ISO 17025 Compliant Calibration Certificate

14A0054A-IC-6788-230111-1

Oxford Technical Solutions

UKAS CALIBRATION
4647

OXTS

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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.

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	[redacted]
Consignee	[redacted]
Confidentiality	Confidential customer information

1.1. Calibration Information

Calibration by	[redacted]
Calibration ID	[redacted]
Calibration method	14A0054A
Calibration date	2023-01-11
Document revision	1

1.2. Certificated Item

This calibration only applies to the product listed here:

Model	RT3003GG
Serial number	[redacted]
Result	Pass
Condition	Old

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/s²)	9.81204 ± 0.00001

3. Equipment Used

Equipment used during the calibration:

3.1. Frequency Meter

Name	Thurlby Thandar TF930

Serial	444273
Calibration by	RS Calibration
Calibration ID	1756790
Calibration date	2022-08-25
Calculated ratiometric uncertainty	0.0000040
Frequency uncertainty (Hz)	0.0004

3.2. Voltage Supply

Name	Fluke 289 Digital Multimeter
Serial	55550087
Calibration by	RS Calibration
Calibration ID	1778408
Calibration date	2022-12-28
Absolute uncertainty (V)	0.05

3.3. Temperature Sensor

Name	Digitron 2000T
Serial	5604251717
Calibration by	C.I.S Calibration Laboratories
Calibration ID	68466
Calibration date	2022-09-20
Absolute uncertainty (°C)	1.21
Difference uncertainty (°C)	0.25
Measurement bias (°C)	0.29

3.4. Calibration Table

Name	OxTS Calibration Table
Model	14A0052A
Serial	2

3.5. Calibration Software

Name	OxTS Calibrate
Version	220412.14g

4. Environmental Conditions

Recorded environmental conditions during the calibration:

IMU frequency (Hz)	100.000 ± 0.0004

Start nominal voltage (V)	15.2 ± 0.05
Final nominal voltage (V)	15.2 ± 0.05
Start temperature (°C)	35.8 ± 1.21
Final temperature (°C)	36.4 ± 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

$$\text{Change} = \text{Final Temperature} - \text{Start Temperature}$$
$$\text{Result} = |\text{Change}| \pm \text{Uncertainty} < \text{Limit}$$

Table 1. Analysis of temperature conditions

Change °C	Uncertainty °C	Limit °C	Result
0.60	0.25	1.00	Pass

5.2. Accelerometer Results

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

$$\text{Error} = \text{Output acceleration} - \text{Input acceleration}$$
$$\text{Limit} = 0.01\ \text{m/s}^2$$
$$\text{Result} = |\text{Error}| \pm \text{Uncertainty} < \text{Limit}$$

Table 2. Analysis of the x-axis acceleration

Input m/s²	Output m/s²	Error m/s²	Uncertainty m/s²	Result
−9.4948	−9.4947	0.0000	0.0010	Pass
−8.1602	−8.1605	−0.0002	0.0010	Pass
−6.8600	−6.8599	0.0001	0.0010	Pass
−4.9594	−4.9595	−0.0001	0.0013	Pass
−4.4556	−4.4555	0.0001	0.0014	Pass
−3.2878	−3.2878	0.0000	0.0018	Pass
−1.1749	−1.1748	0.0001	0.0049	Pass
−0.3061	−0.3060	0.0002	0.0062	Pass
0.2085	0.2087	0.0002	0.0062	Pass
2.6979	2.6981	0.0002	0.0022	Pass

Input m/s²	Output m/s²	Error m/s²	Uncertainty m/s²	Result
4.4504	4.4507	0.0002	0.0014	Pass
5.0675	5.0678	0.0003	0.0013	Pass
7.1042	7.1045	0.0003	0.0010	Pass
8.1335	8.1339	0.0004	0.0010	Pass
9.4982	9.4983	0.0001	0.0010	Pass

Table 3. Analysis of the y-axis acceleration

Input m/s²	Output m/s²	Error m/s²	Uncertainty m/s²	Result
−9.5259	−9.5261	−0.0002	0.0010	Pass
−8.3464	−8.3467	−0.0003	0.0010	Pass
−6.7624	−6.7623	0.0000	0.0010	Pass
−4.9774	−4.9775	−0.0000	0.0013	Pass
−3.2580	−3.2580	0.0000	0.0018	Pass
−2.8081	−2.8081	0.0000	0.0021	Pass
−1.3826	−1.3825	0.0001	0.0042	Pass
−0.0212	−0.0210	0.0002	0.0062	Pass
2.2586	2.2590	0.0004	0.0026	Pass
2.8160	2.8164	0.0004	0.0021	Pass
3.2532	3.2535	0.0003	0.0019	Pass
4.9779	4.9783	0.0004	0.0013	Pass
6.8720	6.8726	0.0006	0.0010	Pass
8.3550	8.3554	0.0004	0.0010	Pass
9.5331	9.5336	0.0004	0.0010	Pass

Table 4. Analysis of the z-axis acceleration

Input m/s²	Output m/s²	Error m/s²	Uncertainty m/s²	Result
−9.8072	−9.8073	−0.0001	0.0010	Pass
−8.3528	−8.3533	−0.0005	0.0010	Pass
−5.1469	−5.1469	−0.0000	0.0012	Pass
−5.1428	−5.1428	−0.0000	0.0012	Pass
−4.6244	−4.6245	−0.0001	0.0014	Pass
−4.6162	−4.6164	−0.0002	0.0014	Pass
−0.2763	−0.2763	0.0001	0.0062	Pass
−0.2723	−0.2721	0.0002	0.0062	Pass
0.3011	0.3012	0.0001	0.0062	Pass
4.6407	4.6412	0.0005	0.0014	Pass
4.6440	4.6446	0.0006	0.0014	Pass
5.1518	5.1523	0.0005	0.0012	Pass
8.6533	8.6539	0.0006	0.0010	Pass
8.6544	8.6550	0.0006	0.0010	Pass
9.8077	9.8077	0.0001	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 = $|\text{Error}| \pm \text{Uncertainty} < \text{Limit}$

Table 5. Analysis of the x-axis angular rate

Input °/s	Output °/s	Error °/s	Uncertainty °/s	Result
−23.805	−23.810	−0.005	0.039	Pass
−19.158	−19.163	−0.005	0.042	Pass
−11.167	−11.180	−0.013	0.026	Pass
−7.878	−7.892	−0.013	0.019	Pass
−6.416	−6.426	−0.010	0.036	Pass
−0.011	−0.020	−0.010	0.037	Pass
−0.006	−0.016	−0.010	0.040	Pass
−0.001	−0.007	−0.006	0.041	Pass
0.006	0.001	−0.005	0.039	Pass
0.011	0.002	−0.009	0.037	Pass
4.377	4.364	−0.013	0.021	Pass
6.536	6.533	−0.003	0.037	Pass
9.698	9.683	−0.016	0.032	Pass
14.847	14.830	−0.017	0.031	Pass
21.786	21.769	−0.018	0.034	Pass

Table 6. Analysis of the y-axis angular rate

Input °/s	Output °/s	Error °/s	Uncertainty °/s	Result
−22.380	−22.380	−0.000	0.037	Pass
−17.378	−17.379	−0.000	0.038	Pass
−10.715	−10.702	0.013	0.018	Pass
−5.805	−5.801	0.004	0.020	Pass
−2.590	−2.586	0.004	0.019	Pass
−0.009	0.000	0.009	0.038	Pass
−0.001	−0.000	0.001	0.028	Pass
−0.000	0.003	0.003	0.039	Pass
0.001	0.004	0.003	0.035	Pass
0.009	0.014	0.004	0.030	Pass
5.207	5.208	0.001	0.035	Pass
7.781	7.775	−0.006	0.018	Pass
12.361	12.358	−0.003	0.035	Pass
15.251	15.250	−0.001	0.025	Pass
21.908	21.911	0.003	0.036	Pass

Table 7. Analysis of the z-axis angular rate

Input °/s	Output °/s	Error °/s	Uncertainty °/s	Result
−24.512	−24.516	−0.005	0.040	Pass
−20.505	−20.507	−0.002	0.032	Pass
−16.147	−16.151	−0.004	0.029	Pass
−4.502	−4.506	−0.004	0.030	Pass
−0.022	−0.018	0.004	0.040	Pass
−0.006	−0.007	−0.001	0.027	Pass
−0.004	−0.011	−0.007	0.043	Pass
−0.001	−0.004	−0.003	0.021	Pass
0.001	0.009	0.008	0.036	Pass
0.003	0.002	−0.001	0.021	Pass
0.006	0.002	−0.004	0.035	Pass

Input °/s	Output °/s	Error °/s	Uncertainty °/s	Result
4.031	4.031	−0.000	0.042	Pass
16.912	16.919	0.007	0.027	Pass
21.723	21.728	0.005	0.031	Pass
27.976	27.975	−0.001	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
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 [redacted]

Date 2023-01-11