

# ISO 17025 Compliant Calibration Certificate

14A0054A-IC-8137-200811-1

Oxford Technical Solutions



4647



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This calibration certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurements to the SI system of units and/or to units of measurement realised of the National Physical Laboratory or other recognised institutes.

This calibration has been performed in compliance with the requirements of ISO/IEC 17025:2017 (BS EN ISO/IEC 17025:2017). Oxford Technical Solutions is a UKAS accredited calibration laboratory No. 4647.

This certificate states the performance of the product after any change to the internal IMU sensor model.

Each reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of two, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Other measurements made by the product are not traceable.

This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

## 1. Overview

Issued by

Oxford Technical Solutions Ltd.

77 Heyford Park, Upper Heyford, Oxfordshire, OX25 5HD, UK

Registered in England and Wales No. 3534778

UKAS accreditation number	4647
End-user	Demo
Consignee	Demo
Confidentiality	Confidential customer information

## 1.1. Calibration Information

Calibration by	Sam Whelan
Calibration ID	14A0054A-IC-8137-200811
Calibration method	14A0054A
Calibration date	2020-08-11
Document revision	1

## 1.2. Certificated Item

This calibration only applies to the product listed here:

Model	RT3003G
Serial number	8137
Result	Pass
Condition	Test

This product generates status information giving indications of the accuracy of each of the outputs. This information should be monitored to ensure that the outputs are within the accuracy required.

## 2. Physical Conditions

Certified fixed physical conditions used during the calibration:

### 2.1. Local Gravity Estimation

Name	Estimated Value Of Gravity
Calibration by	British Geological Survey
Calibration ID	RG/84/14
Calibration date	2005-11-28
Location	78 Heyford Park, Upper Heyford, Oxfordshire, OX25 5HD, UK
Estimation (m/s <sup>2</sup> )	9.81204 ± 0.00001

## 3. Equipment Used

Equipment used during the calibration:

### 3.1. Frequency Meter

Name	Thurlby Thandar TF930
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Serial	444273
Calibration by	RS Calibration
Calibration ID	1601062
Calibration date	2019-10-07
Calculated radiometric uncertainty	0.0000040
Frequency uncertainty	0.0004

### 3.2. Temperature Sensor

Name	Digitron 2000T
Serial	5101187929
Calibration by	C.I.S Calibration Laboratories
Calibration ID	62528
Calibration date	2019-11-19
Absolute uncertainty (°C)	1.21
Difference uncertainty (°C)	0.25
Measurement bias (°C)	0.29

### 3.3. Calibration Table

Name	OxTS Calibration Table
Model	14A0032A
Serial	9

### 3.4. Calibration Software

Name	OxTS Calibrate
Version	200807.14g

## 4. Environmental Conditions

Recorded environmental conditions during the calibration:

IMU frequency (Hz)	100.000 ± 0.0004
Start temperature (°C)	31.9 ± 1.21
Final temperature (°C)	32.0 ± 1.21

## 5. Calibration Validation

Four categories of result are used when presenting measurements:

- Pass The result can be classified as a pass with a confidence in excess of 95%
- Pass \* The error has a probability of between 50% and 95% of being inside the limit
- Fail \*** The error has a probability of between 5% and 50% of being inside the limit

**Fail** The result can be classified as a fail with a confidence in excess of 95%

The measurement process used during the calibration of the product causes the uncertainties to vary: some measurements are more accurate than others along specific sensor axes; this is not a fault in the product, but an unavoidable limitation of the calibration process.

### 5.1. Environmental Results

The detailed analysis of temperature is shown in the following table, where

Change = Final Temperature-Start Temperature

Result = |Change|±Uncertainty < Limit

**Table 1. Analysis of temperature conditions**

Change °C	Uncertainty °C	Limit °C	Result
0.10	0.25	1.00	Pass

### 5.2. Accelerometer Results

The detailed analysis for the three axis accelerations is shown in the following tables, where

Error = Output acceleration-Input acceleration

Limit = 0.01 m/s<sup>2</sup>

Result = |Error|±Uncertainty < Limit

**Table 2. Analysis of the x-axis acceleration**

Input m/s <sup>2</sup>	Output m/s <sup>2</sup>	Error m/s <sup>2</sup>	Uncertainty m/s <sup>2</sup>	Result
-9.5620	-9.5618	0.0003	0.0010	Pass
-8.1540	-8.1537	+0.0003	0.0010	Pass
-6.6569	-6.6568	0.0001	0.0010	Pass
-5.4863	-5.4862	0.0001	0.0010	Pass
-4.4141	-4.4139	0.0002	0.0010	Pass
-2.9357	-2.9355	0.0002	0.0013	Pass
-0.7656	-0.7655	0.0001	0.0046	Pass
0.0196	0.0197	0.0001	0.0062	Pass
1.4546	1.4546	0.0000	0.0025	Pass
3.0707	3.0706	-0.0000	0.0013	Pass
4.1722	4.1722	-0.0000	0.0010	Pass
5.0255	5.0255	-0.0001	0.0010	Pass
6.6340	6.6339	-0.0000	0.0010	Pass
8.1238	8.1237	-0.0001	0.0010	Pass
9.5633	9.5632	-0.0001	0.0010	Pass

**Table 3. Analysis of the y-axis acceleration**

Input m/s <sup>2</sup>	Output m/s <sup>2</sup>	Error m/s <sup>2</sup>	Uncertainty m/s <sup>2</sup>	Result
-9.5887	-9.5885	0.0002	0.0010	Pass
-8.3091	-8.3090	0.0001	0.0010	Pass
-6.5793	-6.5794	-0.0000	0.0010	Pass
-4.9324	-4.9326	-0.0002	0.0010	Pass
-3.8424	-3.8425	-0.0001	0.0011	Pass
-3.2757	-3.2758	-0.0000	0.0012	Pass
-1.7258	-1.7258	-0.0001	0.0021	Pass

Input m/s <sup>2</sup>	Output m/s <sup>2</sup>	Error m/s <sup>2</sup>	Uncertainty m/s <sup>2</sup>	Result
-0.3566	-0.3567	-0.0001	0.0062	Pass
1.0542	1.0540	-0.0002	0.0034	Pass
3.0481	3.0479	-0.0002	0.0013	Pass
3.4688	3.4687	-0.0002	0.0012	Pass
4.8686	4.8684	-0.0002	0.0010	Pass
6.5626	6.5624	-0.0002	0.0010	Pass
8.3254	8.3250	-0.0005	0.0010	Pass
9.5823	9.5819	-0.0004	0.0010	Pass

**Table 4. Analysis of the z-axis acceleration**

Input m/s <sup>2</sup>	Output m/s <sup>2</sup>	Error m/s <sup>2</sup>	Uncertainty m/s <sup>2</sup>	Result
-9.8074	-9.8074	0.0000	0.0010	Pass
-8.6731	-8.6729	0.0002	0.0010	Pass
-5.1811	-5.1812	-0.0001	0.0010	Pass
-5.1497	-5.1498	-0.0000	0.0010	Pass
-4.6402	-4.6401	0.0001	0.0010	Pass
-4.6075	-4.6073	0.0002	0.0010	Pass
-0.3023	-0.3024	-0.0001	0.0062	Pass
0.3038	+0.3039	0.0001	0.0062	Pass
0.3306	0.3304	-0.0002	0.0062	Pass
4.6153	4.6151	-0.0002	0.0010	Pass
4.6270	4.6271	+0.0001	0.0010	Pass
5.1629	5.1630	0.0001	0.0010	Pass
8.3213	8.3214	0.0001	0.0010	Pass
8.3609	8.3609	+0.0000	0.0010	Pass
9.8055	9.8051	-0.0005	0.0010	Pass

### 5.3. Gyroscope Results

The detailed analysis for the three axis angular rates is shown in the following tables, where

Error = Output angular rate-Input angular rate

Limit = 0.12 °/s

Result = |Error|± Uncertainty < Limit

**Table 5. Analysis of the x-axis angular rate**

Input °/s	Output °/s	Error °/s	Uncertainty °/s	Result
-22.915	-22.912	0.003	0.036	Pass
-16.297	-16.299	-0.002	0.027	Pass
-10.696	-10.694	0.003	0.033	Pass
-5.299	-5.295	0.004	0.022	Pass
-4.529	-4.531	-0.002	0.018	Pass
-0.019	-0.019	-0.000	0.038	Pass
-0.016	-0.013	0.003	0.040	Pass
0.010	0.011	0.001	0.022	Pass
0.014	0.011	-0.002	0.034	Pass
0.020	0.023	0.004	0.041	Pass
5.061	5.067	0.006	0.037	Pass
8.568	8.569	0.000	0.019	Pass

Input %/s	Output %/s	Error %/s	Uncertainty %/s	Result
12.557	12.568	0.010	0.027	Pass
19.566	19.586	0.019	0.042	Pass
24.490	24.498	0.008	0.039	Pass

**Table 6. Analysis of the y-axis angular rate**

Input %/s	Output %/s	Error %/s	Uncertainty %/s	Result
-22.701	-22.702	-0.001	0.037	Pass
-17.005	-17.003	0.002	0.028	Pass
-11.765	-11.752	0.013	0.028	Pass
-7.814	-7.809	0.005	0.022	Pass
-7.040	-7.033	0.007	0.037	Pass
-0.062	-0.052	0.010	0.038	Pass
-0.048	-0.039	0.009	0.033	Pass
0.024	0.030	0.005	0.021	Pass
+0.048	+0.049	0.002	0.037	Pass
0.063	0.063	-0.000	0.040	Pass
3.451	+3.453	0.002	0.019	Pass
5.249	+5.253	0.005	0.021	Pass
11.159	+11.168	0.009	0.018	Pass
17.239	17.252	0.014	0.023	Pass
22.713	22.722	-0.010	0.037	Pass

**Table 7. Analysis of the z-axis angular rate**

Input %/s	Output %/s	Error %/s	Uncertainty %/s	Result
-25.150	-25.151	-0.001	0.041	Pass
-20.672	-20.669	0.003	0.033	Pass
-16.231	-16.224	0.007	0.029	Pass
-4.702	-4.700	0.002	0.031	Pass
-0.049	-0.051	-0.002	0.030	Pass
-0.035	-0.035	0.001	0.022	Pass
-0.021	-0.019	0.002	0.040	Pass
0.003	0.001	-0.002	0.038	Pass
0.016	0.018	0.001	0.021	Pass
0.026	0.025	-0.002	0.029	Pass
0.053	0.051	-0.002	0.034	Pass
4.352	4.347	-0.005	0.024	Pass
17.099	17.112	0.013	0.027	Pass
23.047	23.052	0.005	0.033	Pass
28.293	28.296	0.003	0.037	Pass

### 5.4. Summaries

Summaries of the preceding temperature, accelerometer and gyroscope results:

**Table 8. Summaries of calibration results**

Summary	Result
Temperature change result	Pass
Accelerometer x-axis result	Pass

Summary	Result
Accelerometer y-axis result	Pass
Accelerometer z-axis result	Pass
Gyroscope x-axis result	Pass
Gyroscope y-axis result	Pass
Gyroscope z-axis result	Pass

## 6. Certificate Authorization

Authorization details regarding revision 1 of this calibration certificate:

Name Sam Whelan

Date 2020-08-11

SAMPLE