

Calibration Certificate

14A0054A-IC-215-120410-1

Oxford Technical Solutions



4647



Table of Contents

1 Overview	2
1.1 Calibration Information	2
1.2 Certificated Item	2
2 Physical Conditions	2
2.1 Local Gravity Estimation	2
3 Equipment Used	3
3.1 Frequency Meter	3
3.2 Power Supply	3
3.3 Temperature Sensor	3
3.4 Calibration Table	3
3.5 Calibration Software	3
4 Environmental Conditions	4
5 Calibration Validation	4
5.1 Environmental Results	4
5.2 Accelerometer Results	4
5.3 Gyroscope Results	6
5.4 Summaries	7
6 Certificate Authorization	7

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 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	Sample Company
Consignee	Sample Company
Confidentiality	Confidential customer information

1.1. Calibration Information

Calibration by	Sample Person
Calibration ID	14A0054A-IC-215-120410
Calibration method	14A0054A
Calibration date	2012-04-10
Document revision	1

1.2. Certificated Item

This calibration only applies to the product listed here:

Model	RT3102
Serial number	215
Result	Pass *
Condition	New

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 (ms^{-2})	9.81204 ± 0.00001

3. Equipment Used

Equipment used during the calibration:

3.1. Frequency Meter

Name	Thurlby Thandar TF930
Serial	353518
Calibration by	TER Instruments Ltd
Calibration ID	TERUKAS27390
Calibration date	2011-09-02
Ratiometric uncertainty	0.0000017

3.2. Power Supply

Name	Iso-Tech IPS 303DD Power Sypply
Serial	130D169G2
Calibration by	RS Calibration
Calibration ID	1249745
Calibration date	2012-01-28
Absolute uncertainty (V)	0.45

3.3. Temperature Sensor

Name	Digitron 2000T
Serial	450997485
Calibration by	TER Instruments Ltd
Calibration ID	TERUKAS27209
Calibration date	2011-08-11
Absolute uncertainty (°C)	0.75
Difference uncertainty (°C)	0.23

3.4. Calibration Table

Name	OxTS Calibration Table
Model	14A0032A
Serial	1

3.5. Calibration Software

Name	OxTS Calibrate
Version	120320.14g

4. Environmental Conditions

Recorded environmental conditions during the calibration:

IMU frequency (Hz)	100.000 ± 0.0002
Start applied voltage (V)	12.5 ± 0.45
Final applied voltage (V)	12.5 ± 0.45
Start temperature (°C)	32.1 ± 0.75
Final temperature (°C)	33.0 ± 0.75

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 below the limit
- Fail *** The error has a probability of between 5% and 50% of being below 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.

Should a product measurement be reported as "Pass *", we advise customers to look for nearby measurements with lower uncertainties to get a more confident indication of the performance of the product.

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
0.90	0.23	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 ms⁻²
 Result = |Error| ± Uncertainty < Limit

Table 2. Analysis of the x-axis acceleration

Input ms ⁻²	Output ms ⁻²	Error ms ⁻²	Uncertainty ms ⁻²	Result
-9.4629	-9.4657	-0.0028	0.0007	Pass

Input ms ⁻²	Output ms ⁻²	Error ms ⁻²	Uncertainty ms ⁻²	Result
-8.2688	-8.2715	-0.0027	0.0008	Pass
-6.8366	-6.8387	-0.0021	0.0009	Pass
-5.0447	-5.0462	-0.0015	0.0011	Pass
-4.0721	-4.0735	-0.0014	0.0012	Pass
-3.0323	-3.0335	-0.0012	0.0016	Pass
-1.0346	-1.0352	-0.0005	0.0044	Pass
-0.3847	-0.3850	-0.0003	0.0062	Pass
0.5601	0.5601	-0.0001	0.0062	Pass
2.6180	2.6185	0.0005	0.0018	Pass
4.0447	4.0456	0.0009	0.0013	Pass
5.3530	5.3543	0.0013	0.0010	Pass
6.8526	6.8544	0.0018	0.0009	Pass
8.3025	8.3049	0.0024	0.0008	Pass
9.4655	9.4678	0.0023	0.0007	Pass

Table 3. Analysis of the y-axis acceleration

Input ms ⁻²	Output ms ⁻²	Error ms ⁻²	Uncertainty ms ⁻²	Result
-9.4354	-9.4375	-0.0021	0.0007	Pass
-8.0872	-8.0888	-0.0017	0.0008	Pass
-6.9294	-6.9308	-0.0015	0.0009	Pass
-5.3972	-5.3981	-0.0009	0.0010	Pass
-3.0986	-3.0988	-0.0002	0.0016	Pass
-2.4976	-2.4974	0.0002	0.0019	Pass
-1.5265	-1.5265	0.0000	0.0030	Pass
-0.3076	-0.3071	0.0005	0.0062	Pass
2.1340	2.1353	0.0013	0.0022	Pass
2.9236	2.9250	0.0014	0.0017	Pass
3.2468	3.2482	0.0014	0.0015	Pass
5.4034	5.4055	0.0021	0.0010	Pass
6.8512	6.8537	0.0025	0.0009	Pass
8.0132	8.0159	0.0026	0.0008	Pass
9.4304	9.4335	0.0031	0.0007	Pass

Table 4. Analysis of the z-axis acceleration

Input ms ⁻²	Output ms ⁻²	Error ms ⁻²	Uncertainty ms ⁻²	Result
-9.7767	-9.7792	-0.0026	0.0007	Pass
-8.0784	-8.0805	-0.0021	0.0008	Pass
-5.6430	-5.6442	-0.0013	0.0010	Pass
-5.6378	-5.6391	-0.0013	0.0010	Pass
-4.2162	-4.2172	-0.0010	0.0012	Pass
-4.2067	-4.2078	-0.0011	0.0012	Pass
-0.8431	-0.8430	0.0001	0.0054	Pass
-0.8305	-0.8304	0.0001	0.0055	Pass
0.7698	0.7703	0.0005	0.0059	Pass
4.1667	4.1683	0.0016	0.0012	Pass
4.1728	4.1743	0.0015	0.0012	Pass
5.5638	5.5657	0.0018	0.0010	Pass

Input ms ⁻²	Output ms ⁻²	Error ms ⁻²	Uncertainty ms ⁻²	Result
8.8511	8.8543	0.0031	0.0008	Pass
8.8619	8.8651	0.0032	0.0008	Pass
9.7806	9.7834	0.0028	0.0007	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⁻¹

Result = |Error| ± Uncertainty < Limit

Table 5. Analysis of the x-axis angular rate

Input °s ⁻¹	Output °s ⁻¹	Error °s ⁻¹	Uncertainty °s ⁻¹	Result
-23.690	-23.683	0.007	0.039	Pass
-19.200	-19.192	0.008	0.042	Pass
-10.179	-10.176	0.004	0.023	Pass
-6.637	-6.638	-0.001	0.029	Pass
-4.302	-4.307	-0.005	0.027	Pass
-0.014	-0.009	0.004	0.037	Pass
-0.003	-0.001	0.001	0.040	Pass
0.002	0.002	0.000	0.032	Pass
0.010	0.007	-0.003	0.039	Pass
0.021	0.015	-0.005	0.032	Pass
4.008	3.997	-0.011	0.025	Pass
4.714	4.713	-0.001	0.029	Pass
8.687	8.691	0.004	0.018	Pass
15.224	15.218	-0.007	0.029	Pass
22.868	22.865	-0.004	0.036	Pass

Table 6. Analysis of the y-axis angular rate

Input °s ⁻¹	Output °s ⁻¹	Error °s ⁻¹	Uncertainty °s ⁻¹	Result
-17.595	-17.537	0.058	0.029	Pass
-15.110	-15.044	0.066	0.021	Pass
-9.448	-9.391	0.057	0.016	Pass
-5.209	-5.151	0.057	0.019	Pass
-2.939	-2.874	0.065	0.019	Pass
-0.337	-0.275	0.062	0.042	Pass
-0.012	0.048	0.060	0.027	Pass
0.001	0.057	0.056	0.028	Pass
0.008	0.070	0.062	0.030	Pass
0.021	0.080	0.059	0.039	Pass
4.749	4.811	0.063	0.020	Pass
6.634	6.696	0.062	0.019	Pass
9.992	10.047	0.055	0.023	Pass
13.624	13.684	0.059	0.023	Pass
17.854	17.909	0.055	0.029	Pass

