdoor use cases.

Picture 3.1 Test Setup

Keeping in mind that often in applications the distance to objects are measured from different angles, the test is divided into two parts:

- During Test A, distance values were taken perpendicular (90 degrees) to both glass surfaces, measuring from a number of distances: 3, 5 and 7 meters.
- In Test B (2), distance values were taken from an angle of 45 degrees to the glass surfaces, measuring distance from 3 and 5 meters.

A laser distance meter was used to confirm the distance to the glass. Each distance measurement was made over a time period of five seconds. Figure 3.2 and 3.3 illustrate the arrangement of both A and B tests.

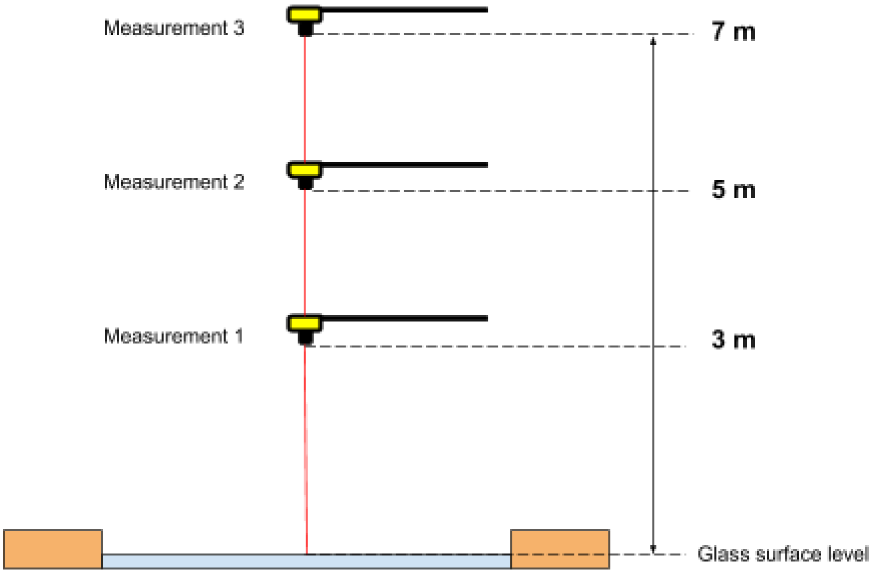

Figure 3.2 Test A environment illustration: perpendicular to glass

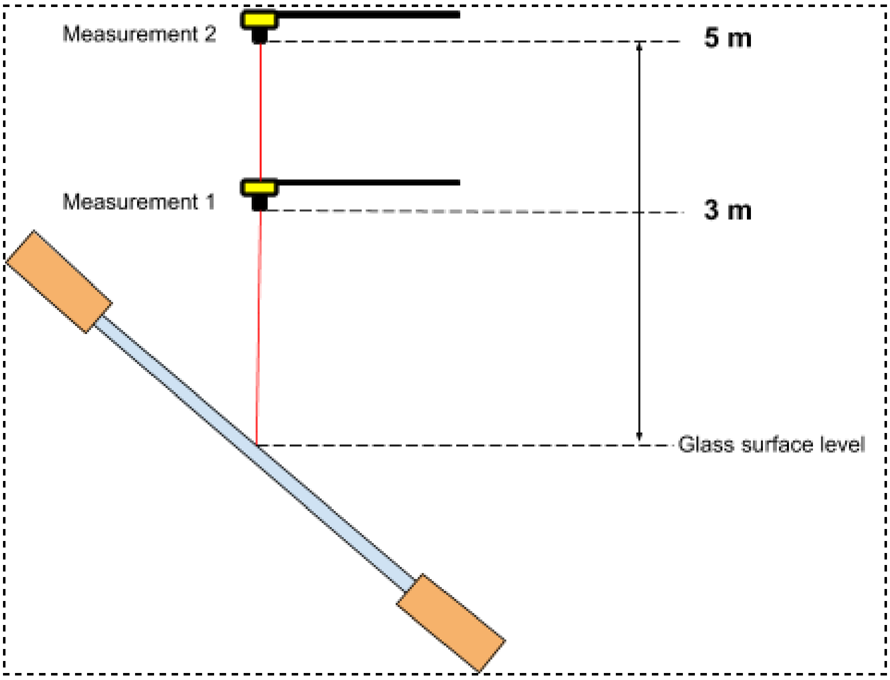

Figure 3.3 Test B environment illustration: 45 degrees to glass

For measuring the distance to the glass window from approximately a 45 degree angle, in the case of “Terabee control window”, TeraRanger Duo was simply turned and positioned to the mentioned angle.

However to test the metallic coated window at a 45 degree angle, a complex environment was found where a glass wall serves as the side of a building (Figure 3.4).

Picture 3.4 Test B (45 degrees): Terabee control window (left): Metallic coated window (right)

4. Test Results

The results of both test measurements are displayed in the following graphs. The left vertical axis always represents the distance values in millimeters. Charts are “zoomed” to illustrate patterns and precision for both sensing technologies used in the TeraRanger Duo; Time-of-Flight and ultrasound. Last, but not least, this experiment was conducted under strong ambient light conditions, in order to test the ToF element of TeraRanger Duo in highly challenging conditions.

4.1 Test A: perpendicular to window

Distance: 3 meters

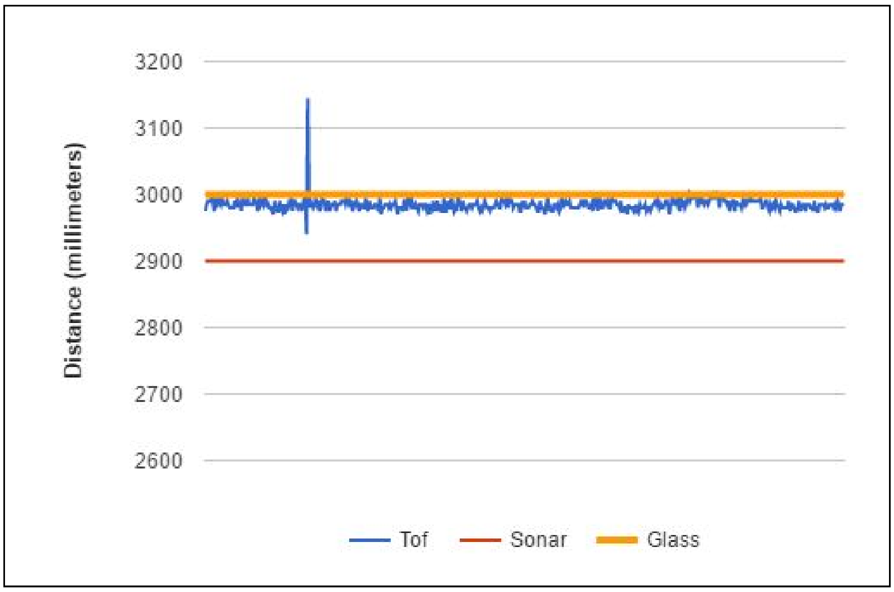

Figure 4.1 Surface: Terabee control window

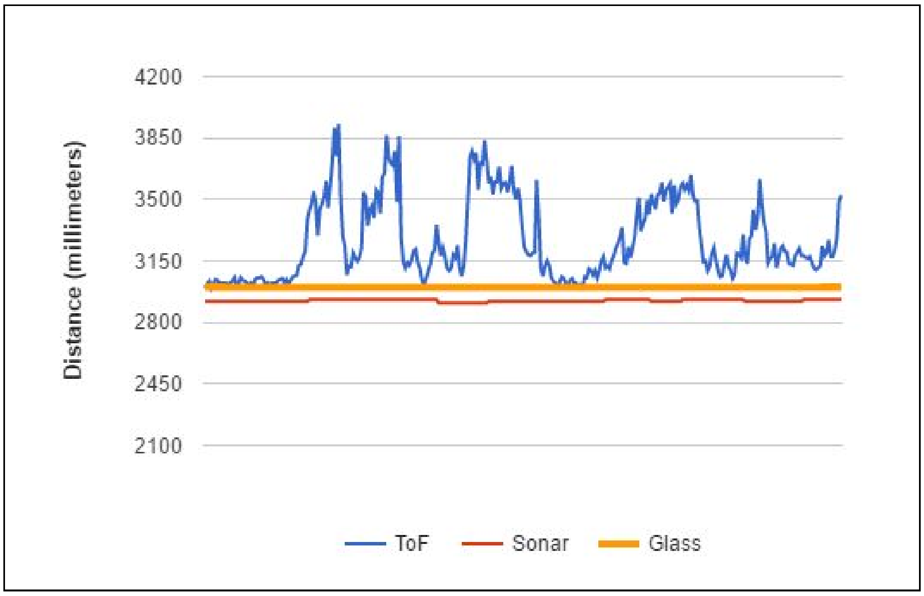

Figure 4.2 Surface: Metallic Coated Window

Terabee
90 Rue Henri Fabre
01630 Saint-Genis-Pouilly

Website: www.teraranger.com
Commercial: teraranger@terabee.com

Distance: 5 meters

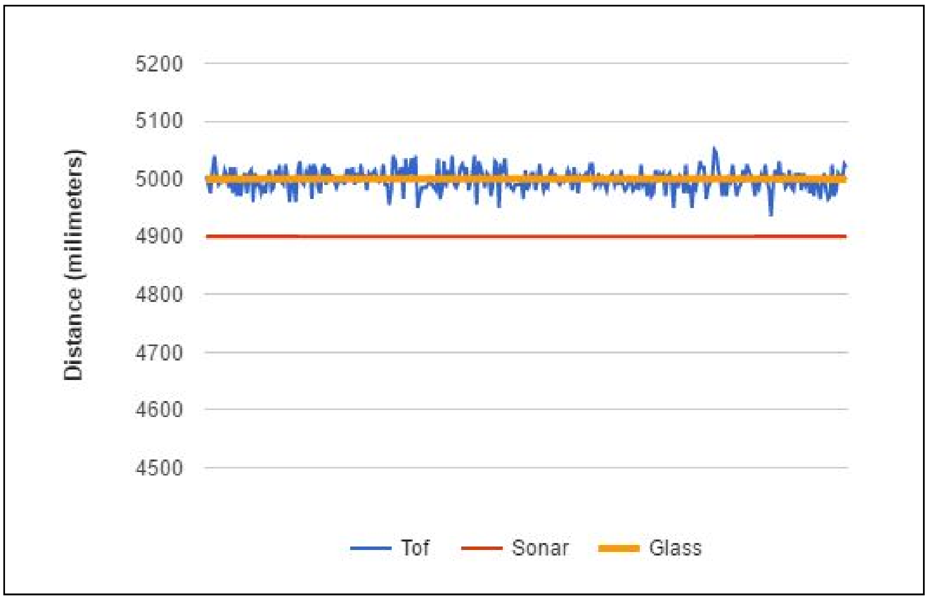

Figure 4.3 Surface: Terabee Control Window

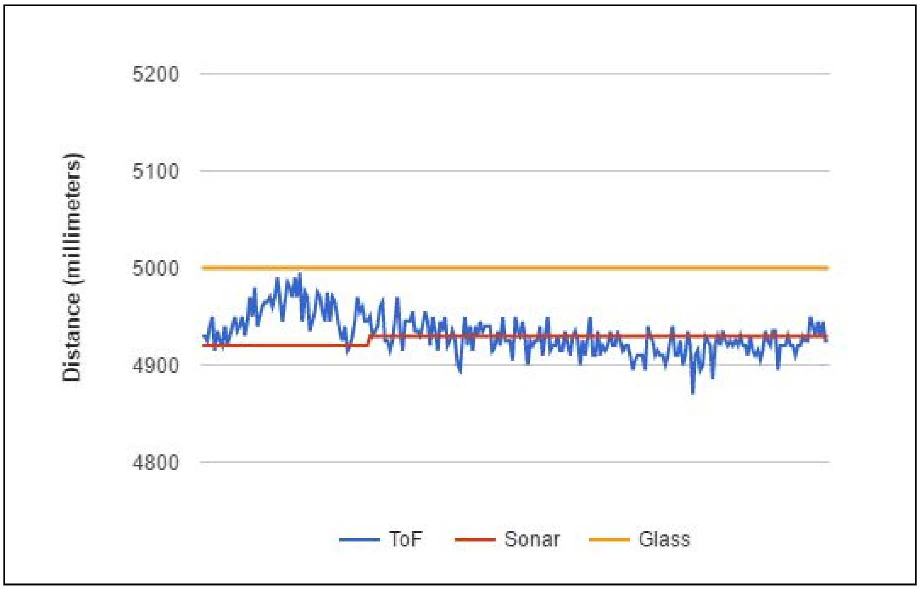

Figure 4.4 Surface: Metallic Coated Window

Distance: 7 meters

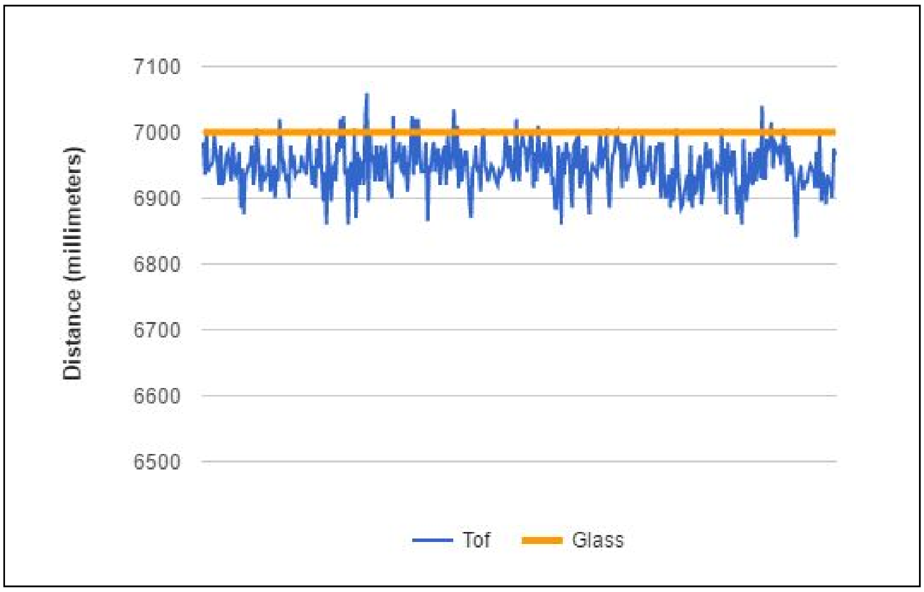

Figure 4.5 Surface: Terabee Control Window
(Note: Ultrasound was unable to attain a reading at this range and in these conditions and is therefore not present in this figure)

Conclusion for test perpendicular to glass
Test A results show that, when positioned perpendicular to both window types, TeraRanger Duo always detects the glass surface. It also demonstrates that in a lot of cases the Time-of-Flight component of the sensor can do a reasonably good job of detecting glass, but in the cases when ToF infrared light goes through the window surface (see in Figure 4.2), ultrasound will always recognize the glass surface.

4.2 Test B: 45 degree to window

Distance: 3 meters

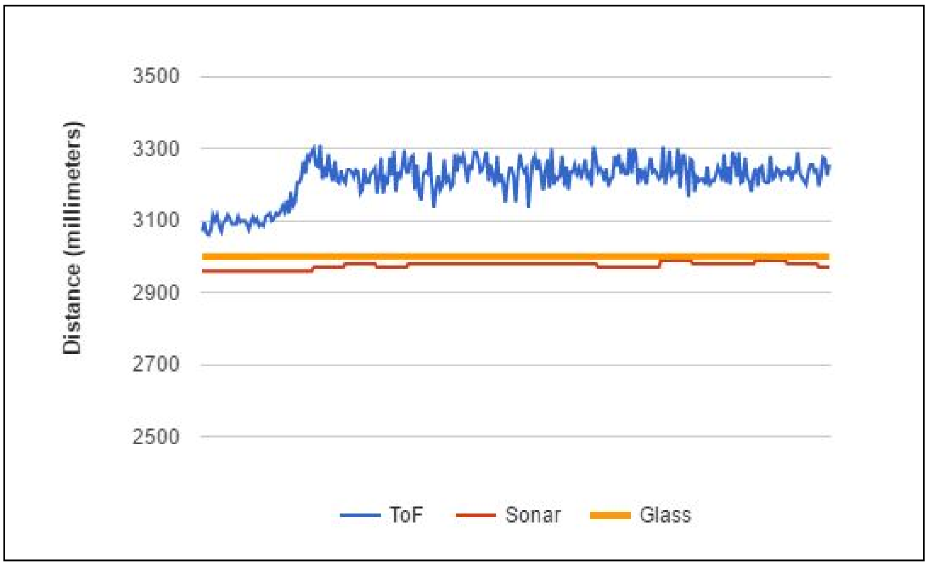

Figure 4.6 Surface: Terabee Control Window

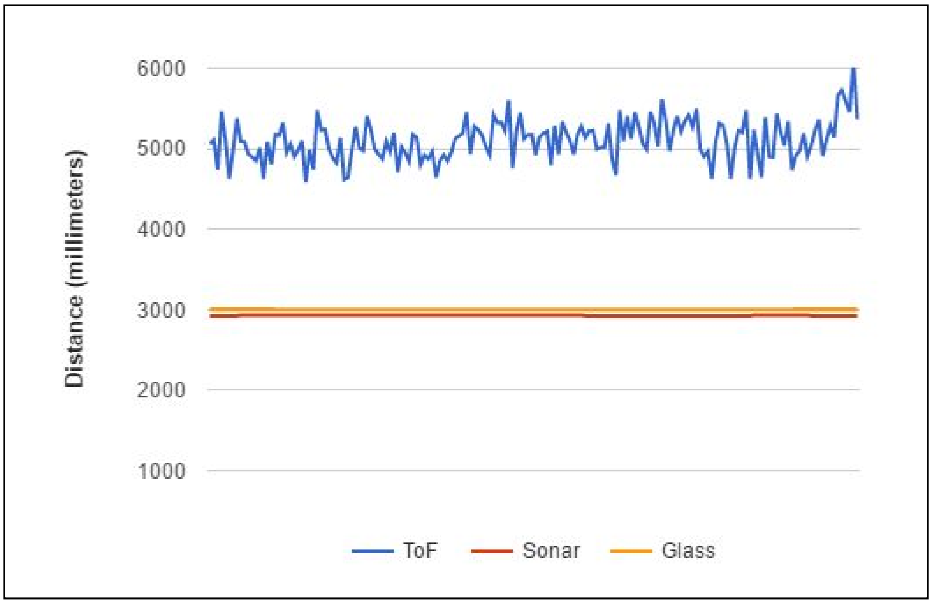

Figure 4.7 Surface: Metallic Coated Window

Distance: 5 meters

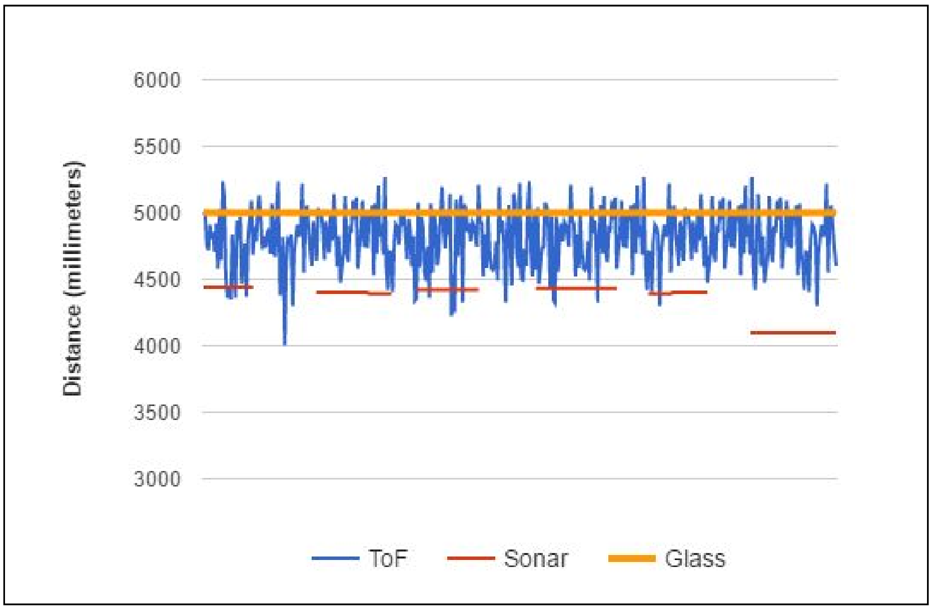

Figure 4.8 Surface: Terabee Control Window

Conclusions on tests on windows at 45 degrees
Test B results demonstrate that detecting window surfaces can become more complicated when measurements are taken from an angle (in this case: 45 degrees.). Figures 4.6 and 4.7 show how ToF signals fail to detect the real distance of the window surfaces, instead detecting objects behind the window glass. However, as can be seen, the sonar technology works as a redundancy measure for these situations, reliably returning a signal from the glass surfaces. (Figure 4.6, 4.7).

It should be noted that test B demonstrates a suboptimal approach angle for any sensor technology. One implication of this is that, as the distance from the window increases, the accuracy of the reading can degrade for both ToF and sonar (Figure 4.8). However, even in these “difficult” conditions, TeraRanger Duo has been able to clearly detect window surfaces from a 45 degree angle in all attempts, although in some cases the ultrasound measurement has not converged for the full five second test period.

6. Conclusion

In outdoor sunny conditions, and from a different number of distances and angles, TeraRanger Duo has been able to clearly detect window surfaces in all measuring attempts. When measuring the distance to window surfaces, under certain angles, accuracy can be affected. Nevertheless, the sonar technology has proven to recognize window surfaces in situations where ToF failed to do so reliably. The results of this test prove the suitability of

TeraRanger Duo for applications where glass surfaces will be encountered. In most real-world applications many different surfaces and targets will be encountered and in most situations ToF provides a longer range solution with far faster data refresh rates. The combination of ToF and sonar creates a solution with redundancy for the surfaces - notably plate glass - where ToF alone may not always be the optimum solution.

Terabee
90 Rue Henri Fabre
01630 Saint-Genis-Pouilly
Website: www.teraranger.com
Commercial: teraranger@terabee.com