

## Report on the EMC Testing of:

Vesper Marine Ltd  
Marlin POD, Model: Cortex M1  
Handset. Model: Cortex H1

In accordance with IEC 60945, ETSI EN 301 843-1  
and ETSI EN 301 843-2

Prepared for: Vesper Marine Ltd  
Auckland  
1142  
New Zealand



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## COMMERCIAL-IN-CONFIDENCE

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| NAME          | JOB TITLE       | RESPONSIBLE FOR      | ISSUE DATE    |
|---------------|-----------------|----------------------|---------------|
| Andrew Lawson | Senior Engineer | Authorised Signatory | 21 April 2020 |

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### EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with IEC 60945: 2002 C1:2008, ETSI EN 301 843-1 V2.2.1 (2017-11) and ETSI EN 301 843-2 V2.2.1 (2017-11)



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# 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                       | 09 January 2020 |
| 2     | Additional modes of testing added | 21 April 2020   |

**Table 1**

## 1.2 Introduction

|                               |                                                                                                                                        |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Applicant                     | Vesper Marine Ltd                                                                                                                      |
| Manufacturer                  | Vesper Marine Ltd                                                                                                                      |
| Model Number(s)               | Cortex M1<br>Cortex H1                                                                                                                 |
| Serial Number(s)              | M100000069<br>M100000065<br>H1.0000000B<br>H1.0000000F                                                                                 |
| Hardware Version(s)           | B<br>C                                                                                                                                 |
| Software Version(s)           | 0.2<br>0.9                                                                                                                             |
| Number of Samples Tested      | 2                                                                                                                                      |
| Test Specification/Issue/Date | IEC 60945: 2002 C1:2008<br>ETSI EN 301 843-1 V2.2.1 (2017-11)<br>ETSI EN 301 843-2 V2.2.1 (2017-11)                                    |
| Test Plan/Issue/Date          | Marlin Compliance Testing/EMC Test Plan v0.1/10<br>December 2018                                                                       |
| Order Number                  | 13976                                                                                                                                  |
| Date                          | 20-September-2018                                                                                                                      |
| Date of Receipt of EUT        | 10-December-2018                                                                                                                       |
| Start of Test                 | 12-December-2018                                                                                                                       |
| Finish of Test                | 25-March-2020                                                                                                                          |
| Name of Engineer(s)           | Colin McKean and Jack Tuckwell                                                                                                         |
| Related Document(s)           | IEC 61000-4-2: 2008<br>IEC 61000-4-4: 2012<br>IEC 61000-4-11: 2004<br>IEC 61000-4-3: 2006 + A1: 2007 + A2: 2010<br>IEC 61000-4-6: 2013 |



### 1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with IEC 60945, ETSI EN 301 843-1 and ETSI EN 301 843-2 is shown below.

| Section                                                         | IEC 60945<br>Specification<br>Clause | ETSI EN<br>301 843-1<br>Specification<br>Clause | Test Description                                                  | Result | Comments/Base Standard |
|-----------------------------------------------------------------|--------------------------------------|-------------------------------------------------|-------------------------------------------------------------------|--------|------------------------|
| Configuration and Mode: POD DC Powered - AIS                    |                                      |                                                 |                                                                   |        |                        |
| 2.2                                                             | 9.2                                  | 8.3                                             | Conducted Emissions                                               | Pass   | CISPR 16-1-2           |
| 2.3                                                             | 10.9                                 | 9.3                                             | Immunity to Electrostatic Discharge                               | Pass   | IEC 61000-4-2          |
| 2.4                                                             | 10.5                                 | 9.4                                             | Immunity to Fast Transients on AC Power, Signal and Control Lines | Pass   | IEC 61000-4-4          |
| 2.5                                                             | 10.8                                 | 9.6                                             | Immunity to Power Supply Failure                                  | Pass   | IEC 61000-4-11         |
| 2.6                                                             | 10.4                                 | 9.2                                             | Immunity to Radiated Radio Frequencies                            | Pass   | IEC 61000-4-3          |
| 2.7                                                             | 10.3                                 | 9.5                                             | Immunity to Conducted Radio Frequency Disturbance                 | Pass   | IEC 61000-4-6          |
| Configuration and Mode: POD DC Powered - Not Transmitting       |                                      |                                                 |                                                                   |        |                        |
| 2.1                                                             | 9.3                                  | 8.2                                             | Radiated Emissions                                                | Pass   | CISPR 16-1-4           |
| Configuration and Mode: POD and Handset, DC Powered - VHF TX/RX |                                      |                                                 |                                                                   |        |                        |
| 2.6                                                             | 10.4                                 | 9.2                                             | Immunity to Radiated Radio Frequencies                            | Pass   | IEC 61000-4-3          |
| 2.7                                                             | 10.3                                 | 9.5                                             | Immunity to Conducted Radio Frequency Disturbance                 | Pass   | IEC 61000-4-6          |
| Configuration and Mode: POD and Handset, DC Powered - DSC       |                                      |                                                 |                                                                   |        |                        |
| 2.6                                                             | 10.4                                 | 9.2                                             | Immunity to Radiated Radio Frequencies                            | Pass   | IEC 61000-4-3          |
| 2.7                                                             | 10.3                                 | 9.5                                             | Immunity to Conducted Radio Frequency Disturbance                 | Pass   | IEC 61000-4-6          |

**Table 2**



#### 1.4 Declaration of Build Status

| MAIN EUT                                                                                                               |                                                                                   |              |                                                                     |
|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------|---------------------------------------------------------------------|
| MANUFACTURING DESCRIPTION                                                                                              | AIS/VHF/Monitoring Transceiver                                                    |              |                                                                     |
| MANUFACTURER                                                                                                           | Vesper Marine Ltd                                                                 |              |                                                                     |
| MODEL NAME/NUMBER                                                                                                      | Cortex M1                                                                         |              |                                                                     |
| PART NUMBER                                                                                                            | CM1                                                                               |              |                                                                     |
| SERIAL NUMBER                                                                                                          | 100                                                                               |              |                                                                     |
| HARDWARE VERSION                                                                                                       | C                                                                                 |              |                                                                     |
| SOFTWARE VERSION                                                                                                       | 0.21                                                                              |              |                                                                     |
| PSU VOLTAGE/FREQUENCY/CURRENT                                                                                          | 12-24V,350mA nominal                                                              |              |                                                                     |
| HIGHEST INTERNALLY GENERATED FREQUENCY                                                                                 | 2.4GHz                                                                            |              |                                                                     |
| FCC ID (if applicable)                                                                                                 | YJDVESPM1                                                                         |              |                                                                     |
| INDUSTRY CANADA ID (if applicable)                                                                                     | 9118A-M1                                                                          |              |                                                                     |
| TECHNICAL DESCRIPTION<br>(a brief technical description of the intended use and operation)                             | A VHF and Class B AIS Transponder with integrated WiFi and Cellular Connectivity. |              |                                                                     |
| COUNTRY OF ORIGIN                                                                                                      | New Zealand                                                                       |              |                                                                     |
| RF CHARACTERISTICS (if applicable)                                                                                     |                                                                                   |              |                                                                     |
| TRANSMITTER FREQUENCY OPERATING RANGE (MHz)                                                                            | 156.025-162.025                                                                   |              |                                                                     |
| RECEIVER FREQUENCY OPERATING RANGE (MHz)                                                                               | 156.025-162.025                                                                   |              |                                                                     |
| INTERMEDIATE FREQUENCIES                                                                                               | SDR DC                                                                            |              |                                                                     |
| EMISSION DESIGNATOR(S):<br><a href="https://fccid.io/Emissions-Designator/">https://fccid.io/Emissions-Designator/</a> |                                                                                   |              |                                                                     |
| MODULATION TYPES: (i.e. GMSK, QPSK)                                                                                    | FM,GMSK,FSK                                                                       |              |                                                                     |
| OUTPUT POWER (W or dBm)                                                                                                | 25W max, 1W min                                                                   |              |                                                                     |
| SEPARATE BATTERY/POWER SUPPLY (if applicable)                                                                          |                                                                                   |              |                                                                     |
| MANUFACTURING DESCRIPTION                                                                                              |                                                                                   |              |                                                                     |
| MANUFACTURER                                                                                                           |                                                                                   |              |                                                                     |
| TYPE                                                                                                                   |                                                                                   |              |                                                                     |
| PART NUMBER                                                                                                            |                                                                                   |              |                                                                     |
| PSU VOLTAGE/FREQUENCY/CURRENT                                                                                          |                                                                                   |              |                                                                     |
| COUNTRY OF ORIGIN                                                                                                      |                                                                                   |              |                                                                     |
| MODULES (if applicable)                                                                                                |                                                                                   |              |                                                                     |
| MANUFACTURING DESCRIPTION                                                                                              | WiFi                                                                              | 3G           |                                                                     |
| MANUFACTURER                                                                                                           | TI                                                                                | Sierra       |                                                                     |
| TYPE                                                                                                                   | WL18MODGB                                                                         | HL8548       |                                                                     |
| POWER                                                                                                                  | 17dBm                                                                             | 23dBm        |                                                                     |
| FCC ID                                                                                                                 | Z84-WL18SBMOD                                                                     | N7NHL8548    |                                                                     |
| INDUSTRY CANADA ID                                                                                                     | 23244-WL18SBMOD                                                                   | 2417C-HL8548 |                                                                     |
| EMISSION DESIGNATOR                                                                                                    | n/a                                                                               | n/a          | <a href="https://fccid.io/N7NHL8548">https://fccid.io/N7NHL8548</a> |
| DHSS/FHSS/COMBINED OR OTHER                                                                                            | n/a                                                                               | n/a          |                                                                     |
| COUNTRY OF ORIGIN                                                                                                      | U.S.A                                                                             | Canada       |                                                                     |
| 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: Darcy Williams  
Position held: Engineer  
Date: 26-02-2020



| MAIN EUT                                                                         |                                                                       |  |  |
|----------------------------------------------------------------------------------|-----------------------------------------------------------------------|--|--|
| MANUFACTURING DESCRIPTION                                                        | Cortex H1 / H1P Handset                                               |  |  |
| MANUFACTURER                                                                     | Vesper Marine Ltd                                                     |  |  |
| MODEL NAME/NUMBER                                                                | Cortex H1                                                             |  |  |
| PART NUMBER                                                                      | CH1                                                                   |  |  |
| SERIAL NUMBER                                                                    |                                                                       |  |  |
| HARDWARE VERSION                                                                 | C                                                                     |  |  |
| SOFTWARE VERSION                                                                 | 0.9                                                                   |  |  |
| PSU VOLTAGE/FREQUENCY/CURRENT                                                    | 12-24V, 200mA nominal                                                 |  |  |
| HIGHEST INTERNALLY GENERATED / USED FREQUENCY                                    | 2.4GHz                                                                |  |  |
| FCC ID (if applicable)                                                           | YJDVESP1                                                              |  |  |
| INDUSTRY CANADA ID (if applicable)                                               | 9118A-H1                                                              |  |  |
| TECHNICAL DESCRIPTION<br>(a brief description of the intended use and operation) | Handset for the Cortex VHF system, with integrated Wi-Fi connectivity |  |  |
| COUNTRY OF ORIGIN                                                                | New Zealand                                                           |  |  |
| RF CHARACTERISTICS (if applicable)                                               |                                                                       |  |  |
| TRANSMITTER FREQUENCY OPERATING RANGE (MHz)                                      |                                                                       |  |  |
| RECEIVER FREQUENCY OPERATING RANGE (MHz)                                         |                                                                       |  |  |
| INTERMEDIATE FREQUENCIES                                                         |                                                                       |  |  |
| EMISSION DESIGNATOR(S):<br>(i.e. G1D, GXW)                                       |                                                                       |  |  |
| MODULATION TYPES:<br>(i.e. GMSK, QPSK)                                           |                                                                       |  |  |
| OUTPUT POWER (W or dBm)                                                          |                                                                       |  |  |
| SEPARATE BATTERY/POWER SUPPLY (if applicable)                                    |                                                                       |  |  |
| MANUFACTURING DESCRIPTION                                                        | 3.7V Lithium-Ion Battery                                              |  |  |
| MANUFACTURER                                                                     | General Electronics Technology Co. Ltd.                               |  |  |
| TYPE                                                                             | Polymer Lithium-Ion                                                   |  |  |
| PART NUMBER                                                                      | GEB 654060                                                            |  |  |
| PSU VOLTAGE/FREQUENCY/CURRENT                                                    | 3.7V, 2000mAh, 7.4 W                                                  |  |  |
| COUNTRY OF ORIGIN                                                                | China                                                                 |  |  |
| MODULES (if applicable)                                                          |                                                                       |  |  |
| MANUFACTURING DESCRIPTION                                                        | Open-Q 410 SOM                                                        |  |  |
| MANUFACTURER                                                                     | Intrinsyc                                                             |  |  |
| TYPE                                                                             | Open-Q 410 SOM                                                        |  |  |
| POWER                                                                            | < 20 dBm                                                              |  |  |
| FCC ID                                                                           | 2AFDI-ITCOQ410S                                                       |  |  |
| INDUSTRY CANADA ID                                                               | 9049A-ITCOQ410S                                                       |  |  |
| EMISSION DESIGNATOR                                                              |                                                                       |  |  |
| DHSS/FHSS/COMBINED OR OTHER                                                      |                                                                       |  |  |
| COUNTRY OF ORIGIN                                                                | U.S.A.                                                                |  |  |
| 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: Darcy Williams  
 Date: 20 January 2020

Position held: Engineer

## 1.5 Product Information

### 1.5.1 Technical Description

The Equipment Under Test (EUT) was a Vesper Marine, Cortex VHF System consisting of a POD, Model: Cortex M1 and Handset Model: Cortex H1.

The primary function of the Cortex System (POD + Handset) is to provide a fully featured 25 W VHF radio with complete Class D DSC functionality and AIS Class B SOTDMA transponder functionality with integrated on-board and on-land vessel monitoring and control.

The system also features integrated 802.11 b/g/n WLAN functionality which allows configuration and control via a dedicated smartphone app or via the Cortex handset.

The EUT features integrated 802.11 b/g/n Wi-Fi functionality which allows configuration and control via a dedicated smart phone app or via the Marine Remote.

On-land vessel monitoring, and control are supported via a built-in cellular modem and a sim with global roaming capability.

The POD also features an integrated GNSS receiver (supporting GPS, GLONASS, BeiDou) fully isolated NMEA0183 / NMEA2000 ports and 2 x high-power (10W/30W) external speaker drivers.



Figure 1 – POD - General View



Figure 2 – POD - Rear View



Figure 3 – Handset – Front View





**Figure 4 – Handset – Rear View**

### 1.5.2 EUT Port/Cable Identification

| Port                                                 | Max Cable Length specified | Usage             | Type      | Screened |
|------------------------------------------------------|----------------------------|-------------------|-----------|----------|
| Configuration and Mode: All configurations and Modes |                            |                   |           |          |
| DC Power Port                                        | <3 m                       | 12 V DC           | 2 Core    | No       |
| VHF/AIS Antenna                                      | >3 m                       | VHF & AIS TX / RX | Coaxial   | Yes      |
| External GPS                                         | >3 m                       | Signal            | Coaxial   | Yes      |
| NMEA2000                                             | >3 m                       | Data              | Multicore | Yes      |
| GPIO, NMEA0183 & Test IO                             | >3 m                       | Data              | Multicore | Yes      |
| External Speakers                                    | >3 m                       | Data              | Multicore | Yes      |

**Table 3**

### 1.5.3 Test Configuration

| Configuration              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| POD DC Powered             | <p>The POD was powered from a 12 V DC supply.<br/>The EUT had the following connections:</p> <ul style="list-style-type: none"><li>• An external active GPS antenna.</li><li>• A VHF Co-axial cable terminated into a 50 Ohm load.</li><li>• An NMEA2000 Cable terminated into a 120 Ohm load.</li><li>• An unterminated GPIO Cable.</li><li>• An audio Cable terminated into 2 x 10 Ohm loads.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| POD and Handset DC Powered | <p>For VHF TX/RX - The system consisted of a pod and handset for transmitting and a pod and handset for receiving.<br/>The pods and handsets were powered from a 12 V DC Power Supply.<br/>The two pods were connected directly at their VHF antenna ports via an RF cable and an antenna.<br/>A 1 kHz tone was injected into the microphone of the transmitting handset using a hose pipe attached to audio setup.<br/>Another hose pipe was attached to the receive handset connected to audio equipment measuring a SINAD level.</p> <p>For DSC - The system consists of a pod and handset for transmitting a DSC message and a pod and handset for receiving the DSC message. The pods and handsets were powered from a 12 V DC Power Supply. The two pods were connected directly at their VHF antenna ports via an RF cable and an antenna.</p> |

Table 4

### 1.5.4 Modes of Operation

| Mode             | Description                                                                                                                                                                                                                                                     |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AIS              | The EUT was powered and receiving a GPS location from a GPS simulator and a 2.4 GHz Wi-Fi signal from a router.                                                                                                                                                 |
| Not Transmitting | The EUT was powered but not transmitting.                                                                                                                                                                                                                       |
| VHF TX/RX        | The EUT was place into a VHF transmitting mode via the handset controls. The PTT button was depressed sending a 1 kHz tone over a direct link to a receive pod and handset where the audio 1 kHz tone was heard from the output speaker of the receive handset. |
| DSC              | The EUT was place into a DSC transmitting mode using the handset.<br>The second handset displayed the received message.                                                                                                                                         |

Table 5

### 1.5.5 Monitoring of Performance

#### AIS

The EUT was monitored for correct performance visually by ensuring that the indication light on top of the EUT remained green indicating a GPS signal was being received and a Wi-Fi link was present.

To confirm normal operation, a supplied smart phone was used with the Cortex application installed. Normal AIS transmit and receive was confirmed correct using a test AIS transponder.

#### DSC

The RX Handset was monitored for a received message transmitted from the EUT every time a call was activated.

#### VHF TX/RX

A 1 kHz tone received at the output speaker of the Received Handset was monitored for a SINAD level of greater than 20 dB.



#### 1.5.6 Performance Criteria

##### **Performance Criteria A – IEC 60945**

*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.*

##### **Performance Criteria B – IEC 60945**

*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 – IEC 60945**

*Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.*

##### **Performance criteria A for continuous phenomena applied to transmitters and receivers – ETSI EN 301 843-1**

*If no further details are given in the relevant part of the present document dealing with the particular type of radio equipment, the following general performance criteria A for continuous phenomena shall apply.*

*During and after the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level as defined in the immunity performance check, or as specified by the manufacturer for the intended use. In some cases, this permissible performance level may be replaced by a permissible loss of performance.*

*During the test the EUT shall not unintentionally transmit or change its actual operating state and stored data.*

*If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.*

*The EUT shall be subjected to the performance check (see clause 6.4) during and after the test.*

*The EUT shall meet the requirements of the performance check.*

**Performance criteria B for transient phenomena applied to transmitters and receivers – ETSI EN 301 843-1**

*If no further details are given in the relevant part of the present multi-part deliverable dealing with the particular type of radio equipment, the following general performance criteria B for transient phenomena shall apply.*

*After the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level as defined in the immunity performance check, or as specified by the manufacturer for the intended use. In some cases, this permissible performance level may be replaced by a permissible loss of performance.*

*During the EMC exposure to an electromagnetic phenomenon, a degradation of performance is, however, allowed. No change of the actual mode of operation (e.g. unintended transmission) or stored data is allowed.*

*If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.*

*The EUT shall be subjected to the performance check (see clause 6.4) after the test. The EUT shall meet the requirements of the performance check.*

**Performance criteria C applied to power supply failure – ETSI EN 301 843-1**

*During the test sequence the EUT shall not unintentionally transmit or change stored data. Temporary degradation or loss of function or performance is allowed during the test sequence, provided the function, as defined by the immunity performance assessment procedure and in the technical specification published by the manufacturer, is self-recoverable or can be restored after the test by operation of user controls.*

*The EUT shall be subjected to the performance check (see clause 6.4) after the test. The EUT shall meet the requirements of the performance check.*

**The manufacturers specified performance level is detailed as:**

The EUT was to continue to operate as per the requirements of the manufacturer with no unexpected behaviour.

DSC - The transmit handset shall continue to transmit message data the Receive Handset with no loss of performance.

VHF TX/RX - The EUT shall continue to transmit with a SINAD level > 20 dB received speaker port of the Receive handset.

Normal AIS transmit and receive was confirmed using a test AIS transponder.



## 1.6 Deviations from the Standard

### Section 2.1 – Radiated Emissions

In order to avoid carrying out the test twice, testing was carried out to the limits in both standards with the EUT at a height of 0.8 m from the ground plane.

## 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: M0000065 |                                                                                                  |                        |                          |
| 0                       | As supplied by the customer                                                                      | Not Applicable         | Not Applicable           |
| 1                       | On-board PSU filtering optimised to minimise noise coupling to external connectors.              | Client                 | 17-December-2019         |
| 2                       | TVS protection strategy for all ports optimised to provide comprehensive protection against FTB. | Client                 | 21-December-2019         |

**Table 6**

| Modification State      | Description of Modification still fitted to EUT | Modification Fitted By | Date Modification Fitted |
|-------------------------|-------------------------------------------------|------------------------|--------------------------|
| Serial Number: M0000069 |                                                 |                        |                          |
| 0                       | As supplied by the customer                     | Not Applicable         | Not Applicable           |

**Table 7**

| Modification State         | Description of Modification still fitted to EUT | Modification Fitted By | Date Modification Fitted |
|----------------------------|-------------------------------------------------|------------------------|--------------------------|
| Serial Number: H1.0000000B |                                                 |                        |                          |
| 0                          | As supplied by the customer                     | Not Applicable         | Not Applicable           |

**Table 8**

| Modification State         | Description of Modification still fitted to EUT | Modification Fitted By | Date Modification Fitted |
|----------------------------|-------------------------------------------------|------------------------|--------------------------|
| Serial Number: H1.0000000F |                                                 |                        |                          |
| 0                          | As supplied by the customer                     | Not Applicable         | Not Applicable           |

**Table 9**



## 1.8 Test Location

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

| Test Name                                                                               | Name of Engineer(s)            | Accreditation |
|-----------------------------------------------------------------------------------------|--------------------------------|---------------|
| Configuration and Mode: DC Powered – AIS                                                |                                |               |
| Conducted Emissions                                                                     | Colin McKean                   | UKAS          |
| Immunity to Electrostatic Discharge                                                     | Colin McKean                   | UKAS          |
| Immunity to Power Supply Failure                                                        | Colin McKean                   | UKAS          |
| Immunity to Fast Transients on AC Power, Signal and Control Lines                       | Colin McKean                   | UKAS          |
| Immunity to Radiated Radio Frequencies                                                  | Colin McKean                   | UKAS          |
| Immunity to Conducted Radio Frequency Disturbance                                       | Colin McKean                   | UKAS          |
| Configuration and Mode: DC Powered – Not Transmitting                                   |                                |               |
| Radiated Emissions                                                                      | Colin McKean                   | UKAS          |
| Configuration and Mode: Configuration and Mode: Pod and Handset, DC Powered - VHF TX/RX |                                |               |
| Immunity to Radiated Radio Frequencies                                                  | Colin McKean                   | UKAS          |
| Immunity to Radio Frequency, Common Mode                                                | Colin McKean and Jack Tuckwell | UKAS          |
| Configuration and Mode: Pod and Handset, DC Powered - DSC                               |                                |               |
| Immunity to Radiated Radio Frequencies                                                  | Colin McKean                   | UKAS          |
| Immunity to Radio Frequency, Common Mode                                                | Colin McKean and Jack Tuckwell | UKAS          |

**Table 10**

Office Address:

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



## 2 Test Details

### 2.1 Radiated Emissions

#### 2.1.1 Specification Reference

IEC 60945, Clause 9.3  
ETSI EN 301 843-1, Clause 8.2  
ETSI EN 301 843-2

#### 2.1.2 Equipment Under Test and Modification State

Cortex M1, S/N: M0000065 - Modification State 2

#### 2.1.3 Date of Test

26-March-2019

#### 2.1.4 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 antenna-to-EUT azimuth and antenna-to-EUT polarisation 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 a Quasi-Peak detector. The readings were maximised by adjusting the antenna height, polarisation and turntable azimuth, in accordance with the specification.

#### 2.1.5 Environmental Conditions

Ambient Temperature 20.0 °C  
Relative Humidity 45.0 %

#### 2.1.6 Specification Limits

150 kHz to 30 MHz

| Required Specification Limits (@ 3m)                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Frequency Range (MHz)                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Quasi-peak (dBμV/m) |
| 0.15 to 0.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 80 - 52*            |
| 0.3 to 30                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 52 - 34*            |
| <b>Supplementary Information:</b><br>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.<br>*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 11

30 MHz to 2 GHz

| Required Specification Limits (@ 3m)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------|
| Frequency Range (MHz)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Quasi-peak (dBμV/m) | Peak (dBμV/m) |
| 30 to 2000 <sup>(1)</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 54*                 | N/A           |
| 156 to 165 <sup>(2)</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 24*                 | 30*           |
| <b>Supplementary Information:</b><br>*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.<br><sup>(1)</sup> 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.<br><sup>(2)</sup> Alternatively, for the frequency band 156 MHz to 165 MHz, a peak receiver or a frequency analyser may be used, in accordance with the agreement between the manufacturer and the test house. |                     |               |

**Table 12**





2.1.7 Test Results

Results for Configuration and Mode: POD DC Powered - Not Transmitting.

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

Detailed results are shown below.

Frequency Range of Test: 150 kHz to 30 MHz

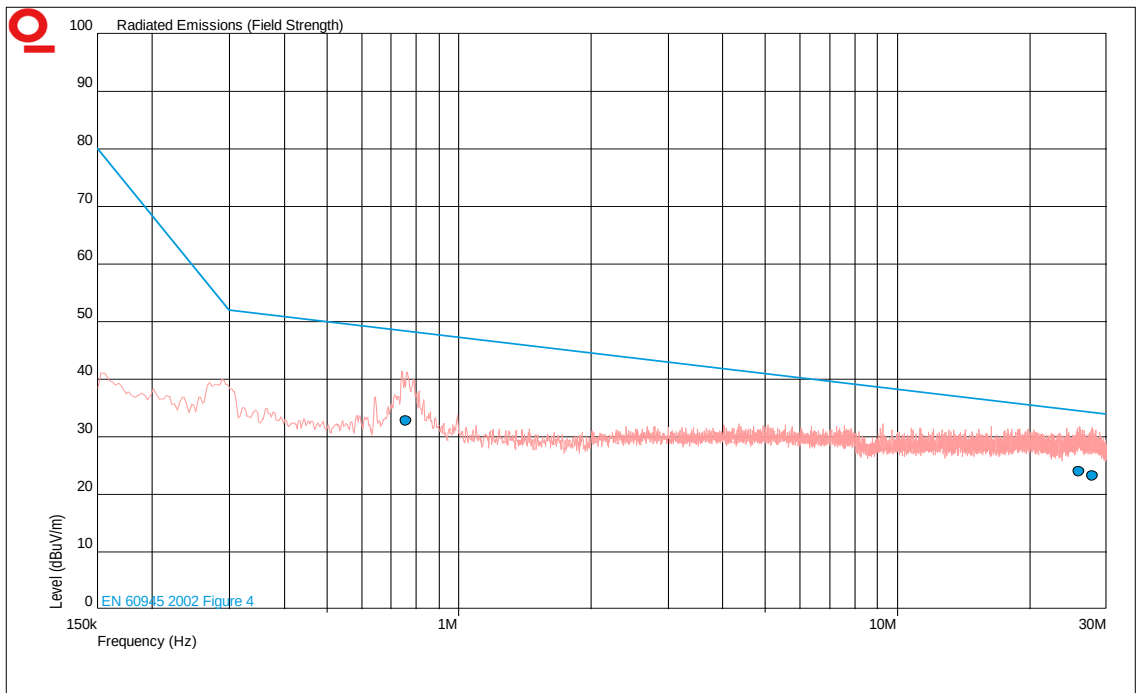


Figure 5 - Graphical Results - Horizontal and Vertical Polarity

| Frequency (MHz) | QP Level (dBμV/m) | QP Limit (dBμV/m) | QP Margin (dB) | Angle (Deg) | Height(m) | Polarity |
|-----------------|-------------------|-------------------|----------------|-------------|-----------|----------|
| 0.759           | 32.7              | 48.4              | 15.7           | 129         | 1.50      | Edge On  |
| 25.929          | 23.9              | 34.6              | 10.7           | 360         | 1.50      | Face On  |
| 27.815          | 23.2              | 34.3              | 11.1           | 54          | 1.50      | Edge On  |

Table 13



Frequency Range of Test: 30 MHz to 2 GHz

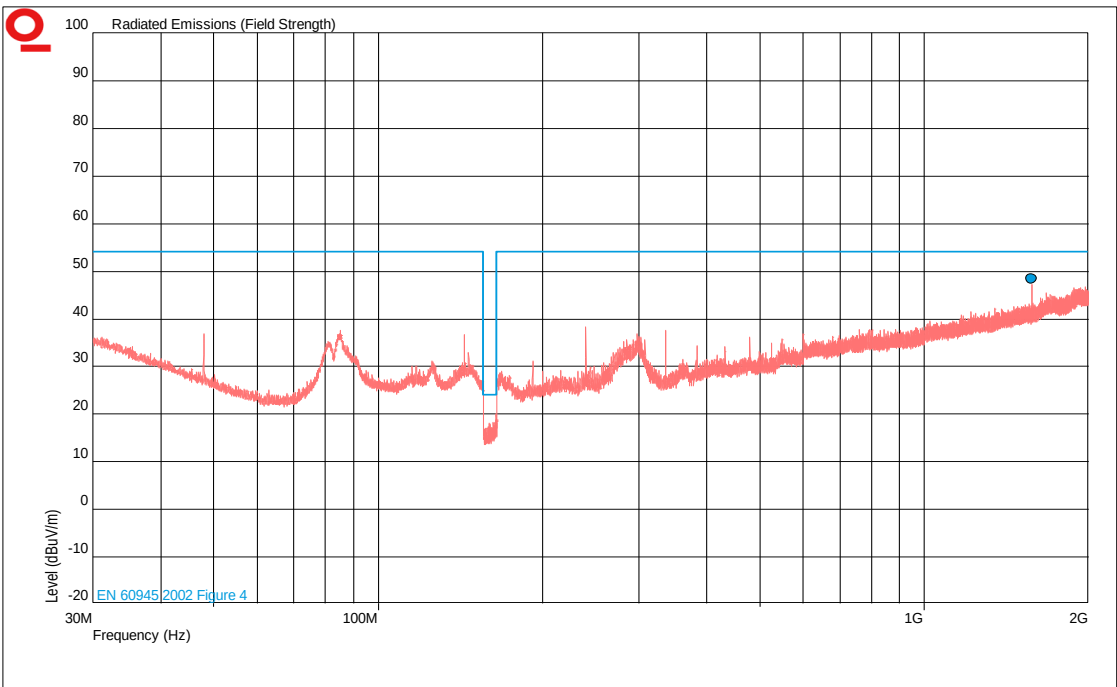


Figure 6 - Graphical Results - Horizontal and Vertical Polarity

| Frequency (MHz) | QP Level (dBμV/m) | QP Limit (dBμV/m) | QP Margin (dB) | Angle (Deg) | Height(m) | Polarity |
|-----------------|-------------------|-------------------|----------------|-------------|-----------|----------|
| 1572.480        | 48.4              | 54.0              | 5.6            | 253         | 1.37      | Vertical |

Table 14

No other measurements were made as all peak emissions seen in the pre-scan were greater than 10 dB below the Quasi-Peak test limit.



Frequency Range of Test: 156 MHz to 165 MHz

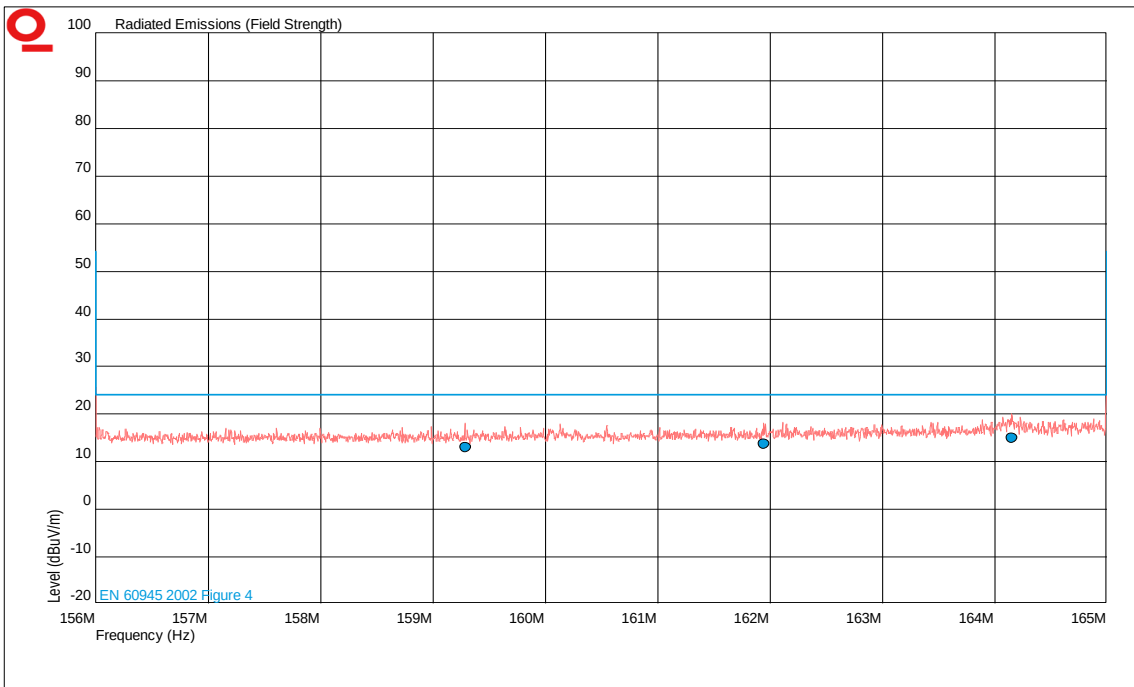


Figure 7 - Graphical Results - Horizontal and Vertical Polarity

| Frequency (MHz) | QP Level (dBμV/m) | QP Limit (dBμV/m) | QP Margin (dB) | Angle (Deg) | Height(m) | Polarity   |
|-----------------|-------------------|-------------------|----------------|-------------|-----------|------------|
| 159.293         | 12.8              | 24.0              | 11.2           | 359         | 1.00      | Vertical   |
| 161.949         | 13.6              | 24.0              | 10.4           | 0           | 1.00      | Horizontal |
| 164.158         | 14.9              | 24.0              | 9.1            | 359         | 2.49      | Horizontal |

Table 15



Figure 8 - Test Setup – 150 kHz to 30 MHz



Figure 9 - Test Setup – 30 MHz to 2 GHz



### 2.1.8 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                          | 23-Jan-2021     |
| Compliance 5 Emissions                    | Teseq           | V5.26.51  | 3275  | -                           | Software        |
| EMI Test Receiver                         | Rohde & Schwarz | ESU40     | 3506  | 12                          | 17-Dec-2019     |
| Turntable Controller                      | Inn-Co GmbH     | CO 1000   | 1606  | -                           | TU              |
| Tilt Antenna Mast                         | Maturo GmbH     | TAM 4.0-P | 3916  | -                           | TU              |
| Mast Controller                           | Maturo GmbH     | NCD       | 4810  | -                           | TU              |
| Antenna (Active Loop, 9kHz-30MHz)         | Rohde & Schwarz | HFH2-Z2   | 333   | 24                          | 11-Jan-2021     |
| Antenna with permanent attenuator (Bilog) | Chase           | CBL6143   | 2904  | 24                          | 08-Aug-2019     |

**Table 16**

TU - Traceability Unscheduled



## 2.2 Conducted Emissions

### 2.2.1 Specification Reference

IEC 60945, Clause 9.2  
ETSI EN 301 843-1, Clause 8.3  
ETSI EN 301 843-2

### 2.2.2 Equipment Under Test and Modification State

Cortex M1, S/N: M0000065 - Modification State 2

### 2.2.3 Date of Test

07-March-2019

### 2.2.4 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.

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

### 2.2.5 Environmental Conditions

Ambient Temperature 22.0 °C  
Relative Humidity 45.0 %

### 2.2.6 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*               |
| <b>Supplementary information:</b><br>Note 1: The emission shall be measured by means of the quasi-peak measuring receiver only.<br>The power input cables between the AC and 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 AC and/or DC power ports, power ports of identical nominal supply voltage may be connected in parallel to the artificial mains supply network.<br>*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 17



2.2.7 Test Results

Results for Configuration and Mode: DC Powered - AIS.

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

Detailed results are shown below.

Line Under Test: +12 V DC Line

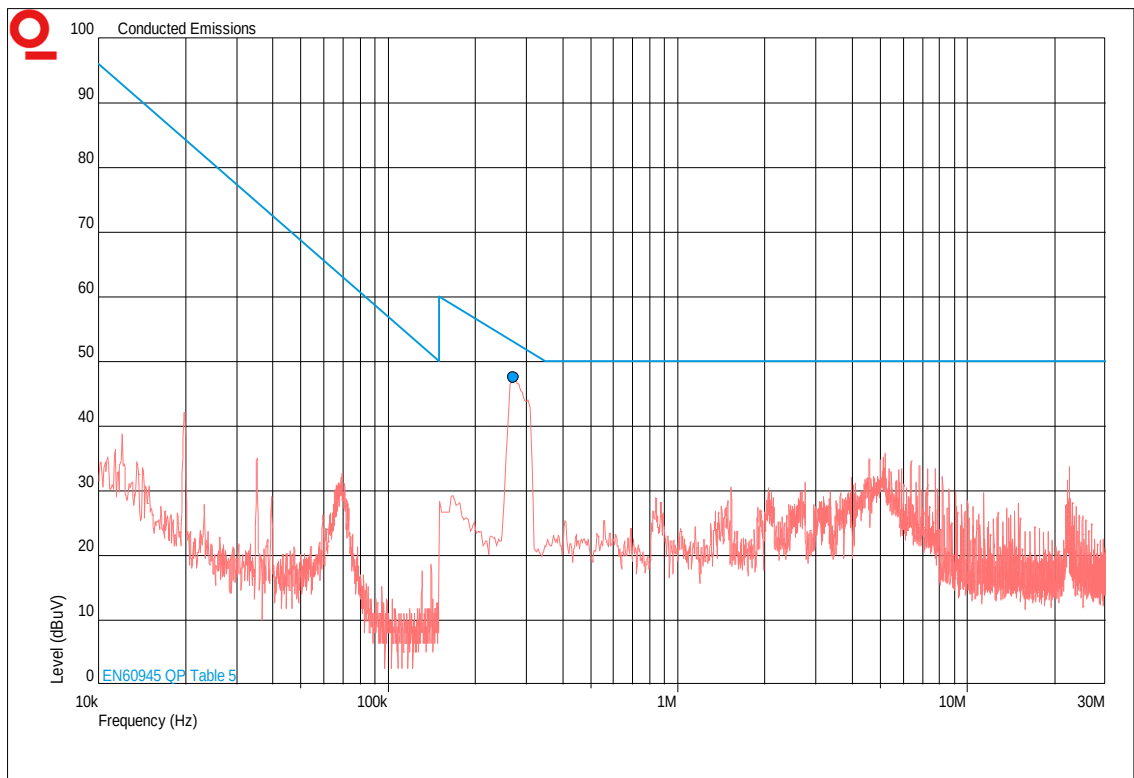


Figure 10 - Graphical Results - +12 V DC Line

| Frequency (MHz) | QP Level (dBμV) | QP Limit (dBμV) | QP Margin (dB) |
|-----------------|-----------------|-----------------|----------------|
| 0.271           | 47.5            | 53.0            | 5.5            |

Table 18

No other measurements were made as all peak emissions seen in the pre-scan were greater than 10 dB below the Quasi-Peak test limit.



Line Under Test: DC Return Line

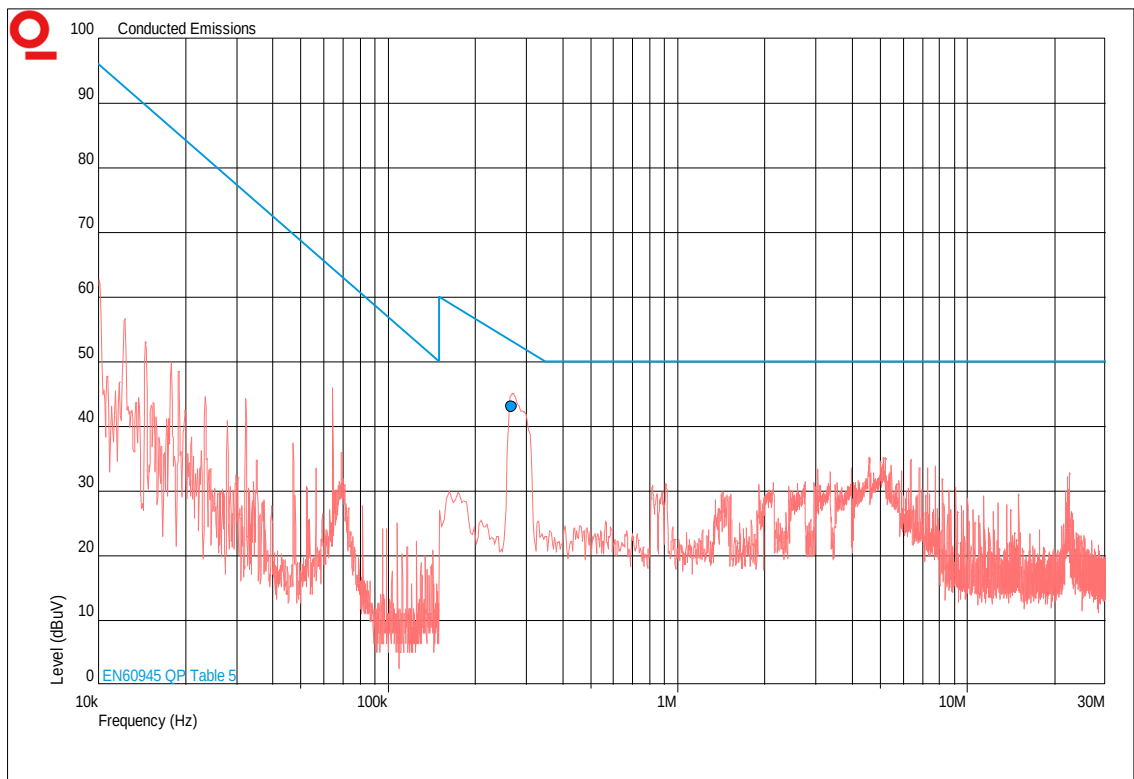


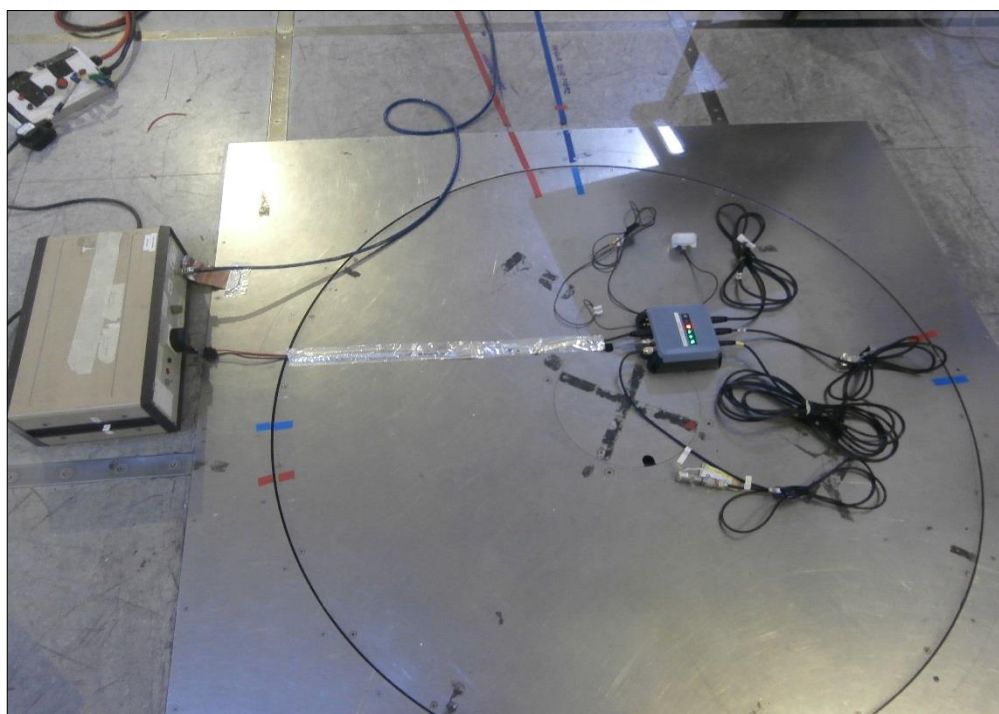
Figure 11 - Graphical Results – DC Return Line

| Frequency (MHz) | QP Level (dBμV) | QP Limit (dBμV) | QP Margin (dB) |
|-----------------|-----------------|-----------------|----------------|
| 0.268           | 43.0            | 53.1            | 10.1           |

Table 19

No other measurements were made as all peak emissions seen in the pre-scan were greater than 10 dB below the Quasi-Peak test limit.





**Figure 12 – Test Setup**

## 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                          | 23-Jan-2021     |
| Compliance 5 Emissions | Teseq           | V5.26.51          | 3275  | -                           | Software        |
| EMI Test Receiver      | Rohde & Schwarz | ESU40             | 3506  | 12                          | 17-Dec-2019     |
| LISN (1 Phase)         | Chase           | MN 2050           | 336   | 12                          | 10-Apr-2019     |
| Transient Limiter      | Hewlett Packard | 11947A            | 15    | 12                          | 26-Jul-2019     |
| Cable (Rx, Km-Km 2m)   | Scott Cables    | KPS-1501-2000-KPS | 4526  | 6                           | 26-Apr-2019     |
| 8 Meter Cable          | Teledyne        | PR90-088-8MTR     | 5212  | 6                           | 28-Jul-2019     |

**Table 20**



## 2.3 Immunity to Electrostatic Discharge

### 2.3.1 Specification Reference

IEC 60945, Clause 10.9  
ETSI EN 301 843-1, Clause 9.3  
ETSI EN 301 843-2

### 2.3.2 Equipment Under Test and Modification State

Cortex M1, S/N: M0000065 - Modification State 2

### 2.3.3 Date of Test

02-January-2019

### 2.3.4 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 non-conductive 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 repetition rate.

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

### 2.3.5 Environmental Conditions

Ambient Temperature 22.0 °C  
Relative Humidity 40.0 %

### 2.3.6 Specification Limits

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

Table 21



### 2.3.7 Test Results

#### Results for Configuration and Mode: DC Powered - AIS.

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

Detailed results are shown below.

○ Contact      □ Air

| 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 | N/A  | N/A |
| Vertical Coupling Plane   | Contact   | N/A     | N/A | ✓   | ✓  | 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 | N/A  | N/A |
| Air Discharge Points      | Air       | ✓*      | ✓*  | ✓*  | ✓* | N/A | N/A | ✓*  | ✓*  | N/A  | N/A |

**Table 22**

| 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 23**

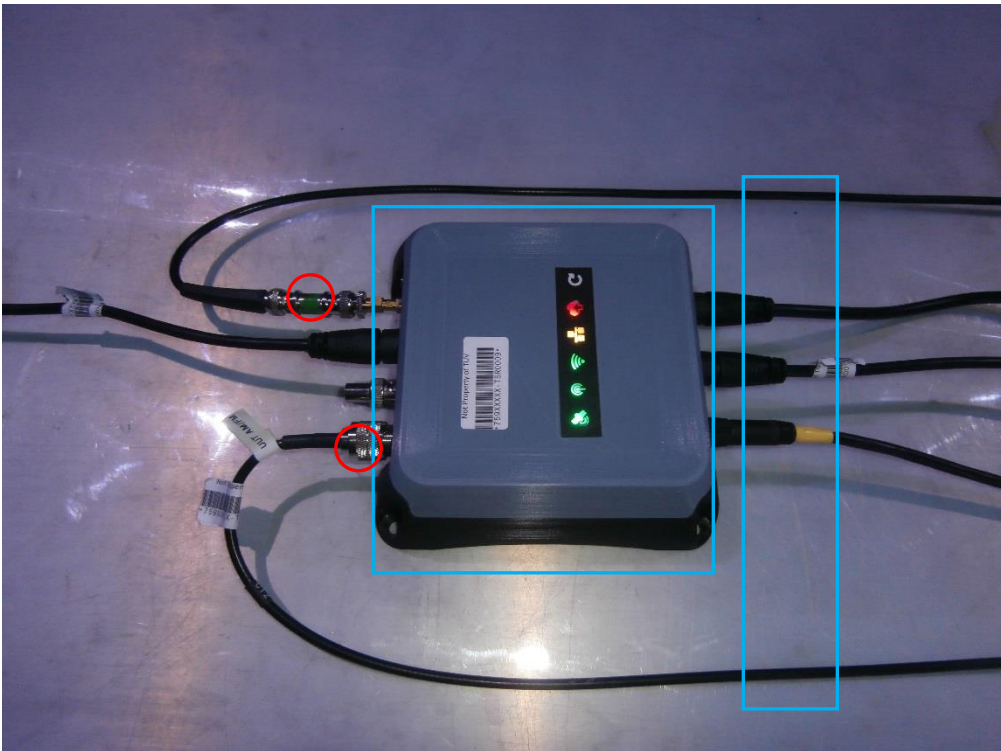


Figure 13 - Test Positions

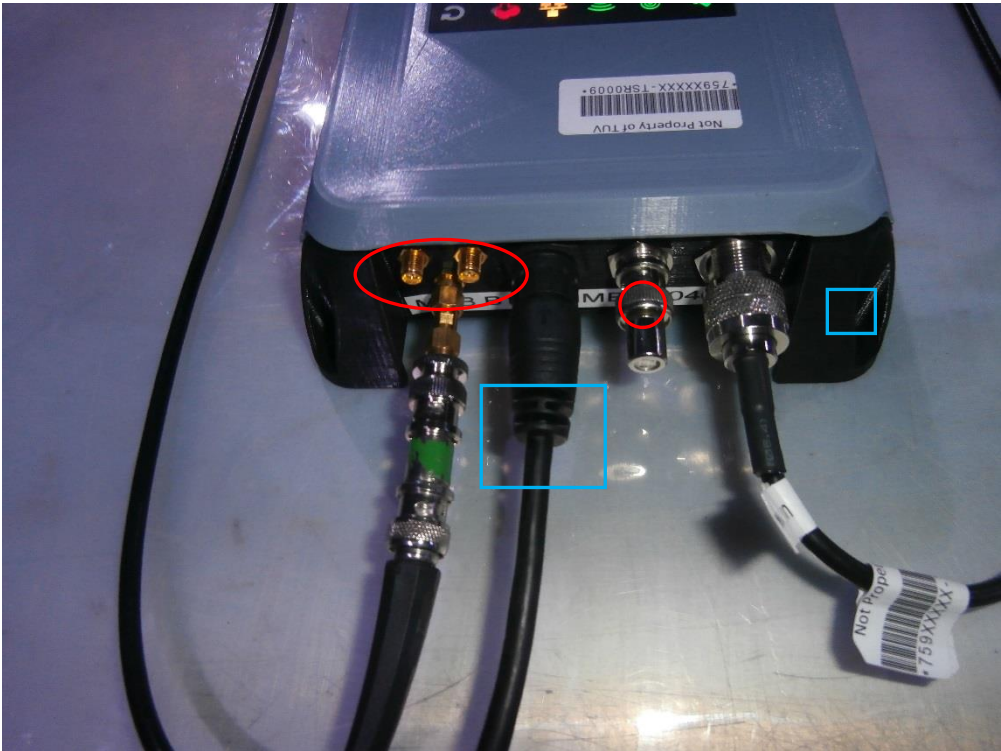


Figure 14 - Test Positions



**2.3.8 Test Location and Test Equipment Used**

This test was carried out in EMC Laboratory 2.

| Instrument    | Manufacturer | Type No    | TE No | Calibration Period (months) | Calibration Due |
|---------------|--------------|------------|-------|-----------------------------|-----------------|
| ESD Generator | Schloder     | SESD 30000 | 4724  | 12                          | 14-May-2019     |

**Table 24**



## 2.4 Immunity to Fast Transients on AC Power, Signal and Control Lines

### 2.4.1 Specification Reference

IEC 60945, Clause 10.5  
ETSI EN 301 843-1, Clause 9.4  
ETSI EN 301 843-2

### 2.4.2 Equipment Under Test and Modification State

Cortex M1, S/N: M0000065 - Modification State 2

### 2.4.3 Date of Test

21-December-2018 to 08-March-2019

### 2.4.4 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 fitted to the top of a 0.8 m non-conductive table for table-top equipment; and on a 0.1 m insulated support for floor standing equipment; 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 repetition rate and duration of test.

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

### 2.4.5 Environmental Conditions

Ambient Temperature 20.0 - 23.0 °C  
Relative Humidity 44.0 - 51.0 %

### 2.4.6 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>None |             |                       |                    |                  |                      |

Table 25



## 2.4.7 Test Results

### Results for Configuration and Mode: DC Powered - AIS.

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 |
| VHF/AIS Antenna                                     | 1.0              | 5                     | 5                   | Capacitive Clamp | Pass   |
| External GPS                                        | 1.0              | 5                     | 5                   | Capacitive Clamp | Pass   |
| NMEA2000                                            | 1.0              | 5                     | 5                   | Capacitive Clamp | Pass   |
| External Speakers                                   | 1.0              | 5                     | 5                   | Capacitive Clamp | Pass   |
| GPIO, NMEA0183 & Test IO                            | 1.0              | 5                     | 5                   | Capacitive Clamp | Pass   |

Table 26



Figure 15 - Immunity to Fast Transients on AC Power, Signal and Control Lines



#### 2.4.8 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 |
|-------------------------------|--------------|----------|-------|-----------------------------|-----------------|
| Capacitive Coupling Clamp     | Omiran       | EFTC 105 | 298   | 12                          | 03-Jul-2019     |
| Coupling / Decoupling Network | Teseq        | CDN3061  | 4555  | 12                          | 03-Jul-2019     |
| Immunity Test Set             | Teseq        | NSG3060  | 4556  | 12                          | 03-Jul-2019     |

**Table 27**



## 2.5 Immunity to Power Supply Failure

### 2.5.1 Specification Reference

IEC 60945, Clause 10.8

### 2.5.2 Equipment Under Test and Modification State

Cortex M1, S/N: M0000065 - Modification State 2

### 2.5.3 Date of Test

21-December-2018 to 08-March-2019

### 2.5.4 Test Method

The equipment under test including associated cabling was configured, on a 0.8 m non-conductive table for table-top equipment and on a 0.1 m insulated support for floor standing equipment above 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.

### 2.5.5 Environmental Conditions

Ambient Temperature 20.0 °C  
Relative Humidity 51.0 %

### 2.5.6 Specification Limits

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

Table 28

## 2.5.7 Test Results

### Results for Configuration and Mode: DC Powered - AIS.

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 |
| DC Power Port                              | N/A                 | 12                  | 0                      | 60           | Pass   |

Table 29



Figure 16 – Test Setup

## 2.5.8 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 |
|--------------------------|--------------|-------------------|-------|-----------------------------|-----------------|
| Multi-function Generator | Teseq        | NSG 3060 FTM 3425 | 4556  | 12                          | 03-July-2019    |
| Single Phase CDN         | Teseq        | NSG 3061          | 4555  | 12                          | 03-July-2019    |
| Variable Supply          | Teseq        | VAR3005           | 4557  | 12                          | 03-July-2019    |

Table 30

## 2.6 Immunity to Radiated Radio Frequencies

### 2.6.1 Specification Reference

IEC 60945, Clause 10.4  
ETSI EN 301 843-1, Clause 9.2  
ETSI EN 301 843-2

### 2.6.2 Equipment Under Test and Modification State

Cortex M1, S/N: M0000065 - Modification State 0  
Cortex M1, S/N: M0000069 - Modification State 0  
Cortex Handset; Model: H1, S/N: H1.0000000F – Modification State 0  
Cortex Handset; Model: H1, S/N: H1.0000000B – Modification State 0

### 2.6.3 Date of Test

12-December-2018 to 06-March-2020

### 2.6.4 Test Method

The equipment under test including associated cabling was configured, on a 0.8 m non-conductive table for table-top equipment and on a 0.1 m insulated support for floor standing equipment; with 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 polarisations.

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

### 2.6.5 Environmental Conditions

Ambient Temperature 22.0 - 23.0 °C  
Relative Humidity 40.0 - 46.0 %

### 2.6.6 Specification Limits

| Required Test Levels                                                                                                                                                                                                                                                                                                                                                                                                         |                   |                             |               |                  | Performance Criteria |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------------|---------------|------------------|----------------------|
| Frequency Range (MHz)                                                                                                                                                                                                                                                                                                                                                                                                        | Level (V/m)       | Modulation                  | Step Size (%) | Dwell (s)        |                      |
| 80 to 1000 <sup>(2)</sup>                                                                                                                                                                                                                                                                                                                                                                                                    | 10 <sup>(3)</sup> | AM (80 %,400 Hz, sine wave) | 1             | 3 <sup>(1)</sup> | A                    |
| 1000 to 2700 <sup>(2)</sup>                                                                                                                                                                                                                                                                                                                                                                                                  | 10 <sup>(3)</sup> | AM (80 %,400 Hz, sine wave) | 1             | 9 <sup>(1)</sup> | A                    |
| <b>Supplementary information:</b><br>Note 1. Dwell times <1 GHz can be reduced to 2 s and >1 GHz to 5 s for samples with fast cycle times.<br>Note 2. EUT powered at one of the nominal input voltages and frequencies<br>Note 3. 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 31

## 2.6.7 Test Results

### Results for Configuration and Mode: POD DC Powered - AIS.

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                              | 3 s                         |                         |                  |        |
| Dwell Time > 1GHz                              | 5 s                         |                         |                  |        |
| Modulation                                     | 400 Hz Sine 80 % AM         |                         |                  |        |
| Frequency Range (MHz)                          | Test Face                   | Antenna Polarisation    | Test Level (V/m) | Result |
| 80 to 2700                                     | Front, Right, Left and Rear | Horizontal and Vertical | 12.6 (10 + MU)   | Pass   |

**Table 32**

### Results for Configuration and Mode: POD and Handset DC Powered - VHF TX/RX.

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                                     | 3 s                         |                         |                  |        |
| Modulation                                     | 400 Hz Sine 80 % AM         |                         |                  |        |
| Frequency Range (MHz)                          | Test Face                   | Antenna Polarisation    | Test Level (V/m) | Result |
| 80 to 2700                                     | Front, Right, Left and Rear | Horizontal and Vertical | 12.6 (10 + MU)   | Pass   |

**Table 33**



**Results for Configuration and Mode: POD and Handset DC Powered - DSC.**

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

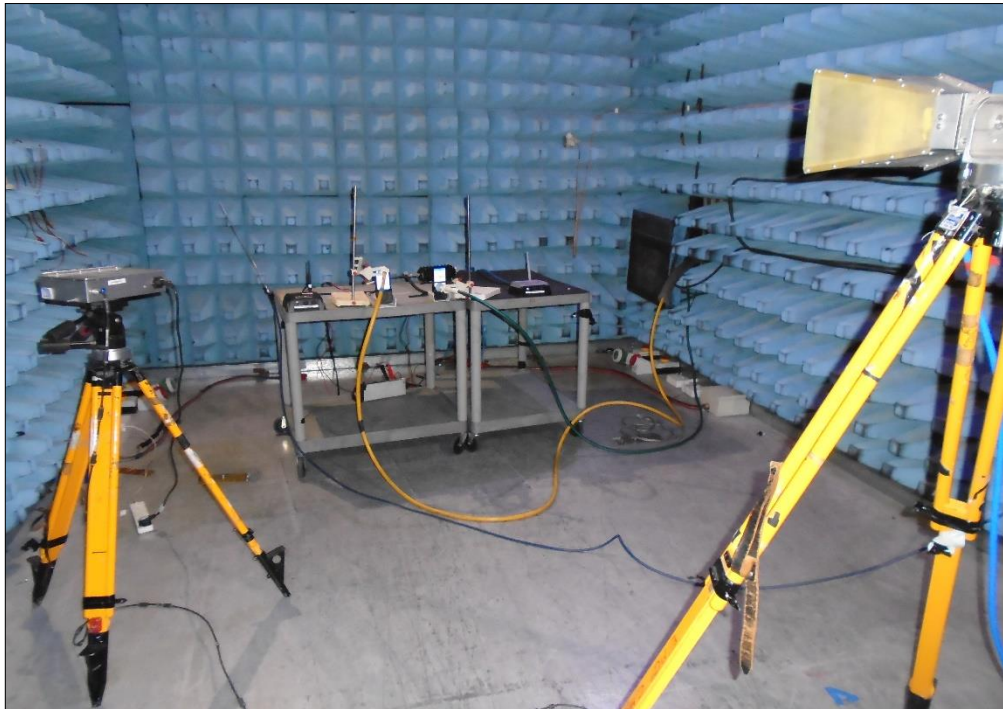
Detailed results are shown below.

| Tabulated Results for RF Electromagnetic Field |                             |                         |                  |        |
|------------------------------------------------|-----------------------------|-------------------------|------------------|--------|
| Step Size                                      |                             | 1%                      |                  |        |
| Dwell Time                                     |                             | 3 s                     |                  |        |
| Modulation                                     |                             | 400 Hz Sine 80 % AM     |                  |        |
| Frequency Range (MHz)                          | Test Face                   | Antenna Polarisation    | Test Level (V/m) | Result |
| 80 to 2700                                     | Front, Right, Left and Rear | Horizontal and Vertical | 12.6 (10 + MU)   | Pass   |

**Table 34**



**Figure 17 - Test Setup - Below 1 GHz**



**Figure 18 - Test Setup - Above 1 GHz**





## 2.6.8 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 |
|------------------------------------------|-----------------|-------------------|-------|-----------------------------|-----------------|
| EmX Test Software                        | TUV SUD         | V1.5.5            | 5125  | -                           | Software        |
| Signal Generator, 9kHz to 6GHz           | Rohde & Schwarz | SMB 100A          | 3500  | 12                          | 15-Apr-2020     |
| Amplifier (250W, 80MHz - 1GHz)           | Amp Research    | 250W1000A         | 3029  | -                           | TU              |
| CW TWT (1 to 2.5 GHz)                    | Thorn           | CW TWT (1-2.5GHz) | 2069  | -                           | TU              |
| CW TWT (2.5 to 8 GHz)                    | Thorn           | PTC6343           | 2068  | -                           | TU              |
| Directional Coupler                      | Amp Research    | DC6180            | 283   | -                           | TU              |
| Directional Coupler                      | Amp Research    | DC6180            | 2763  | -                           | TU              |
| Termination (50ohm)                      | Diamond Antenna | DL-30N            | 219   | 12                          | 20-Feb-2021     |
| Termination (50ohm)                      | Diamond Antenna | DL-30N            | 341   | 12                          | 05-June-2020    |
| Power Meter                              | Rohde & Schwarz | NRVD              | 1391  | -                           | TU              |
| Power Meter                              | Rohde & Schwarz | NRVD              | 747   | -                           | TU              |
| Power Meter                              | Rohde & Schwarz | NRVD              | 748   | -                           | TU              |
| Antenna                                  | Schaffner       | CBL6143           | 322   | -                           | TU              |
| Antenna (Double Ridge Guide, 1GHz-18GHz) | EMCO            | 3115              | 234   | -                           | TU              |

**Table 35**

TU - Traceability Unscheduled



## 2.7 Immunity to Conducted Radio Frequency Disturbance

### 2.7.1 Specification Reference

IEC 60945, Clause 10.3  
ETSI EN 301 843-1, Clause 9.5  
ETSI EN 301 843-2

### 2.7.2 Equipment Under Test and Modification State

Cortex M1, S/N: M0000065 - Modification State 1  
Cortex M1, S/N: M0000069 - Modification State 0  
Cortex Handset; Model: H1, S/N: H1.0000000F – Modification State 0  
Cortex Handset; Model: H1, S/N: H1.0000000B – Modification State 0

### 2.7.3 Date of Test

18-December-2018 to 25-March-2020

### 2.7.4 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.

### 2.7.5 Environmental Conditions

Ambient Temperature 20.0 - 22.0 °C  
Relative Humidity 38.0 - 40.0 %

### 2.7.6 Specification Limits

| Required Test Levels                                                                                                                                                                                                                |                                 |             |                             |               |           | Performance Criteria |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-------------|-----------------------------|---------------|-----------|----------------------|
| Line Under Test                                                                                                                                                                                                                     | Frequency Range (MHz)           | Level (V/m) | Modulation                  | Step Size (%) | Dwell (s) |                      |
| Power Port<br>Signal / Control Port <sup>(1)</sup>                                                                                                                                                                                  | 0.15 to 80                      | 3           | AM (80 %,400 Hz, sine wave) | 1             | 3         | A                    |
|                                                                                                                                                                                                                                     | Spot Frequencies <sup>(2)</sup> | 10          | AM (80 %,400 Hz, sine wave) | -             | 3         | A                    |
| <b>Supplementary information:</b><br>Note 1. EUT powered at one of the nominal input voltages and frequencies.<br>Note 2. 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 36





## 2.7.7 Test Results

### Results for Configuration and Mode: DC Powered - AIS.

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      | Coupling Method | Interference Return Path | Result |
| VHF/AIS Antenna                                              | 150kHz to 80MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| External GPS                                                 | 150kHz to 80MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| NMEA2000                                                     | 150kHz to 80MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| GPIO, NMEA0183 & Test IO                                     | 150kHz to 80MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| External Speakers                                            | 150kHz to 80MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |

**Table 37**

| Tabulated Results for Conducted Radio Frequency Interference (Spot Frequencies) |                                                    |            |                 |                          |        |
|---------------------------------------------------------------------------------|----------------------------------------------------|------------|-----------------|--------------------------|--------|
| Modulation = 80 % AM (400 Hz)                                                   |                                                    |            | Dwell = 3 s     |                          |        |
| Line Under Test                                                                 | Spot Frequencies                                   | Test Level | Coupling Method | Interference Return Path | Result |
| VHF/AIS Antenna                                                                 | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| External GPS                                                                    | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| NMEA2000                                                                        | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| GPIO, NMEA0183 & Test IO                                                        | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| External Speakers                                                               | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |

**Table 38**



**Figure 19 - Test Setup - Signal and Control Port**



### Results for Configuration and Mode: POD and Handset DC Powered - VHF TX/RX.

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 and 5 s      |        |
| Line Under Test                                              | Frequency Range   | Test Level      | Coupling Method | Interference Return Path | Result |
| 12 V DC Power Port Handset and Pod TX Unit                   | 150 kHz to 80 MHz | 10 V            | M2 CDN          | None                     | Pass   |
| VHF/AIS Antenna - TX Unit                                    | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| External GPS - TX Unit                                       | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| NMEA2000 - TX Unit                                           | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| GPIO, NMEA0183 & Test IO - TX Unit                           | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| External Speakers - TX Unit                                  | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| 12 V DC Power Port Handset and Pod RX Unit                   | 150 kHz to 80 MHz | 10 V            | M2 CDN          | None                     | Pass   |
| VHF/AIS Antenna - RX Unit                                    | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| External GPS - RX Unit                                       | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| NMEA2000 - RX Unit                                           | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| GPIO, NMEA0183 & Test IO - RX Unit                           | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| External Speakers - RX Unit                                  | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |

**Table 39**



| Tabulated Results for Conducted Radio Frequency Interference (Spot Frequencies) |                                                    |            |                 |                          |        |
|---------------------------------------------------------------------------------|----------------------------------------------------|------------|-----------------|--------------------------|--------|
| Modulation = 80 % AM (400 Hz)                                                   |                                                    |            | Dwell = 3 s     |                          |        |
| Line Under Test                                                                 | Spot Frequencies                                   | Test Level | Coupling Method | Interference Return Path | Result |
| 12 V DC Power Port Handset and Pod TX Unit                                      | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | M2 CDN          | None                     | Pass   |
| VHF/AIS Antenna - TX Unit                                                       | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| External GPS - TX Unit                                                          | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| NMEA2000 - TX Unit                                                              | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| GPIO, NMEA0183 & Test IO - TX Unit                                              | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| External Speakers - TX Unit                                                     | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| 12 V DC Power Port Handset and Pod RX Unit                                      | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | M2 CDN          | None                     | Pass   |
| VHF/AIS Antenna - RX Unit                                                       | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| External GPS - RX Unit                                                          | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| NMEA2000 - RX Unit                                                              | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| GPIO, NMEA0183 & Test IO - RX Unit                                              | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| External Speakers - RX Unit                                                     | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |

Table 40



### Results for Configuration and Mode: POD and Handset DC Powered - DSC.

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

Detailed results are shown below.

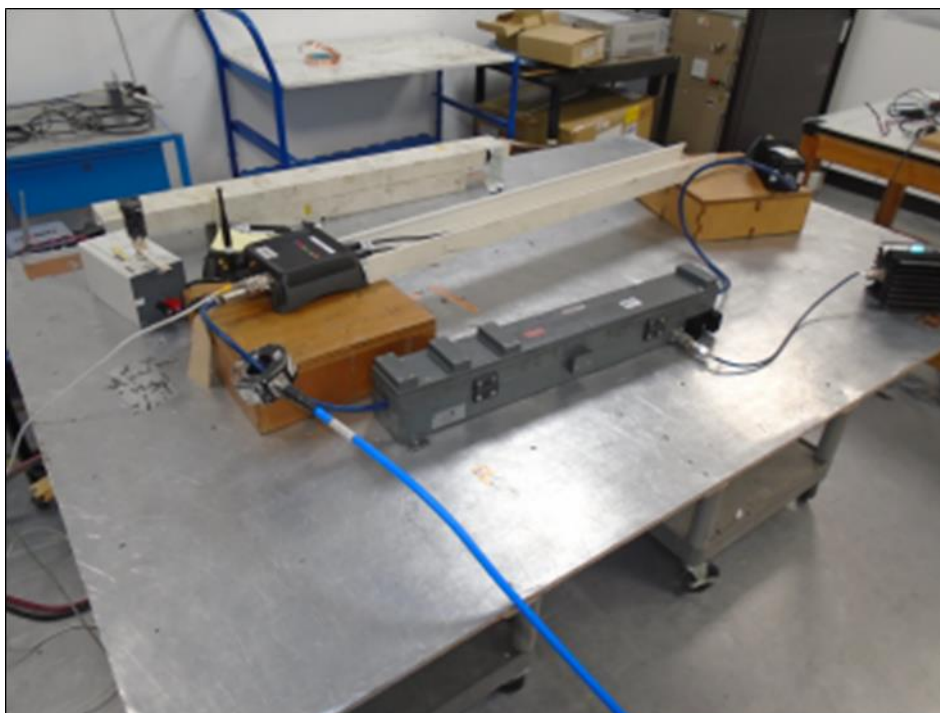
| Tabulated Results for Conducted Radio Frequency Interference |                   |                 |                 |                          |        |
|--------------------------------------------------------------|-------------------|-----------------|-----------------|--------------------------|--------|
| Modulation = 80 % AM (400 Hz)                                |                   | Step Size = 1 % |                 | Dwell = 3 s and 5 s      |        |
| Line Under Test                                              | Frequency Range   | Test Level      | Coupling Method | Interference Return Path | Result |
| 12 V DC Power Port Handset and Pod TX Unit                   | 150 kHz to 80 MHz | 10 V            | M2 CDN          | None                     | Pass   |
| VHF/AIS Antenna - TX Unit                                    | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| External GPS - TX Unit                                       | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| NMEA2000 - TX Unit                                           | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| GPIO, NMEA0183 & Test IO - TX Unit                           | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| External Speakers - TX Unit                                  | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| 12 V DC Power Port Handset and Pod RX Unit                   | 150 kHz to 80 MHz | 10 V            | M2 CDN          | None                     | Pass   |
| VHF/AIS Antenna - RX Unit                                    | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| External GPS - RX Unit                                       | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| NMEA2000 - RX Unit                                           | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| GPIO, NMEA0183 & Test IO - RX Unit                           | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |
| External Speakers - RX Unit                                  | 150 kHz to 80 MHz | 10 V            | EM Clamp        | M2 CDN                   | Pass   |

**Table 41**



| Tabulated Results for Conducted Radio Frequency Interference (Spot Frequencies) |                                                    |            |                 |                          |        |
|---------------------------------------------------------------------------------|----------------------------------------------------|------------|-----------------|--------------------------|--------|
| Modulation = 80 % AM (400 Hz)                                                   |                                                    |            | Dwell = 3 s     |                          |        |
| Line Under Test                                                                 | Spot Frequencies                                   | Test Level | Coupling Method | Interference Return Path | Result |
| 12 V DC Power Port Handset and Pod TX Unit                                      | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | M2 CDN          | None                     | Pass   |
| VHF/AIS Antenna - TX Unit                                                       | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| External GPS - TX Unit                                                          | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| NMEA2000 - TX Unit                                                              | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| GPIO, NMEA0183 & Test IO - TX Unit                                              | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| External Speakers - TX Unit                                                     | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| 12 V DC Power Port Handset and Pod RX Unit                                      | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | M2 CDN          | None                     | Pass   |
| VHF/AIS Antenna - RX Unit                                                       | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| External GPS - RX Unit                                                          | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| NMEA2000 - RX Unit                                                              | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| GPIO, NMEA0183 & Test IO - RX Unit                                              | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |
| External Speakers - RX Unit                                                     | 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz | 10 V       | EM Clamp        | M2 CDN                   | Pass   |

Table 42



**Figure 20 – Signal Cable Test Setup**



## 2.7.8 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 |
|----------------------------------|--------------------|-------------|-------|-----------------------------|-----------------|
| Conducted Immunity Test Software | Schaffner          | WIN2070     | 5251  | -                           | Software        |
| RF Generator + Attenuator        | Schaffner          | NSG2070-400 | 222   | 12                          | 24-Jan-2021     |
| Termination                      | MEB Messelektronik | TRA150      | 209   | -                           | TU              |
| Termination                      | MEB Messelektronik | TRA150      | 210   | -                           | TU              |
| Load (50ohm, 30W)                | JFW                | 50T-054     | 284   | 12                          | 05-Jun-2020     |
| Attenuator 6dB                   | Advance            | 10023-6/MF  | 1539  | 12                          | 31-Jan-2021     |
| Attenuator (30dB, 250W)          | Weinschel          | 45-30-43    | 3071  | 12                          | 03-May-2020     |
| CDN Jig                          | MEB Messelektronik | M2-801      | 213   | -                           | TU              |
| Coupling and Decoupling Network  | Schaffner          | M216        | 224   | 12                          | 11-Oct-2020     |
| CDN, 16A, switchable M2 or M3    | Teseq              | CDN M016    | 3666  | 12                          | 11-Oct-2020     |
| Coupling Clamp                   | MEB Messelektronik | KEMZ-801    | 228   | -                           | TU              |
| Calibration Fixture (x2)         | MEB Messelektronik | KEMZ-801    | 229   | -                           | TU              |
| Current Probe                    | Ailtech            | 91550-1     | 520   | 12                          | 27-Jun-2020     |

**Table 43**

TU - Traceability Unscheduled





### 3 Test Equipment Information

#### 3.1 General Test Equipment Used

| Instrument    | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Due |
|---------------|--------------|---------|-------|-----------------------------|-----------------|
| GPS Simulator | Spirent      | GSS7000 | 4978  | 12                          | 29-Nov-2019     |

Table 44



## 4 Incident Reports

The following Incident Report was issued during testing covered by this test report.

|                  |                                                                   |
|------------------|-------------------------------------------------------------------|
| Report Serial No | IR Serial No 75943855 IR01 Issue 1                                |
| Date of issue    | 17 December 2018                                                  |
| Applicable test  | Conducted Emissions                                               |
| Report Serial No | IR Serial No 75943855 IR02 Issue 1                                |
| Date of issue    | 21 December 2018                                                  |
| Applicable test  | Immunity to Fast Transients on AC Power, Signal and Control Lines |

## 5 Measurement Uncertainty

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

| Test Name                                                         | Measurement Uncertainty                                                                                                                                                                                                           |
|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Radiated Emissions                                                | 9 kHz to 30 MHz, Active Loop Antenna, $\pm 3.4$ dB<br>30 MHz to 2 GHz, Bilog Antenna, $\pm 5.2$ dB                                                                                                                                |
| Conducted Emissions                                               | 10 kHz to 30 MHz, LISN, $\pm 3.7$ dB                                                                                                                                                                                              |
| Immunity to Electrostatic Discharge                               | The test was applied using proprietary equipment that meets the requirements of EN 61000-4-2                                                                                                                                      |
| Immunity to Fast Transients on AC Power, Signal and Control Lines | The test was applied using proprietary equipment that meets the requirements of EN 61000-4-4                                                                                                                                      |
| Immunity to Power Supply Failure                                  | The test was applied using proprietary equipment that meets the requirements of EN 61000-4-11                                                                                                                                     |
| Immunity to Radiated Radio Frequencies                            | 80 MHz to 2 GHz Test Amplitude $\pm 2.0$ dB                                                                                                                                                                                       |
| Immunity to Conducted Radio Frequency Disturbance                 | 150 kHz to 80 MHz<br>EM Clamp Method of Test, Amplitude $\pm 3.1$ dB<br>CDN Method of Test, Amplitude $\pm 1.2$ dB<br>BCI Clamp Method of Test, Amplitude $\pm 1.1$ dB<br>Direct Injection Method of Test, Amplitude $\pm 1.2$ dB |

**Table 45**

Worst case error for both Time and Frequency measurement 12 parts in  $10^6$ .  
All measurement uncertainties have been calculated in accordance with CISPR guidelines.

### Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2007, clause 4.4.3 and 4.5.1.