# Report on the EMC Testing of:

## Ocean Signal
## Class A Transceiver, Model: ATA100
## Part: 760S-02697
## GPS antenna (763S-02845)

## In accordance with IEC 60945

Prepared for: Ocean Signal Limited
Ocivan Way
Margate
CT9 4NN
United Kingdom

Add value.
Inspire trust.

## COMMERCIAL-IN-CONFIDENCE

Document Number: 75936860-04 | Issue: 01

| SIGNATURE | | | |
|---|---|---|---|
| AJ Lawson. | | | |
| **NAME** | **JOB TITLE** | **RESPONSIBLE FOR** | **ISSUE DATE** |
| Andy Lawson | Senior Engineer | Authorised Signatory | 18 December 2019 |

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD document control rules.


**EXECUTIVE SUMMARY**
A sample of this product was tested and found to be compliant with IEC 60945: 2002 C1:2008





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is a trading name of TUV SUD Ltd
Registered in Scotland at East Kilbride,
Glasgow G75 0QF, United Kingdom
Registered number: SC215164

TUV SUD Ltd is a
TÜV SÜD Group Company

Phone: +44 (0) 1489 558100
Fax: +44 (0) 1489 558101
**www.tuv-sud.co.uk**

TÜV SÜD
Octagon House
Concorde Way
Fareham
Hampshire PO15 5RL
United Kingdom

# Contents

# 1 Report Summary

## 1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

| Issue | Description of Change | Date of Issue |
|---|---|---|
| 1 | First Issue | 18 December 2019 |

**Table 1**

## 1.2 Introduction

| | |
|---|---|
| Applicant | Ocean Signal Limited |
| Manufacturer | Ocean Signal Limited |
| Model Number(s) | ATA100 |
| Serial Number(s) | TA008 |
| Hardware Version(s) | 01.00 |
| Software Version(s) | 0.2.00 |
| Number of Samples Tested | 1 |
| Test Specification/Issue/Date | IEC 60945: 2002 C1:2008 |
| Order Number<br>Date | 3123-00<br>31-October-2016 |
| Date of Receipt of EUT | 03-April-2017<br>24-April-2017<br>31-January-2018<br>01-April-2019 |
| Start of Test | 29-March-2019 |
| Finish of Test | 12-April-2019 |
| Name of Engineer(s) | Francis Kane, Matthew Dawkins, Thomas Mockett and Jack Tuckwell |
| Related Document(s) | IEC 61000-4-6: 2006<br>IEC 61000-4-3: 2006<br>IEC 61000-4-11: 2004<br>IEC 61000-4-2: 2001<br>IEC 61000-4-4: 2004<br>CISPR 16-1-2: 2006<br>CISPR 16-1-4: 2007<br>ISO 694; 2000 |

## 1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with IEC 60945 is shown below.

| Section | Specification Clause | Test Description | Result | Comments/Base Standard |
|---|---|---|---|---|
| Configuration and Mode: DC Powered - Operating | | | | |
| 2.1 | 9.2 | Conducted emissions | Pass | CISPR 16-1-2:2006 |
| 2.2 | 9.3 | Radiated emissions | Pass | CISPR 16-1-4:2007 |
| 2.3 | 10.3 | Immunity to conducted radio frequency disturbance | Pass | IEC 61000-4-6: 2006 |
| 2.4 | 10.4 | Immunity to radiated radiofrequencies | Pass | IEC 61000-4-3: 2006 |
| 2.5 | 10.7 | Immunity to power supply short-term variation | Not applicable | Test not applicable to DC powered equipment. IEC 61000-4-11: 2004 |
| 2.6 | 10.8 | Immunity to power supply failure | Pass | IEC 61000-4-11: 2004 |
| 2.7 | 10.9 | Immunity to electrostatic discharge | Pass | IEC 61000-4-2: 2001 |
| 2.8 | 11.2 | Compass safe distance | Pass | ISO 694; 2000 |
| 2.9 | 10.5 | Immunity to fast transients on DC power, signal and control lines | Pass | IEC 61000-4-4: 2004 |

**Table 2**

## 1.4 Declaration of Build Status

| MAIN EUT | | | |
|---|---|---|---|
| MANUFACTURING DESCRIPTION | Class A AIS transponder | | |
| MANUFACTURER | Ocean Signal Ltd. | | |
| MODEL NAME/NUMBER | ATA100 | | |
| PART NUMBER | 760S-02697 | | |
| SERIAL NUMBER | N/A | | |
| HARDWARE VERSION | TBD | | |
| SOFTWARE VERSION | TBD | | |
| PSU VOLTAGE/FREQUENCY/CURRENT | 10.8-31.2Volts DSC, 6 amps | | |
| HIGHEST INTERNALLY GENERATED / USED FREQUENCY | 207.025MHz | | |
| FCC ID (if applicable) | N/A | | |
| INDUSTRY CANADA ID (if applicable) | N/A | | |
| TECHNICAL DESCRIPTION (a brief description of the intended use and operation) | Class A AIS transponder | | |
| COUNTRY OF ORIGIN | United Kingdom | | |
| RF CHARACTERISTICS (if applicable) | | | |
| TRANSMITTER FREQUENCY OPERATING RANGE (MHz) | 156.025 - 162.025 MHz | | |
| RECEIVER FREQUENCY OPERATING RANGE (MHz) | 156.025 - 162.025 MHz | | |
| INTERMEDIATE FREQUENCIES | 38.85/30.875/21.4MHz, 455kHz | | |
| EMISSION DESIGNATOR(S): (i.e. G1D, GXW) | 16K0GXW | | |
| MODULATION TYPES: (i.e. GMSK, QPSK) | GMSK | | |
| OUTPUT POWER (W or dBm) | 12.5W | | |
| SEPARATE BATTERY/POWER SUPPLY (if applicable) | | | |
| MANUFACTURING DESCRIPTION | ***** | | |
| MANUFACTURER | ***** | | |
| TYPE | ***** | | |
| PART NUMBER | ***** | | |
| PSU VOLTAGE/FREQUENCY/CURRENT | ***** | | |
| COUNTRY OF ORIGIN | ***** | | |
| MODULES (if applicable) | | | |
| MANUFACTURING DESCRIPTION | ***** | ***** | ***** |
| MANUFACTURER | ***** | ***** | ***** |
| TYPE | ***** | ***** | ***** |
| POWER | ***** | ***** | ***** |
| FCC ID | ***** | ***** | ***** |
| INDUSTRY CANADA ID | ***** | ***** | ***** |
| EMISSION DESIGNATOR | ***** | ***** | ***** |
| DHSS/FHSS/COMBINED OR OTHER | ***** | ***** | ***** |
| COUNTRY OF ORIGIN | | | |
| ANCILLARIES (if applicable) | | | |
| MANUFACTURING DESCRIPTION | ***** | ***** | ***** |
| MANUFACTURER | ***** | ***** | ***** |
| TYPE | ***** | ***** | ***** |
| PART NUMBER | ***** | ***** | ***** |
| SERIAL NUMBER | ***** | ***** | ***** |
| COUNTRY OF ORIGIN | ***** | ***** | ***** |

I hereby declare that the information supplied is correct and complete.

Name: David Sheekey → Position held: Type Approval Manager

Date: 5/4/18

## 1.5 Product Information

### 1.5.1 Technical Description

The Equipment Under Test was an Ocean Signal ATA100 Class A AIS Transponder.

The primary function of the EUT is to combine SOLAS and Inland approved solutions capable of exchanging dynamic and static ship data with other AIS systems to aid collision-avoidance and improve safety for both commercial and recreational vessels.

A full description and detailed product specification details are available from the manufacturer.


**Figure 1 - General View**

**Figure 2 - Rear View**


**Figure 3 - Rating Plate**

### 1.5.2 EUT Port/Cable Identification

| Port | Max Cable Length specified | Usage | Type | Screened |
|---|---|---|---|---|
| Configuration and Mode: DC Powered - Operating | | | | |
| DC Power Port | 2 Meters | 12 V DC Power Supply Line | 2 Core Cable | No |
| RF Port | over 3 meters | AIS | Co-axial Cable | Yes |
| Sensor 1 2 and 3 cable | 1.7 meters | Unknown | Multi Core Cable | No |
| LR Cable | 1.7 meters | Unknown | Multi Core Cable | No |
| GPS Antenna | >3 meters | GPS Antenna Signal | Co-axial Cable | No |
| DGPS | 1.7 meters | DGPS Data | Multi Core | No |
| Pilot Port | 1.7 meters | Data | Data | No |
| ECDIS | 1.7 meters | Data | Multi Core Cable | No |

**Table 3**

### 1.5.3 Test Configuration

| Configuration | Description |
|---|---|
| DC Powered | The EUT was powered from a 12 V DC Supply.<br>The EUT had a GPS antenna connected to it.<br>The EUT had a laptop connected to the EUTs RS422 port.<br>The EUT VHF antenna port was connected to a reference class A transceiver via a power attenuator.<br>All other cables were connected to the EUT but were unterminated during testing. |

**Table 4**

### 1.5.4 Modes of Operation

| Mode | Description |
|---|---|
| Operating | The EUT was powered and receiving a GPS signal from a GPS simulator.<br>A laptop was used to compare AIS data from the EUT directly with AIS data received from the EUT by the AIS transceiver. |

**Table 5**

### 1.5.5 Monitoring of Performance

The reference AIS Class A transceiver was used to monitor transmissions from the EUT. It was also used to provide transmissions to the EUT to allow monitoring of the EUT receivers.

The laptop was decoding the details of the transmission and reception data from the EUT and comparing this to the transmission and reception data from the reference transceiver.

### 1.5.6 Performance Criteria

***Performance Criteria A***

*The apparatus shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.*

***The manufacturers specified performance level is detailed as:***
*The content of the log reports and the reporting intervals shall not be degraded during or after the test. A packet error rate degradation of up to 20% is acceptable for both transmitter and receiver performance. No change of operating state is allowed, and the display shall continue to operate without degradation*

***Performance Criteria B***

*The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.*

***Performance Criteria C***

*Temporary loss of function is allowed, provided the function is self-recoverable.*

## 1.6 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

## 1.7 EUT Modification Record

The table below details modifications made to the EUT during the test programme.
The modifications incorporated during each test are recorded on the appropriate test pages.

| Modification State | Description of Modification still fitted to EUT | Modification Fitted By | Date Modification Fitted |
|---|---|---|---|
| Serial Number: TA008 | | | |
| 0 | As supplied by the customer | Not Applicable | Not Applicable |
| 1 | Spring fingers added to keypad PCB to connect overall shield to 0V (radiated emissions) | Manufacturer | Supplied 11 April 2019 |

**Table 6**

## 1.8 Test Location

TÜV SÜD Product Service conducted the following tests at our Fareham Test Laboratory.

| Test Name | Name of Engineer(s) | Accreditation |
|---|---|---|
| Configuration and Mode: DC Powered - Operating | | |
| Conducted emissions | Francis Kane | UKAS |
| Radiated emissions | Matthew Dawkins and Thomas Mockett | UKAS |
| Immunity to conducted radio frequency disturbance | Francis Kane | UKAS |
| Immunity to radiated radiofrequencies | Matthew Dawkins and Francis Kane | UKAS |
| Immunity to power supply short-term variation | Francis Kane | UKAS |
| Immunity to power supply failure | Francis Kane | UKAS |
| Immunity to electrostatic discharge | Francis Kane | UKAS |
| Compass safe distance | Francis Kane | UKAS |
| Immunity to fast transients on DC power, signal and control lines | Francis Kane | UKAS |

**Table 7**

Office Address:

Octagon House
Concorde Way
Segensworth North
Fareham
Hampshire
PO15 5RL
United Kingdom

# 2 Test Details

## 2.1 Conducted emissions

### 2.1.1 Specification Reference

IEC 60945, Clause 9.2

### 2.1.2 Equipment Under Test and Modification State

ATA100, S/N: TA008 - Modification State 0

### 2.1.3 Date of Test

12-April-2019

### 2.1.4 Test Method

The EUT was powered from an artificial Mains Network.

Measurements were made with all measuring equipment and the EUT mounted on and bonded to an earth plane. Where provision of an earth plane was not practicable, equivalent arrangements were made using the metallic frame or mass of the EUT as the earth reference.

The power input cables between the power ports of the EUT and the artificial mains network were screened and 0.8 m in length.

If the EUT consisted of more than one unit with individual power ports, power ports of identical nominal supply voltage were connected in parallel to the artificial mains supply network.

### 2.1.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 21.0 °C |
| Relative Humidity | 35.0 % |

### 2.1.6 Specification Limits

| Required Specification Limits | | |
|---|---|---|
| Line Under Test | Frequency Range (MHz) | Quasi-peak (dBµV) |
| Power Input | 0.01 to 0.15 | 96 to 50* |
| | 0.15 to 0.35 | 60 to 50* |
| | 0.35 to 30 | 50* |

**Supplementary information:**
Note 1: The emission shall be measured by means of the quasi-peak measuring receiver only.

The power input cables between the DC power ports of the EUT and the artificial mains network shall be screened and not exceed 0,8 m in length. If the EUT consists of more than one unit with individual DC and/or DC power ports, power ports of identical nominal supply voltage may be connected in parallel to the artificial mains supply network.

*As detailed in specification clause 5.3 Test results, the EUT shall pass the test only if the measured performance margin is favourable and greater than the test measurement uncertainty.

**Table 8**

### 2.1.7 Test Results

**Results for Configuration and Mode: DC Powered - Operating**

Performance assessment of the EUT made during this test: *Pass*.

Detailed results are shown below.

Line Under Test: 12 V DC Power Supply Line

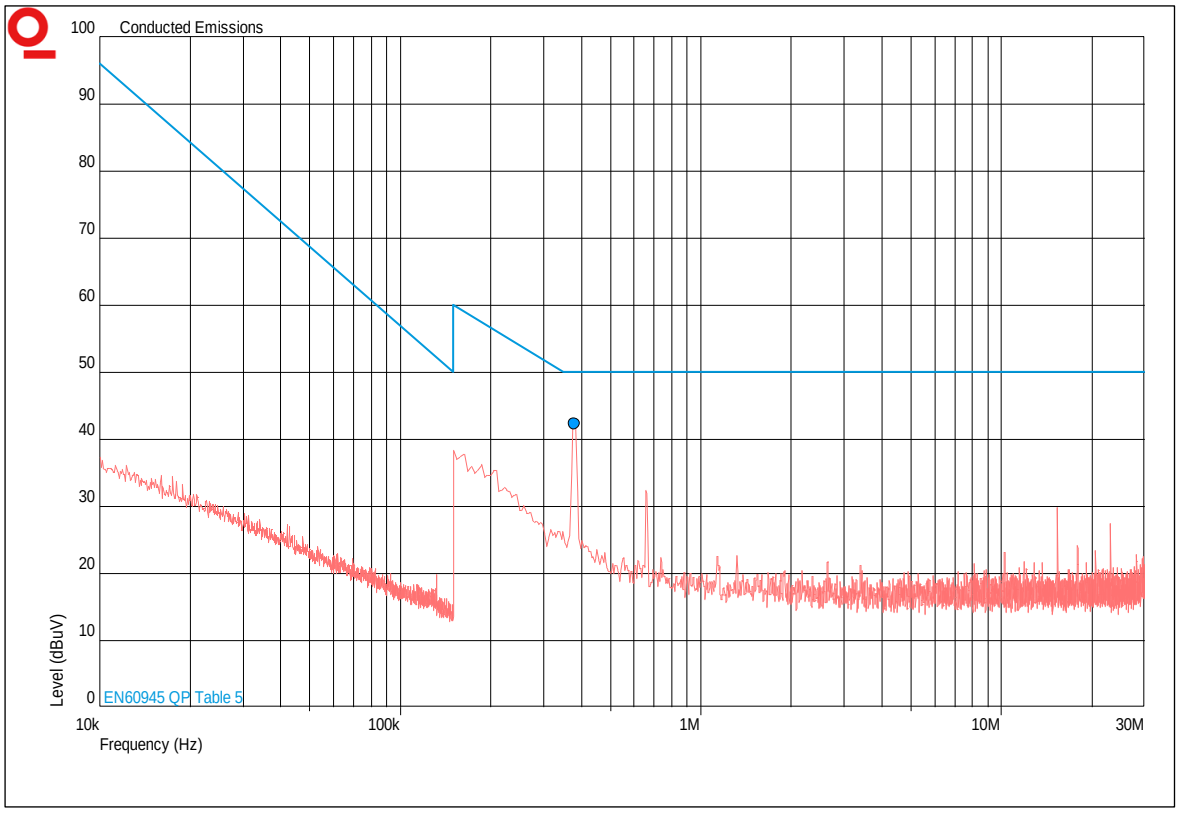


**Figure 4 - Graphical Results - 12 V DC Power Supply Line**

| Frequency (MHz) | QP Level (dBµV) | QP Limit (dBµV) | QP Margin (dB) |
|---|---|---|---|
| 0.379 | 42.3 | 50.0 | -7.7 |

**Table 9**

All other emissions seen were greater than 10dB below the test limit.

Line Under Test: 0 V DC Return Line

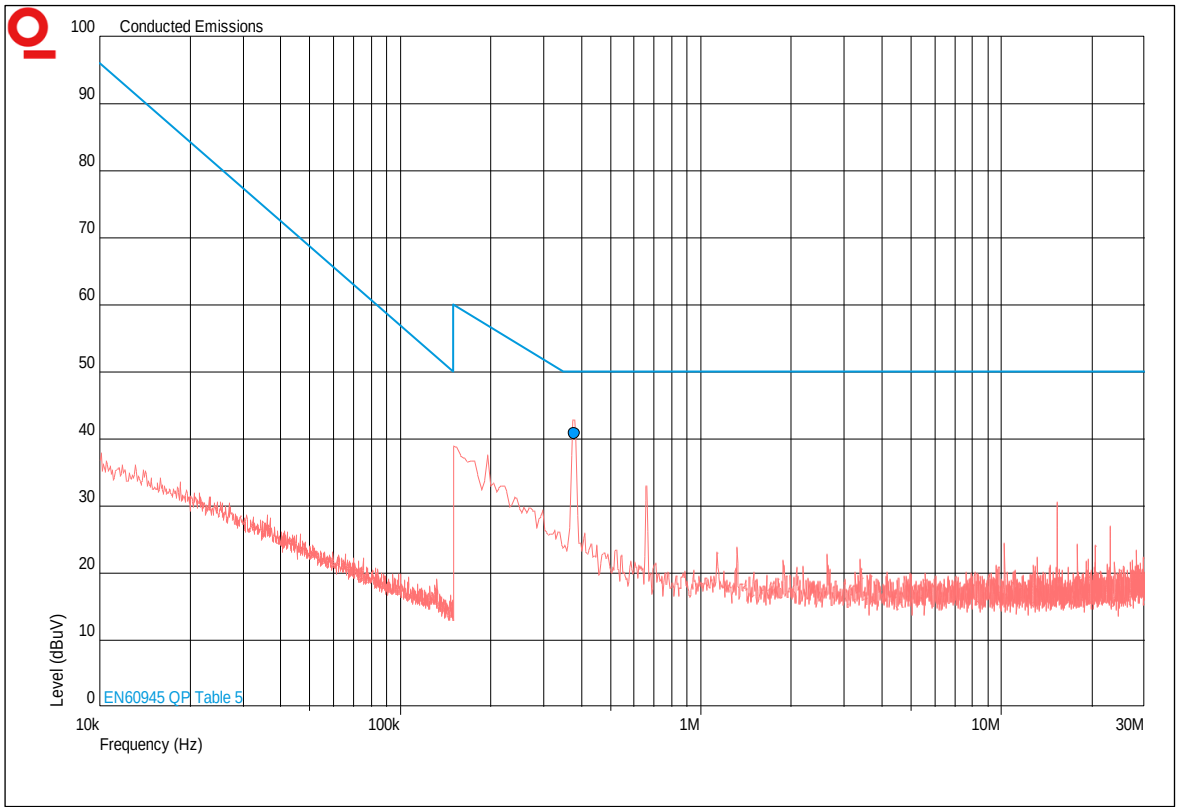


**Figure 5 - Graphical Results - 0 V DC Return Line**

| Frequency (MHz) | QP Level (dBµV) | QP Limit (dBµV) | QP Margin (dB) |
|---|---|---|---|
| 0.379 | 40.8 | 50.0 | -9.2 |

**Table 10**

All other emissions seen were greater than 10dB below the test limit.

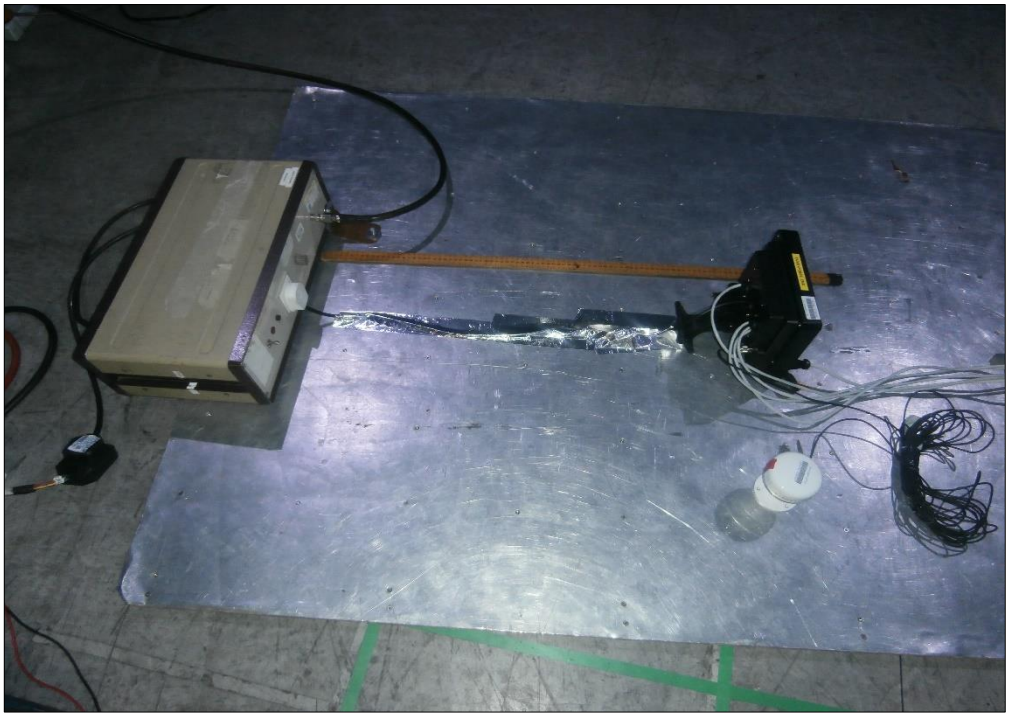

**Figure 6 - Test Setup - Conducted Emissions**

### 2.1.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 1.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| Compliance 5 Emissions | Teseq | V5.26.51 | 3275 | - | Software |
| EMI Receiver | Keysight Technologies | N9038A MXE | 4629 | 12 | 09-Oct-2019 |
| Transient Limiter | Hewlett Packard | 11947A | 2378 | 12 | 21-Jul-2019 |
| LISN (1 Phase) | Chase | MN 2050 | 336 | 12 | 28-May-2019 |
| 8 Meter Cable | Teledyne | PR90-088-8MTR | 5212 | 6 | 28-Jul-2019 |

**Table 11**

## 2.2 Radiated emissions

### 2.2.1 Specification Reference

IEC 60945, Clause 9.3

### 2.2.2 Equipment Under Test and Modification State

ATA100, S/N: TA008 - Modification State 1

### 2.2.3 Date of Test

11-April-2019

### 2.2.4 Test Method

The EUT was set up in a semi-anechoic chamber on a remotely controlled turntable and placed on a non-conductive table 0.8 m above a reference ground plane.

A pre-scan of the EUT emissions profile was made while varying the antennae-to-EUT azimuth and antennae-to-EUT polarization using a peak detector; measurements were taken at a 3m distance.

Using the pre-scan list of the highest emissions detected, their bearing and associated antenna polarisation, the EUT was then formally measured using Quasi-Peak and Average detectors, as appropriate. The readings were maximised by adjusting the antenna height, polarisation and turntable azimuth, in accordance with the specification.

### 2.2.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 18.0 °C |
| Relative Humidity | 43.0 % |

### 2.2.6 Specification Limits

<u>150 kHz to 30 MHz</u>

| Required Specification Limits (@ 3m) | |
|---|---|
| Frequency Range (MHz) | Quasi-peak (dBµV/m) |
| 0.15 to 0.3 | 80 - 52* |
| 0.3 to 30 | 52 - 34* |
| **Supplementary Information:** The measured test results shall be compared with the corresponding acceptable performance limits, and the EUT shall pass the test only if the measured performance margin is favourable and greater than the test measurement uncertainty. *As detailed in specification clause 5.3 Test results, the EUT shall pass the test only if the measured performance margin is favourable and greater than the test measurement uncertainty. | |

**Table 12**

30 MHz to 2 GHz

| Required Specification Limits (@ 3m) | | |
|---|---|---|
| Frequency Range (MHz) | Quasi-peak (dBµV/m) | Peak (dBµV/m) |
| 30 to 2000(1) | 54* | N/A |
| 156 to 165(2) | 24* | 30* |

**Supplementary Information:**
*As detailed in specification clause 5.3 Test results, the EUT shall pass the test only if the measured performance margin is favourable and greater than the test measurement uncertainty.
(1) In addition, for the frequency band 156 MHz to 165 MHz, the measurement shall be repeated with a receiver bandwidth of 9 kHz, all other conditions hereinbefore remaining unchanged.
(2) Alternatively, for the frequency band 156 MHz to165 MHz, a peak receiver or a frequency analyser may be used, in accordance with the agreement between the manufacturer and the test house.

**Table 13**

### 2.2.7 Test Results

**Results for Configuration and Mode: DC Powered - Operating**

Performance assessment of the EUT made during this test: *Pass*.

Detailed results are shown below.

Frequency Range of Test: 30 MHz to 2 GHz

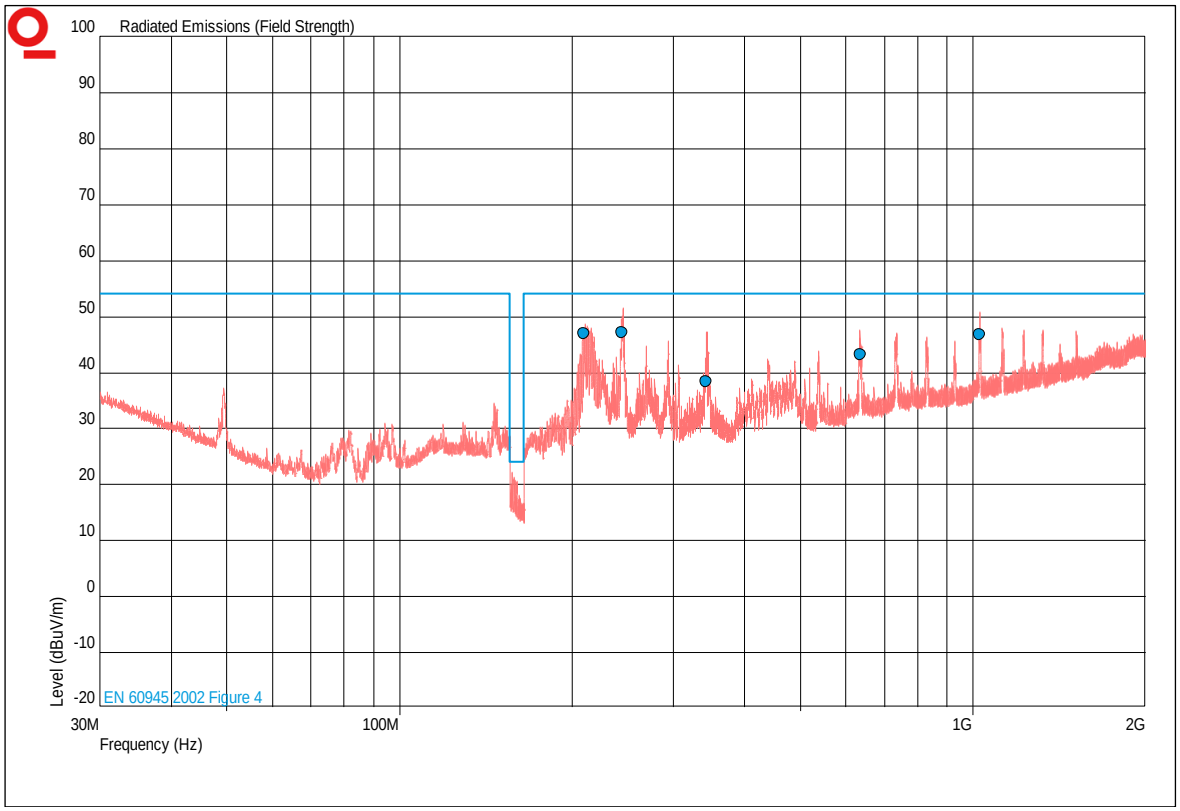


**Figure 7 - Graphical Results - Horizontal and Vertical Polarity**

| Frequency (MHz) | QP Level (dBµV/m) | QP Limit (dBµV/m) | QP Margin (dB) | Angle (Deg) | Height (m) | Polarity |
|---|---|---|---|---|---|---|
| 210.188 | 47.0 | 54.0 | -7.0 | 184 | 1.00 | Vertical |
| 244.567 | 47.1 | 54.0 | -6.9 | 338 | 1.00 | Horizontal |
| 342.997 | 38.2 | 54.0 | -15.8 | 54 | 1.47 | Horizontal |
| 638.045 | 43.1 | 54.0 | -10.9 | 25 | 1.00 | Vertical |
| 1029.808 | 46.7 | 54.0 | -7.3 | 277 | 1.00 | Vertical |

**Table 14**

Frequency Range of Test: 156MHz to 165MHz

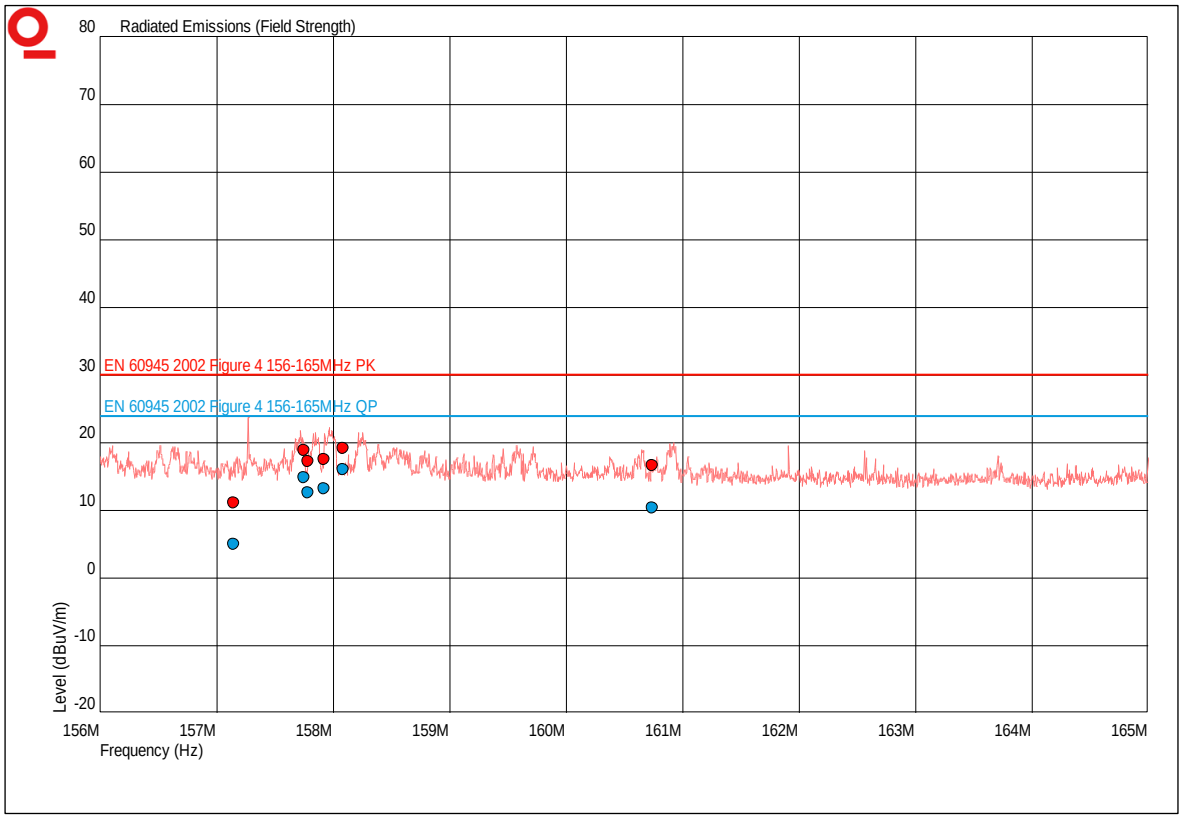


**Figure 8 - Graphical Results - Horizontal and Vertical Polarity**

| Frequency (MHz) | QP Level (dBµV/m) | QP Limit (dBµV/m) | QP Margin (dB) | Peak Level (dBµV/m) | Peak Limit (dBµV/m) | Peak Margin (dB) | Angle (Deg) | Height (m) | Polarity |
|---|---|---|---|---|---|---|---|---|---|
| 157.150 | 5.0 | 24.0 | -19.0 | 11.2 | 30.0 | -18.8 | 262 | 3.61 | Vertical |
| 157.758 | 14.9 | 24.0 | -9.1 | 18.9 | 30.0 | -11.1 | 126 | 1.00 | Vertical |
| 157.792 | 12.6 | 24.0 | -11.4 | 17.2 | 30.0 | -12.8 | 271 | 1.00 | Vertical |
| 157.929 | 13.2 | 24.0 | -10.8 | 17.5 | 30.0 | -12.5 | 126 | 1.00 | Vertical |
| 158.090 | 16.1 | 24.0 | -7.9 | 19.1 | 30.0 | -10.9 | 78 | 2.71 | Vertical |
| 160.743 | 10.3 | 24.0 | -13.7 | 16.6 | 30.0 | -13.4 | 113 | 1.00 | Vertical |

**Table 15**

Frequency Range of Test: 150kHz to 30MHz

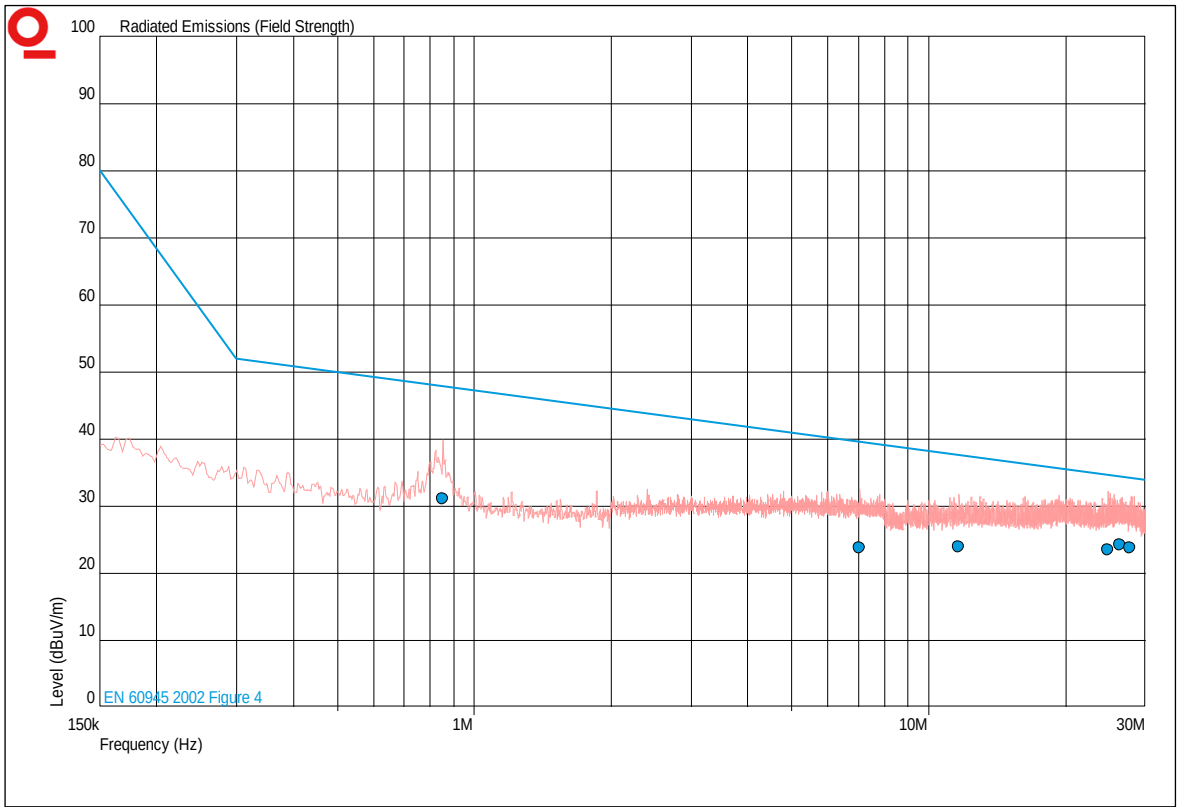


**Figure 9 - Graphical Results - Horizontal and Vertical Polarity**

| Frequency (MHz) | QP Level (dBµV/m) | QP Limit (dBµV/m) | QP Margin (dB) | Angle (Deg) | Height (m) | Polarity |
|---|---|---|---|---|---|---|
| 0.851 | 31.2 | 47.9 | -16.8 | 288 | 1.50 | Edge On |
| 7.028 | 23.8 | 39.7 | -15.8 | 144 | 1.50 | Face On |
| 11.638 | 24.0 | 37.7 | -13.7 | 360 | 1.50 | Edge On |
| 24.803 | 23.5 | 34.7 | -11.2 | 74 | 1.50 | Face On |
| 26.323 | 24.2 | 34.5 | -10.3 | 54 | 1.50 | Edge On |
| 27.775 | 23.9 | 34.3 | -10.4 | 294 | 1.50 | Face On |

**Table 16**


**Figure 10 - Test Setup - Radiated Emissions - 30 MHz to 2 GHz**

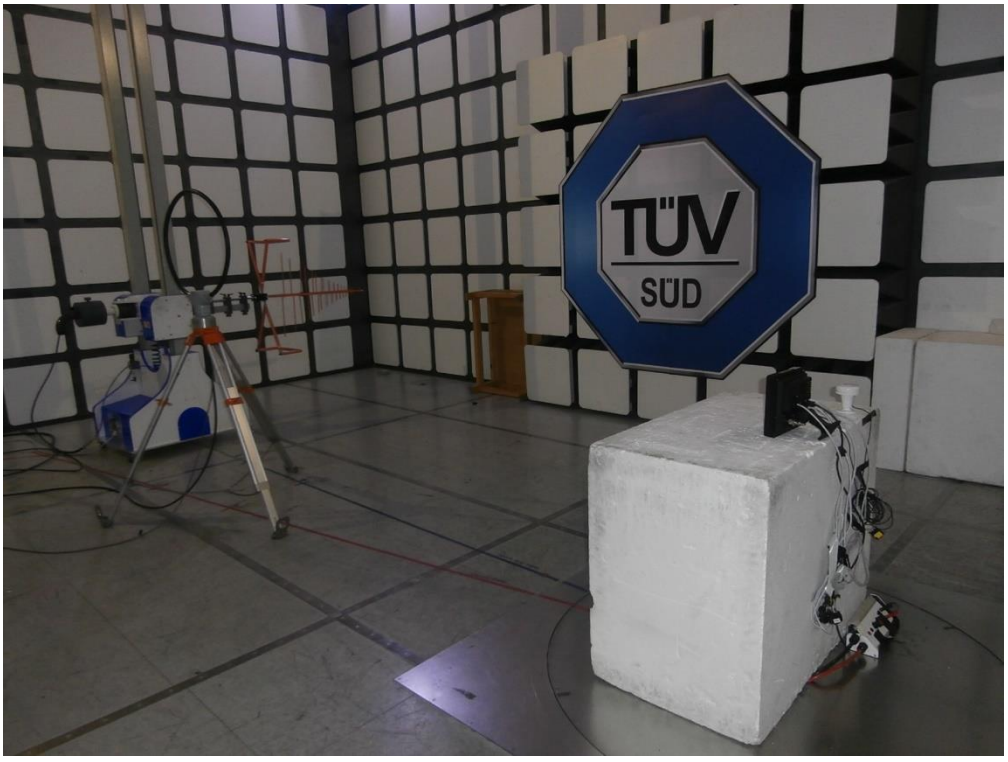


**Figure 11 - Test Setup - Radiated Emissions - 150 kHz to 30 MHz**

### 2.2.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| Screened Room 5 | Rainford | Rainford | 1545 | 36 | 21-Jan-2021 |
| Compliance 5 Emissions | Teseq | V5.26.51 | 3275 | - | Software |
| EMI Receiver | Keysight Technologies | N9038A MXE | 4629 | 12 | 09-Oct-2019 |
| Turntable Controller | Inn-Co GmbH | CO 1000 | 1606 | - | TU |
| Mast Controller | Maturo Gmbh | NCD | 4810 | - | TU |
| Tilt Antenna Mast | Maturo Gmbh | TAM 4.0-P | 4811 | - | TU |
| Antenna (Active Loop, 9kHz-30MHz) | Rohde & Schwarz | HFH2-Z2 | 333 | 24 | 11-Jan-2019 |
| Antenna with permanent attenuator (Bilog) | Chase | CBL6143 | 2904 | 24 | 08-Aug-2019 |
| Cable (Rx, Km-Km 2m) | Scott Cables | KPS-1501-2000-KPS | 4526 | 6 | 26-Apr-2019 |
| 8m N-Type RF Cable | Teledyne | PR90-088-8MTR | 5093 | 12 | 04-Oct-2019 |

**Table 17**

TU - Traceability Unscheduled

## 2.3 Immunity to conducted radio frequency disturbance

### 2.3.1 Specification Reference

IEC 60945, Clause 10.3

### 2.3.2 Equipment Under Test and Modification State

ATA100, S/N: TA008 - Modification State 0

### 2.3.3 Date of Test

01-April-2019 to 02-April-2019

### 2.3.4 Test Method

The equipment under test was configured on, but insulated from, using a 0.1 m isolator, a ground reference plane within a test laboratory.

All associated cabling was configured, on but insulated from, using a 50 mm isolator, the same horizontal coupling plane as the equipment under test.

Using CDNs, EM Clamps or current clamps as appropriate, the power ports and applicable signal and control ports were subjected to the required, pre-calibrated RF injected signal strength, modulated as described, swept over the frequency range of test.

During this test, any anomalies in the equipment under tests performance were recorded.

### 2.3.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 21.0 °C |
| Relative Humidity | 35.0 % |

### 2.3.6 Specification Limits

| Required Test Levels | | | | | | Performance Criteria |
|---|---|---|---|---|---|---|
| Line Under Test | Frequency Range (MHz) | Level (V) | Modulation | Step Size (%) | Dwell (s) | |
| Power Port<br>Signal / Control Port | 0.15 to 80 | 3 | AM (80 %,400 Hz, sine wave) | 1 | 3 | A |
| | Spot Frequencies | 10 | AM (80 %,400 Hz, sine wave) | - | 3 | A |
| **Supplementary information:**<br>Note 1. EUT powered at one of the Nominal input voltages and frequencies<br>Spot Frequencies: 2 MHz, 3 MHz, 4 MHz, 6,2 MHz, 8,2 MHz, 12,6 MHz, 16,5 MHz, 18,8 MHz, 22 MHz and 25 MHz. | | | | | | |

**Table 18**

### 2.3.7 Test Results

**Results for Configuration and Mode: DC Powered - Operating**

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

| Tabulated Results for Conducted Radio Frequency Interference | | | | | |
|---|---|---|---|---|---|
| Modulation = 80 % AM (400 Hz) | | Step Size = 1 % | | Dwell = 3 s | |
| Line Under Test | Frequency Range | Test Level (V) | Coupling Method | Interference Return Path | Result |
| 12 VDC Power Supply Line | 150kHz to 80MHz | 3 + MU | M2 CDN | M2 CDN | Pass |
| 12 VDC Power Supply Line | Spot Frequencies | 10 + MU | M2 CDN | M2 CDN | |
| RF Cable | 150kHz to 80MHz | 3 + MU | EM Clamp | M2 CDN | Pass |
| RF Cable | Spot Frequencies | 10 + MU | EM Clamp | M2 CDN | Pass |
| Sensor 1 2 and 3 cable | 150kHz to 80MHz | 3 + MU | EM Clamp | M2 CDN | Pass |
| Sensor 1 2 and 3 cable | Spot Frequencies | 10 + MU | EM Clamp | M2 CDN | Pass |
| LR Cable | 150kHz to 80MHz | 3 + MU | EM Clamp | M2 CDN | Pass |
| LR Cable | Spot Frequencies | 10 + MU | EM Clamp | M2 CDN | Pass |
| GPS Antenna Cable | 150kHz to 80MHz | 3 + MU | EM Clamp | M2 CDN | Pass |
| GPS Antenna Cable | Spot Frequencies | 10 + MU | EM Clamp | M2 CDN | Pass |
| DGPS | 150kHz to 80MHz | 3 + MU | EM Clamp | M2 CDN | Pass |
| DGPS | Spot Frequencies | 10 + MU | EM Clamp | M2 CDN | Pass |
| Pilot Port | 150kHz to 80MHz | 3 + MU | EM Clamp | M2 CDN | Pass |
| Pilot Port | Spot Frequencies | 10 + MU | EM Clamp | M2 CDN | Pass |
| ECDIS | 150kHz to 80MHz | 3 + MU | EM Clamp | M2 CDN | Pass |
| ECDIS | Spot Frequencies | 10 + MU | EM Clamp | M2 CDN | Pass |

**Table 19**

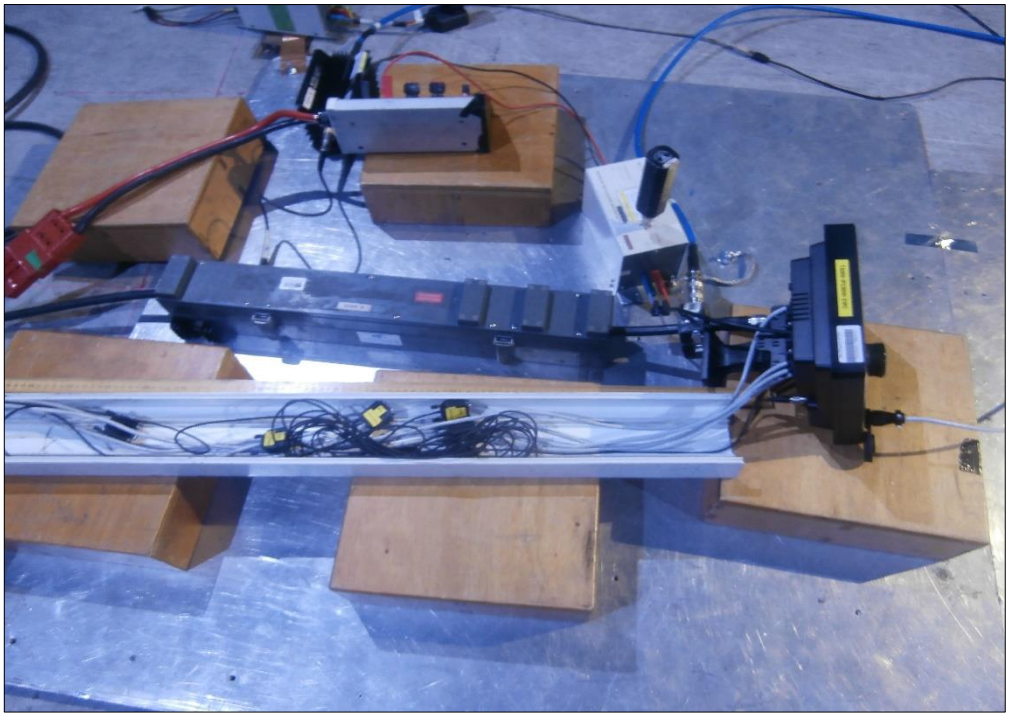

**Figure 12 – Test Setup - Immunity to Conducted Radio Frequency Disturbance**

### 2.3.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 2.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| EMI RF Generator | Schaffner | NSG2070-400 | 2215 | 12 | 13-Nov-2019 |
| Win2070 Software | Schaffner | Version 5.00 | 5251 | - | Software |
| Termination | MEB Messelektronik | TRA150 | 211 | - | TU |
| CDN Jig | MEB Messelektronik | M2-801 | 213 | 12 | 21-Nov-2013 |
| Coupling and Decoupling Network | Schaffner | M216 | 224 | 12 | 10-Oct-2019 |
| Coupling Clamp | MEB Messelektronik | KEMZ-801 | 228 | - | TU |
| Coupling Clamp Jig | MEB Messelektronik | KEMZ-801 | 229 | - | TU |
| Attenuator (10dB) | Weinschel | 45-10-43 | 509 | 12 | 20-Dec-2019 |
| Attenuator 6dB | Advance | 10023-6/MF | 1539 | 12 | 19-Dec-2019 |
| Current Probe | Tegam | 91550-1 | 2135 | 12 | 19-Jun-2019 |
| Attenuator (20dB, 150W) | Narda | 769-20 | 3367 | 12 | 17-Jul-2019 |
| Attenuator (10dB, 150W) | Narda | 769-10 | 3368 | 12 | 17-Jul-2019 |
| Attenuator 40dB 100W | Weinschel | 48-40-43-LIM | 5134 | 12 | 07-Nov-2019 |

**Table 20**

TU - Traceability Unscheduled

## 2.4 Immunity to radiated radio frequencies

### 2.4.1 Specification Reference

IEC 60945, Clause 10.4

### 2.4.2 Equipment Under Test and Modification State

ATA100, S/N: TA008 - Modification State 0

### 2.4.3 Date of Test

29-March-2019 to 01-April-2019

### 2.4.4 Test Method

The equipment under test including associated cabling was configured, on a 0.8 m non-conductive table for table-top equipment; within a pre-calibrated semi anechoic chamber.

All four sides of the equipment under test were subjected to the required RF field strength, modulated as described, swept over the frequency range of test with the antenna positioned in both horizontal and vertical polarizations.

During this test, any anomalies in the equipment under tests performance were recorded.

### 2.4.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 21.0 °C |
| Relative Humidity | 40.0 % |

### 2.4.6 Specification Limits

| Required Test Levels | | | | | Performance Criteria |
|---|---|---|---|---|---|
| Frequency Range (MHz) | Level (V/m) | Modulation | Step Size (%) | Dwell (s) | |
| 80 to 1000 | 10* | AM (80 %,400 Hz, sine wave) | 1 | 3[1] | A |
| 1000 to 2000 | 10* | AM (80 %,400 Hz, sine wave) | 1 | 9[1] | A |

**Supplementary information:**

Note 1. dwell times <1GHz can be reduced to 2 s and >1GHz to 6 s for samples with fast cycle times.

Note 2. EUT powered at one of the Nominal input voltages and frequencies

*As detailed in specification clause 5.3 Test results, the EUT shall pass the test only if the measured performance margin is favourable and greater than the test measurement uncertainty.

**Table 21**

### 2.4.7 Test Results

**Results for Configuration and Mode: DC Powered - Operating**

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

| Tabulated Results for RF Electromagnetic Field | | | | |
|---|---|---|---|---|
| Step Size | 1% | | | |
| Dwell Time < 1GHz<br>Dwell Time > 1GHz | 3 s<br>6 s | | | |
| Modulation | 400Hz Sine 80% AM | | | |
| Frequency Range (MHz) | Test Face | Antenna Polarisation | Test Level (V/m) | Result |
| 80 MHz to 1 GHz | Front, Right, Left and Rear | Horizontal and Vertical | 12.6 (10 + MU) | Pass |
| 1 GHz to 2 GHz | Front, Right, Left and Rear | Horizontal and Vertical | 12.6 (10 + MU) | Pass |

**Table 22**

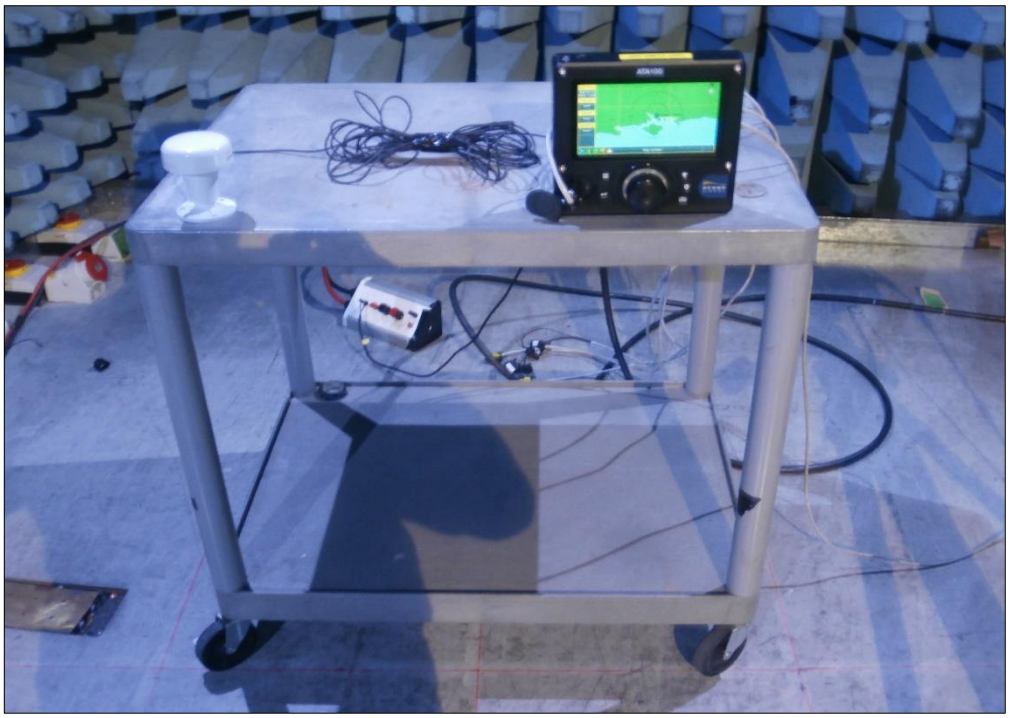

**Figure 13 - Test Setup - Immunity to radiated radio frequencies**

### 2.4.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 2.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| EMCWare | Amp Research | V3.8.2 | 4899 | - | Software |
| Signal Generator, 9kHz to 6GHz | Rohde & Schwarz | SMB 100A | 3500 | 12 | 16-Apr-2019 |
| Amplifier (250W, 80MHz - 1GHz) | Amp Research | 250W1000A | 3029 | - | TU |
| CW TWT (1-2.5GHz) | Thorn | PTC6341 | 2069 | - | TU |
| Directional Coupler | Amp Research | DC6180 | 283 | - | TU |
| Power Meter | Rohde & Schwarz | NRVD | 1391 | 12 | TU |
| Power Sensor (10MHz to 18GHz) | Rohde & Schwarz | NRV-Z1 | 2899 | - | TU |
| Antenna (Double Ridge Guide, 1GHz-18GHz) | EMCO | 3115 | 234 | - | TU |
| Antenna | Schaffner | CBL6143 | 322 | - | TU |
| Load (50ohm, 30W) | JFW | 50T-054 | 351 | 12 | 26-Jun-2019 |
| Attenuator (20dB, 150W) | Narda | 769-20 | 3367 | 12 | 17-Jul-2019 |
| Attenuator (10dB, 150W) | Narda | 769-10 | 3368 | 12 | 17-Jul-2019 |
| Attenuator 40dB 100W | Weinschel | 48-40-43-LIM | 5134 | 12 | 07-Nov-2019 |

**Table 23**

TU - Traceability Unscheduled

## 2.5 Immunity to power supply short term variation

### 2.5.1 Specification Reference

IEC 60945, Clause 10.7

Test not applicable to d.c. powered equipment.

## 2.6 Immunity to power supply failure

### 2.6.1 Specification Reference

IEC 60945, Clause 10.8

### 2.6.2 Equipment Under Test and Modification State

ATA100, S/N: TA008 - Modification State 0

### 2.6.3 Date of Test

04-April-2019

### 2.6.4 Test Method

The equipment under test including associated cabling was configured on but insulated from, using a 0.1 m isolator, a ground reference plane all within a test laboratory.

Using a programmable power supply the equipment under test was subjected to the detailed supply voltage interruptions. The required supply phase synchronisation and test repetition rate, detailed, was controlled by the programmable power supply.

During this test, any anomalies in the equipment under tests performance were recorded.

### 2.6.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 21.0 °C |
| Relative Humidity | 36.0 % |

### 2.6.6 Specification Limits

| Required Test Levels | | | Performance Criteria |
|---|---|---|---|
| Test | Test Level % of nominal Voltage | Duration (s) | |
| Short Interruption | 0 | 60 repeated 3 times | C |
| **Supplementary information:** Note 1. EUT powered at one of the Nominal input voltages and frequencies | | | |

**Table 24**

### 2.6.7 Test Results

**Results for Configuration and Mode: DC Powered - Operating**

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

| Tabulated Results for Power Supply Failure | | | | | |
|---|---|---|---|---|---|
| Line under test | Operating Frequency | Nominal Voltage (V) | Test Level Voltage (V) | Duration (s) | Result |
| 12 V DC Power Supply Line | DC | 12 | 0 | 60 | Pass |

**Table 25**

**Figure 14 - Test Setup - Immunity to Power Supply Failure**

### 2.6.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 2.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| EMI Generator | Teseq | NSG 3040-05 | 4861 | 12 | 08-May-2019 |
| Stepped Transformer | Teseq | INA 6502-05 | 4862 | 12 | 08-May-2019 |

**Table 26**

## 2.7 Immunity to electrostatic discharge

### 2.7.1 Specification Reference

IEC 60945, Clause 10.9

### 2.7.2 Equipment Under Test and Modification State

ATA100, S/N: TA008 - Modification State 0

### 2.7.3 Date of Test

04-April-2019

### 2.7.4 Test Method

The equipment under test including associated cabling was configured on but insulated from, using a 0.5mm isolator, a horizontal coupling plane fitted to the top of a 0.8m nonconductive table for table-top equipment; and on a 0.1m insulated support for floor standing equipment; above a ground reference plane all within a test laboratory.

Using the air discharge method for non-metallic parts, contact discharge method for metallic parts with both vertical and horizontal couple plane discharge methods for the sides of the equipment under test, the required electrostatic discharge voltage levels in both voltage polarities were applied at the detailed pulse repartition rate.

During this test, any anomalies in the equipment under tests performance were recorded.

### 2.7.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 21.0 °C |
| Relative Humidity | 33.0 % |

### 2.7.6 Specification Limits

| Required Test Levels | | | | Performance Criteria |
|---|---|---|---|---|
| Discharge type | Discharge Level (kV) | | Number of discharges per location (each polarity) | |
| | Positive | Negative | | |
| Air – Direct | 2, 4 and 8 | 2, 4 and 8 | 10 | B |
| Contact – Direct | 2, 4 and 6 | 2, 4 and 6 | 10 | B |
| Contact – Indirect | 2, 4 and 6 | 2, 4 and 6 | 10 | B |
| **Supplementary information:** None | | | | |

**Table 27**

### 2.7.7 Test Results

**Results for Configuration and Mode: DC Powered - Operating**

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

◯ Contact ☐ Air

| ID | Test Point | Discharge | Results | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2kV | | 4kV | | 6kV | | 8kV | | 15kV | |
| | | | + | - | + | - | + | - | + | - | + | - |
| | Horizontal Coupling Plane | Contact | ✓ | ✓ | ✓ | ✓ | N/A | N/A | N/A | N/A | N/A | N/A |
| | Vertical Coupling Plane | Contact | ✓ | ✓ | ✓ | ✓ | N/A | N/A | N/A | N/A | N/A | N/A |
| | Contact Discharge Points | Contact | ✓ | ✓ | ✓ | ✓ | N/A | N/A | N/A | N/A | N/A | N/A |
| | Air Discharge Points | Air | ✓* | ✓* | ✓* | ✓* | N/A | N/A | ✓* | ✓* | N/A | N/A |

**Table 28**

| Key to Results | |
|---|---|
| ✓ | The EUT's performance was not impaired at this test point when the ESD pulse was applied. |
| ✓* | No discharge occurred at this point when the ESD pulse was applied. |
| N/A | Not Applicable. |

**Table 29**

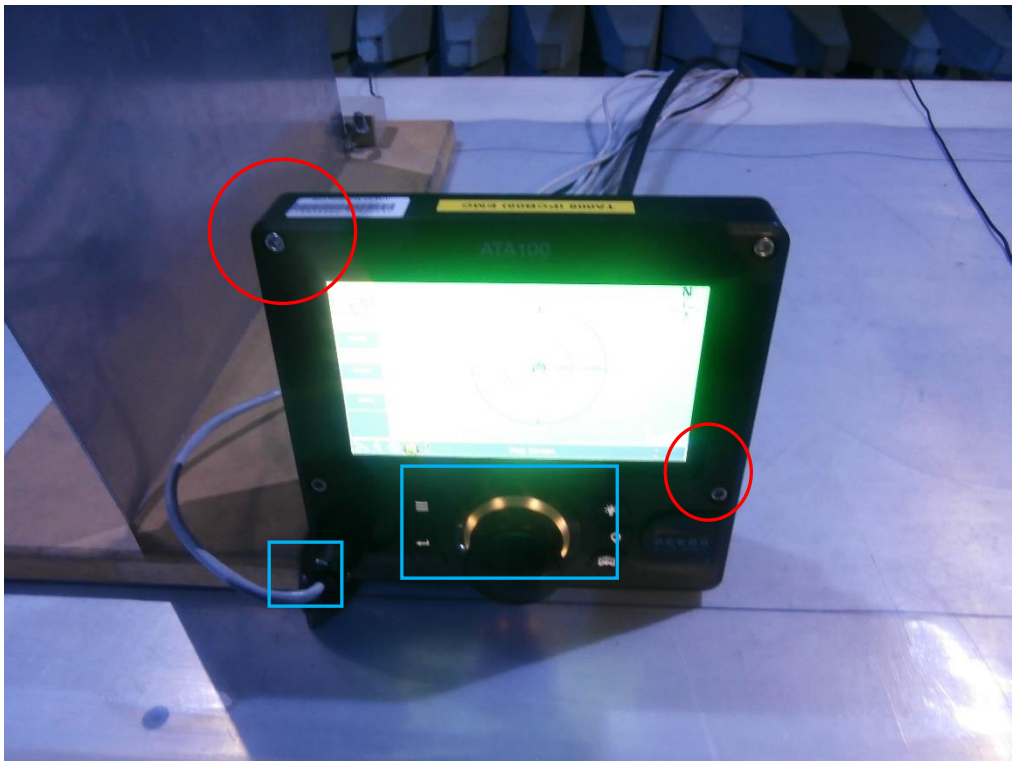

**Figure 15 - Test Positions**

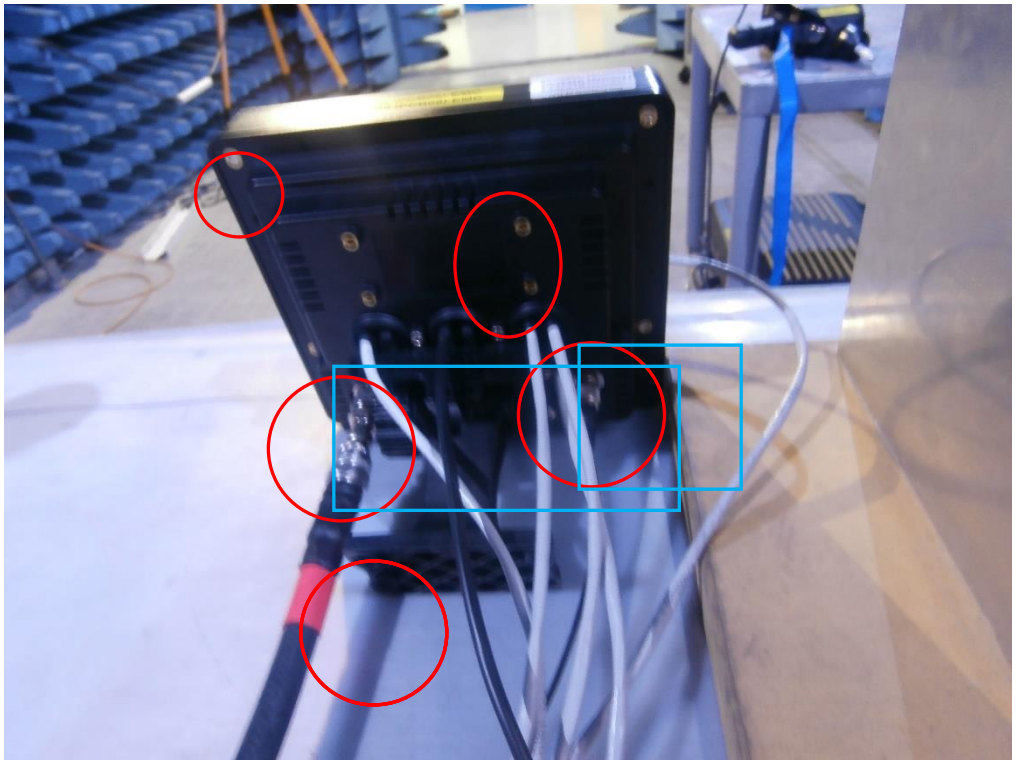

**Figure 16 - Test Positions**

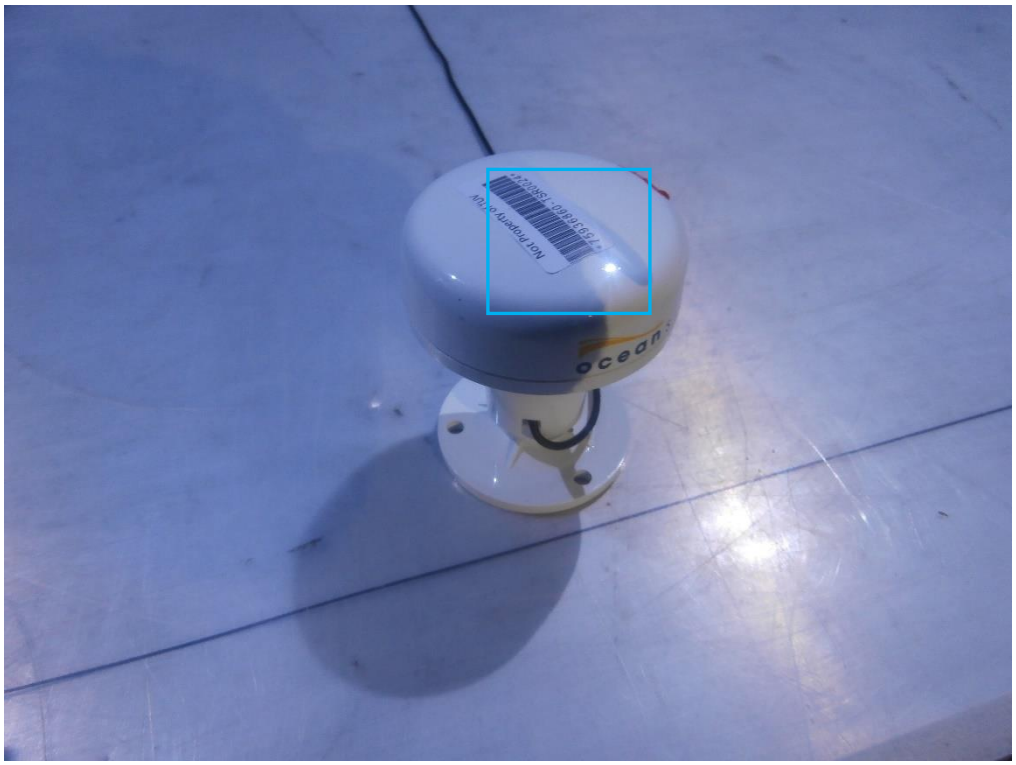

**Figure 17 - Test Positions**

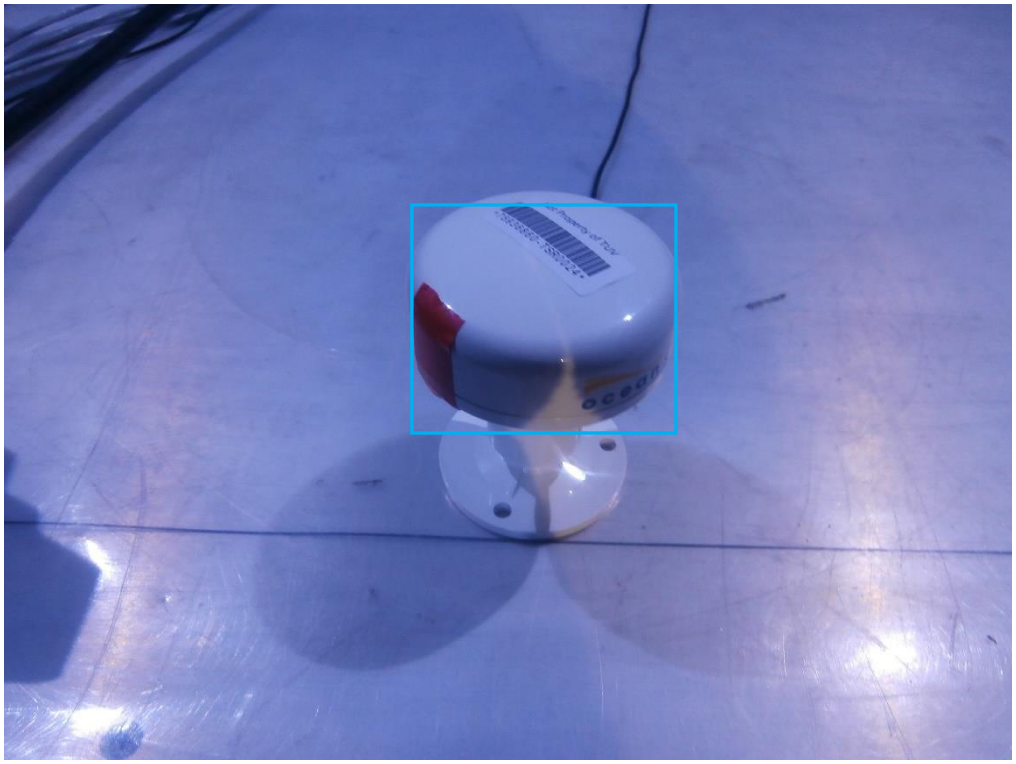

**Figure 18 - Test Positions**

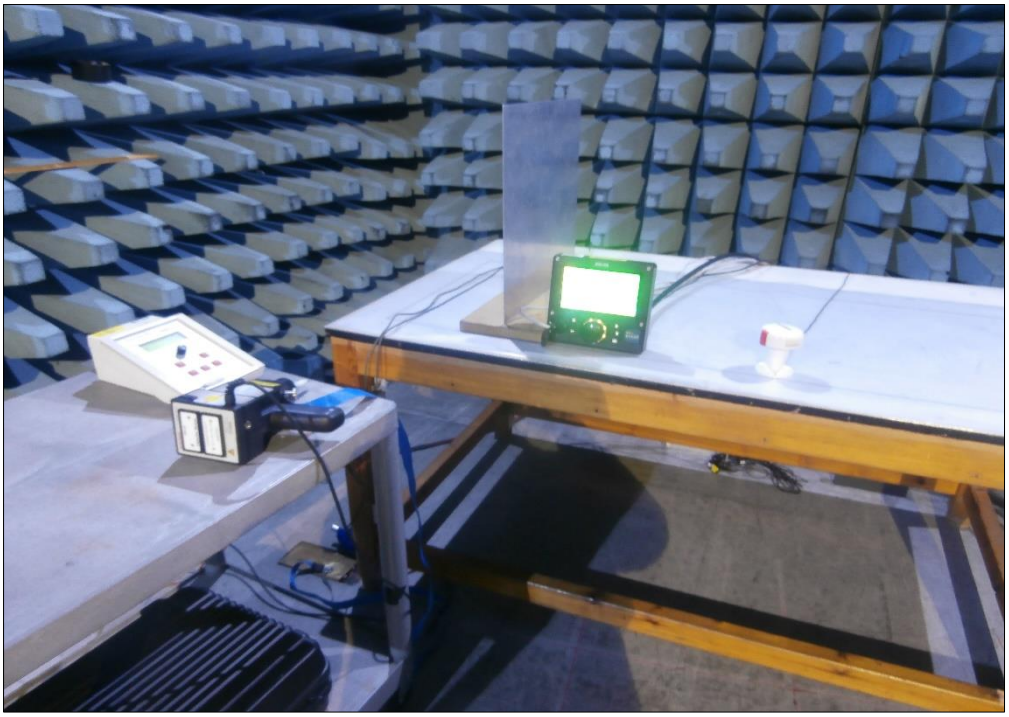

**Figure 19 - Test Setup - Immunity to Electrostatic Discharge**

### 2.7.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 2.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| Multimeter | Iso-tech | IDM 101 | 2170 | 12 | 06-Jun-2019 |
| ESD Generator | Schloder | SESD 30000 | 4724 | 12 | 14-May-2019 |

**Table 30**

## 2.8 Compass safe distance

### 2.8.1 Specification Reference

IEC 60945, Clause 11.2

### 2.8.2 Equipment Under Test and Modification State

ATA100, S/N: TA008 - Modification State 0

### 2.8.3 Date of Test

05-April-2019

### 2.8.4 Test Method

The EUT was setup on an East to West oriented level non-magnetic surface.

A magnetometer was used to take a horizontal magnetic flux density measurement and from this measurement, a standard and an emergency compass deflection was calculated.

A ships magnetic compass was located at the west end of the non-magnetic surface.

The compass was zeroed and the EUT was gradually moved from the east to the west end of the non-magnetic surface towards the compass centre in all 6 of its orthogonal planes and in 3 different states until the calculated compass deflection was achieved, or the EUT had reached the boundary of the ships magnetic compass.

Once all raw readings had been obtained, the worst case reading for each state was rounded up to the nearest 50mm or 100mm.

### 2.8.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 16.0 °C |
| Relative Humidity | 35.0 % |

### 2.8.6 Specification Limits

The greatest distance obtained under all these conditions is the safe distance.

Distances are to be rounded up to the nearest 50 mm or 100 mm.

The findings shall be noted in the test report.

The safe distance shall be marked on the EUT or recorded as described in IEC 60945, Section 4.5.3.

### 2.8.7 Test Results

**Results for Configuration and Mode: DC Powered - Operating**

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

Magnetometer Reading and Calculations

| Horizontal Maximum Flux Density, Magnetic North (H) | Standard Compass Deviation Limit (5.4/H in Degrees) | Emergency Compass Deviation Limit (18/H in Degrees) |
|---|---|---|
| 20.2 | 0.3 | 0.9 |

**Table 31**

EUT In Unpowered State

| EUT Orientation in Relation to Magnetic Compass | Distance from Magnetic Compass when Standard Deviation is seen (mm) | Distance from Magnetic Compass when Emergency Deviation is seen (mm) |
|---|---|---|
| Front | 470 | 280 |
| Top | 320 | 220 |
| Left Hand Side | 470 | 220 |
| Right Hand Side | 340 | 230 |
| Underside | 220 | 165 |
| Rear | 420 | 250 |

**Table 32**

EUT In Normalised State

| EUT Orientation in Relation to Magnetic Compass | Distance from Magnetic Compass when Standard Deviation is seen (mm) | Distance from Magnetic Compass when Emergency Deviation is seen (mm) |
|---|---|---|
| Front | 450 | 290 |
| Top | 300 | 165 |
| Left Hand Side | 650 | 360 |
| Right Hand Side | 330 | 190 |
| Underside | 350 | 300 |
| Rear | 490 | 450 |

**Table 33**

EUT In Powered State

| EUT Orientation in Relation to Magnetic Compass | Distance from Magnetic Compass when Standard Deviation is seen (mm) | Distance from Magnetic Compass when Emergency Deviation is seen (mm) |
|---|---|---|
| Front | 420 | 290 |
| Top | 165 | 165 |
| Left Hand Side | 550 | 320 |
| Right Hand Side | 380 | 165 |
| Underside | 350 | 310 |
| Rear | 750 | 460 |

**Table 34**

GPS Antenna In Unpowered State

| EUT Orientation in Relation to Magnetic Compass | Distance from Magnetic Compass when Standard Deviation is seen (mm) | Distance from Magnetic Compass when Emergency Deviation is seen (mm) |
|---|---|---|
| Front | 165 | 165 |
| Top | 165 | 165 |
| Left Hand Side | 165 | 165 |
| Right Hand Side | 165 | 165 |
| Underside | 165 | 165 |
| Rear | 165 | 165 |

**Table 35**

GPS Antenna In Normalised State

| GPS Orientation in Relation to Magnetic Compass | Distance from Magnetic Compass when Standard Deviation is seen (mm) | Distance from Magnetic Compass when Emergency Deviation is seen (mm) |
|---|---|---|
| Front | 165 | 165 |
| Top | 165 | 165 |
| Left Hand Side | 165 | 165 |
| Right Hand Side | 165 | 165 |
| Underside | 165 | 165 |
| Rear | 165 | 165 |

**Table 36**

GPS Antenna In Powered State

| EUT Orientation in Relation to Magnetic Compass | Distance from Magnetic Compass when Standard Deviation is seen (mm) | Distance from Magnetic Compass when Emergency Deviation is seen (mm) |
|---|---|---|
| Front | 165 | 165 |
| Top | 165 | 165 |
| Left Hand Side | 165 | 165 |
| Right Hand Side | 165 | 165 |
| Underside | 165 | 165 |
| Rear | 165 | 165 |

**Table 37**

Final Results

| Standard Compass Safe Distance (mm) | Emergency Compass Safe Distance (mm) |
|---|---|
| 750 | 500 |

**Table 38**

**Figure 20 Compass Safe Distance**

### 2.8.8 Test Location and Test Equipment Used

This test was carried out in Offsite Testing.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| Sussex Helmholtz Coil | Various | 88771 | 327 | - | TU |
| Compass Verification Unit | TUV SUD | CVU | 3579 | - | TU |
| Marine Binnacle Compass with Repeater Display | Cassens & Plath | Compass: Type 11 | 3834 | - | TU |

**Table 39**

TU - Traceability Unscheduled

## 2.9 Immunity to fast transients on DC power, signal and control lines

### 2.9.1 Specification Reference

IEC 60945, Clause 10.5

### 2.9.2 Equipment Under Test and Modification State

ATA100, S/N: TA008 - Modification State 0

### 2.9.3 Date of Test

03-April-2019

### 2.9.4 Test Method

The equipment under test including associated cabling was configured on but insulated from, using a 0.1 m isolator, a horizontal coupling plane; above a ground reference plane all within a test laboratory.

Using a CDN for power ports, capacitive coupling clamp for signal and control ports and a 33nF coupling capacitor for earth ports, the required fast transient burst voltage levels in both voltage polarities were applied at the detailed pulse repartition rate and duration of test.

During this test, any anomalies in the equipment under tests performance were recorded.

### 2.9.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 21.0 °C |
| Relative Humidity | 35.0 % |

### 2.9.6 Specification Limits

| Required Test Levels | | | | | Performance Criteria |
|---|---|---|---|---|---|
| Line Under Test | Level (±kV) | Repetition Rate (kHz) | Test Duration | Coupling Method | |
| Signal / Control Port (1) | 1.0 | 5 | 3 min per polarity | Capacitive Clamp | B |
| **Supplementary information:**<br>Note 1. Only required in the case of lines > 3m | | | | | |

**Table 40**

### 2.9.7 Test Results

**Results for Configuration and Mode: DC Powered - Operating**

Performance assessment of the EUT made during this test: Pass.

Detailed results are shown below.

| Tabulated Results for Fast Transient Burst Immunity | | | | | |
|---|---|---|---|---|---|
| Line under test | Test Level (kV) | Repetition Rate (kHz) | Test Duration (min) | Coupling Method | Result |
| RF Cable | ±0.25, ±0.5 & ±1.0 | 5 | 300 | Capacitive Clamp | Pass |
| Sensor 1 2 and 3 cable | ±0.25, ±0.5 & ±1.0 | 5 | 300 | Capacitive Clamp | Pass |
| LR Cable | ±0.25, ±0.5 & ±1.0 | 5 | 300 | Capacitive Clamp | Pass |
| GPS Antenna Cable | ±0.25, ±0.5 & ±1.0 | 5 | 300 | Capacitive Clamp | Pass |
| DGPS | ±0.25, ±0.5 & ±1.0 | 5 | 300 | Capacitive Clamp | Pass |
| Pilot Port | ±0.25, ±0.5 & ±1.0 | 5 | 300 | Capacitive Clamp | Pass |
| ECDIS | ±0.25, ±0.5 & ±1.0 | 5 | 300 | Capacitive Clamp | Pass |

**Table 41**

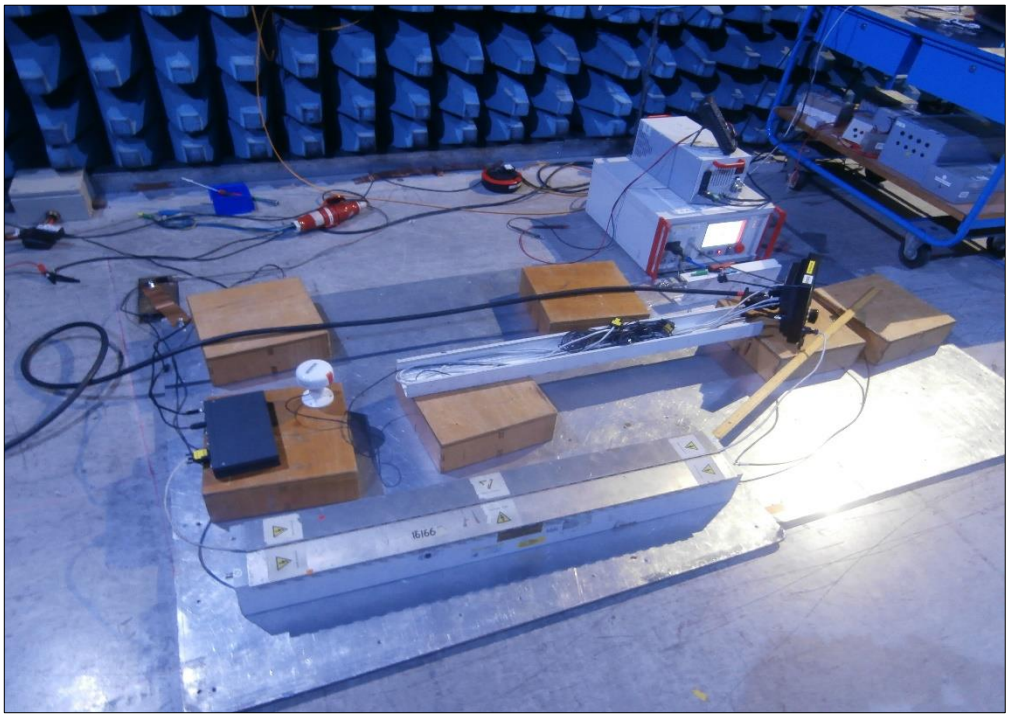

**Figure 21 - Immunity to Fast Transients**

### 2.9.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 2.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| Capacitive Coupling Clamp | Omiran | EFTC 105 | 298 | 12 | 03-Jul-2019 |
| EMI Generator | Teseq | NSG 3040-05 | 4861 | 12 | 08-May-2019 |

**Table 42**

# 3 Test Equipment Information

## 3.1 General Test Equipment Used

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|
| DC Power Supply | Hewlett Packard | 6269B | 326 | - | TU |
| Multimeter | Iso-tech | IDM 101 | 2118 | 12 | 08-Feb-2020 |
| GPS/SBAS Simulator | Spirent | STR4500 | 3056 | - | 06-Oct-2019 |
| GPS Antenna | ACC | PA175-S | 4228 | - | TU |
| Oscilloscope | Tektronix | TDS3052B | 3156 | 12 | 24-May-2019 |
| 35V - 5A Bench Power Supply | Thurlby Thandar Instruments | EX355R | 5223 | - | TU |
| Attenuator (20dB, 150W) | Narda | 769-20 | 3367 | 12 | 17-Jul-2019 |
| Attenuator (10dB, 150W) | Narda | 769-10 | 3368 | 12 | 17-Jul-2019 |
| Attenuator 40dB 100W | Weinschel | 48-40-43-LIM | 5134 | 12 | 07-Nov-2019 |

**Table 43**

TU – Traceability Unscheduled

# 4 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

| Test Name | Measurement Uncertainty |
|---|---|
| Immunity to fast transients on DC power, signal and control lines | The test was applied using proprietary equipment that meets the requirements of EN 61000-4-4 |
| Compass safe distance | 0.1 Degrees |
| Immunity to electrostatic discharge | The test was applied using proprietary equipment that meets the requirements of EN 61000-4-2 |
| Immunity to power supply failure | The test was applied using proprietary equipment that meets the requirements of EN 61000-4-11 |
| Immunity to power supply short-term variation | Frequency and Time Voltage Amplitude - 12 parts in 106 / 0.16% |
| Immunity to radiated radiofrequencies | 80 MHz to 2 GHz Test Amplitude ±2.0 dB |
| Immunity to conducted radio frequency disturbance | 150 kHz to 80 MHz<br>EM Clamp Method of Test, Amplitude ±3.1 dB<br>CDN Method of Test, Amplitude ±1.2 dB<br>BCI Clamp Method of Test, Amplitude ±1.1 dB<br>Direct Injection Method of Test, Amplitude ±1.2 dB |
| Radiated emissions | 9 kHz to 30 MHz, Active Loop Antenna, ±3.4dB<br>30 MHz to 2 GHz, Bilog Antenna, ±5.2 dB |
| Conducted emissions | 10 kHz to 30 MHz, LISN, ±3.7 dB |

**Table 44**

Worst case error for both Time and Frequency measurement 12 parts in 106.
All measurement uncertainties have been calculated using CISPR guidelines.