# EMC Test Report

for the

## McMurdo Limited

## Navtex Receiver Nav5plus

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**for the**

## McMurdo Limited

# Navtex Receiver Nav5plus

Project Engineer: J. A. Jones

Approval Signatory

Approved signatories: S. M. Connolly ☐ I. P. Kenney ☐ R. P. St John James ☑

*The above named are authorised Hursley EMC Services engineers.*

**Hursley EMC Services Ltd.**
**Unit 16, Brickfield Lane**
**Chandlers Ford**
**Hampshire. UK. SO53 4DP**

1871

**Tel. +44 (0) 23 8027 1111**
**Fax. +44 (0) 23 8027 1144**
**e mail. sales@hursley-emc.co.uk**
**www.hursley-emc.co.uk**

# Contents

# 1.0 OVERVIEW

## 1.1 Introduction

The Equipment Under Test (EUT), as described within this document, was submitted for EMC testing as agreed with the customer.

## 1.2 Objective

The purpose of the test was to measure and report the EUT against limits and methods of the emissions and immunity standards, as requested for and listed in section **2.0 Test Summary**.

## 1.3 Product Modifications

To meet the EN 60945 standard the following modifications were applied:

- C110, 111, 112, 116 are fitted at 10nF
- R210, 213, 310, 313 changed from 100k to 22k
- 1nF capacitor added between pins 1 and 2 of U201
- 1nF capacitor added between pins 1 and 2 of U302
- Ferrite added around ribbon cable between processor and RF boards

## 1.4 Conclusion

The EUT, with the above modifications applied, met the emission limits and immunity requirements of the tests defined in section **2.0 Test Summary**.

**This report relates to the sample tested and may not represent the entire population**.

# 2.0 TEST SUMMARY

## 2.1 Summary

The EUT was tested to the EN 60945 emission and immunity standard for maritime navigation and radio communication equipment.

The EUT met the **emission** test requirements of the following standards:

| Description | General Standard | Referenced Standard |
|---|---|---|
| Radiated disturbance | EN 60945:2002† | CISPR 16-1: Class A |
| Radiated H-Field | | CISPR 16-1: Class A |
| Conducted disturbance, DC port | | CISPR 16-1: Class A |

The EUT met the **immunity** test requirements of the following standards:

| | | |
|---|---|---|
| Electrostatic discharge | EN 60945:2002† | EN 61000-4-2:1995 |
| Radiated RF interference | | EN 61000-4-3:1995 |
| Fast transient bursts | | EN 61000-4-4:1995 |
| Conducted RF Interference | | EN 61000-4-6:1996 |

The uncertainty budget for each test has been included to support a level of confidence of approximately 95%.

†The 2002 version of EN 60945 is not currently included in the UKAS Accreditation Schedule for our laboratory but the reference standards are, with the exception of radiated immunity testing for 1-2GHz.

## 2.2 Test Deviations

None.

## 2.3 EMC Test Lab Reference

Hursley EMC Services file: 04J025.

# 3.0 EQUIPMENT & TEST DETAILS

## 3.1 General

| | |
|---|---|
| **EUT:** | Navtex Receiver Nav5plus<br>Assembly number: 28-224A<br>Serial number: 678B |
| **Sample build:** | Production |
| **Customer name:** | McMurdo Limited |
| **Customer address:** | Silver Point, Airport Service Road, Portsmouth PO3 5PB |
| **Representative:** | Mr John Knapp |
| **EUT manufacturer:** | McMurdo Limited |
| **Test commissioned by:** | Mr John Knapp |
| **Date EUT received:** | 5th February 2004 |
| **Test date(s):** | 5th – 12th February 2004 |
| **EMC measurement site:** | Hursley EMC Services Limited<br>Unit 16, Brickfield Lane, Chandlers Ford, Hampshire |

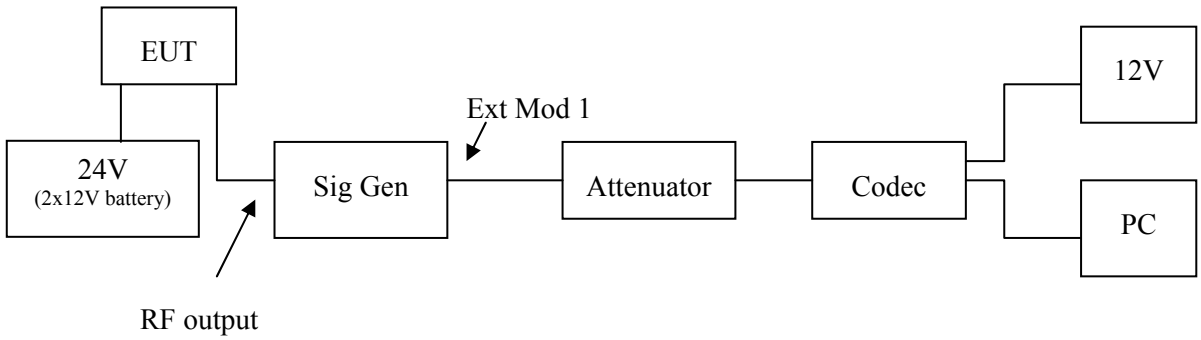
### 3.1.1 EUT Description

The EUT is a Nav5plus GMDSS Navtex receiver. It receives radio transmissions on 490 and 518kHz which contain weather information and other notices to mariners. These messages are then decoded and printed out.

### 3.1.2 EUT Support

- 24V PSU
- Marconi signal generator, 2030, S/N 119562/056
- McMurdo attenuator
- McMurdo Codec, ICS Electronics DSC2-006, S/N 00600775
- Halfords 12V battery (x2)
- HEMCS P120 AT PC, monitor, keyboard and mouse

### 3.1.3 EUT Test Configuration




### 3.1.4 EUT Test Exerciser

The signal generator was set to 517.9133kHz, 200Hz FM deviation (DC coupled), and a test level of -95dBm (6dB above 2uV). With the output from the Codec and the attenuator, this gives a test frequency of 518kHz +/-85Hz, and the correct test level.

The EUT is put into a self test mode where character errors are automatically monitored. To do this, the unit is turned on and the 'alarm' key pressed three or more times in quick succession. The display then shows 'S' followed by the number of characters received and 'E' followed by the number of errors in those characters.

Power is then applied to the Codec and test messages are sent using Hyperterminal on the PC. The test messages consist of multiple repetitions of the Standard Test Signal in IEC1097-6, which includes all the characters required by EN 300 065 and punctuation characters.

### 3.1.5 Environmental Test Conditions

| | |
|---|---|
| Temperature | 17-21º Celsius |
| Relative Humidity | 40-46% |
| Atmospheric Pressure | 998-1012 millibars |

### 3.1.6 EMC Test Equipment

| #ID | Manufacturer | Type | Description | Cal Status |
|---|---|---|---|---|
| 002 | Rohde & Schwarz | ESVP | Test receiver 30-1000MHz | CAL |
| 008 | Hewlett Packard | 8568B | Spectrum analyser | CAL |
| 013 | Chase | CBL6121A | Antenna 30-1000MHz (chamber) | CAL |
| 030 | KeyTek | MZ-15/EC | Minizap/pink (ESD gun) | CAL |
| 033 | Hewlett Packard | 8593EM | Spectrum analyser | CAL |
| 039 | Marconi | 2032 | Signal generator 5.4GHz | CAL |
| 045 | Varian | VZL6941K7DK | TWT amplifier 1-2GHz | CAL |
| 047 | Rohde & Schwarz | HFH2-Z2 | Loop antenna 9kHz-30MHz | CAL |
| 065 | Schaffner | CDN125 | Capacitive coupling clamp | Internal |
| 072 | Chase | CBL6112 | Antenna 30-2000MHz (final) | CAL |
| 082 | Amp Research | FP2000 | Field meter, isotropic RF module | CAL |
| 120 | Kalmus | 7250LC-CE | RF Power amp & pulse opt | CAL |
| 121 | EM | CWS500A | Conducted immunity simulator | CAL |
| 132 | Hewlett Packard | 8447D | 25dB Pre-amplifier | CAL |
| 135 | Bird | 100AMFN06 | 100W 6dB attenuator | CAL |
| 145 | Bird | 4421 | Power meter | CAL |
| 152 | Fischer | 801-M2-16 | CDN 2xwire mains | CAL |
| 158 | Rohde & Schwarz | ESH3-Z2 | Pulse limiter | CAL |
| 160 | EM | UCS500 | Immunity tester | CAL |
| 176 | Rohde & Schwarz | ESS | Receiver | CAL |
| 183 | Comtest | 91888-2 | Horn antenna 1-2GHz | CAL |

**Note:** 'CAL' means that the instrument is certified with a valid calibration.
'Internal' means internally calibrated using HEMCS procedures.

# 4.0 EMISSION RESULTS

## 4.1 Radiated Disturbance

### 4.1.1 Data, 30-156MHz & 165-1000MHz

A profile scan was taken at a distance of three metres on eight azimuths of the EUT in both the vertical and horizontal polarities of the antenna in a semi-anechoic chamber.

Using the data obtained from the chamber profile-scan as an engineering guide, the EUT was then transferred onto the turntable in the Open Area Test Site. The antenna was positioned at a distance of three metres from the periphery of the EUT. Radiated emissions were then systematically maximised by revolving the EUT and adjusting the antenna in polarity and height. The highest emissions are presented here.

| Emission frequency (MHz) | Measured quasi-peak value (dBµV/m) | Specified quasi-peak limit (dBµV/m) | Status |
|---|---|---|---|
| 30.001 | 28.7 | 54 | Pass |
| 34.366 | 18.5 | 54 | Pass |
| 36.864 | 27.5 | 54 | Pass |
| 63.895 | 25.8 | 54 | Pass |
| 68.824 | 30.0 | 54 | Pass |
| 135.753 | 24.5 | 54 | Pass |
| 142.554 | 28.0 | 54 | Pass |
| 154.829 | 25.8 | 54 | Pass |
| 191.693 | 30.0 | 54 | Pass |
| 199.066 | 23.1 | 54 | Pass |
| 331.777 | 24.3 | 54 | Pass |
| 339.150 | 31.8 | 54 | Pass |
| 376.014 | 34.8 | 54 | Pass |
| 383.387 | 36.2 | 54 | Pass |
| 412.878 | 36.5 | 54 | Pass |
| 668.448 | 29.2 | 54 | Pass |

Uncertainty of measurement: +4.3/-4.1dBuV for a 95% confidence level.

The measurements reported are the highest emissions relative to the EN 60945 limit and take into account the antenna and cable loss factors. Measurements made according to the EN 60945 test standard and Hursley EMC Services test procedure RAD-01.

TEST ENGINEER: Andy Jones

## 4.1.2 Data, 155 - 165MHz

A profile scan was taken at a distance of three metres on eight azimuths of the EUT in both the vertical and horizontal polarities of the antenna in a semi-anechoic chamber.

Using the data obtained from the chamber profile-scan as an engineering guide, the EUT was then transferred onto the turntable in the Open Area Test Site. The antenna was positioned at a distance of three metres from the periphery of the EUT. Radiated emissions were then systematically maximised by revolving the EUT and adjusting the antenna in polarity and height. The highest emissions are presented here.

| Emission frequency (MHz) | Measured quasi-peak value (dBµV/m) | Specified quasi-peak limit (dBµV/m) | Status |
|---|---|---|---|
| 157.300 | 18.2 | 24 | Pass |
| 162.400 | 23.1 | 24 | Pass* |

The measured result Pass* is below the specification limit by a margin less than the measurement uncertainty; it is not therefore possible to determine compliance at a level of confidence of 95%. However, the measured result indicates a higher probability that the EUT tested complies with the specification limit.

Uncertainty of measurement: +4.3/-4.1dBuV for a 95% confidence level.

The measurements reported are the highest emissions relative to the EN 60945 limit and take into account the antenna and cable loss factors. Measurements made according to the EN 60945 test standard and Hursley EMC Services test procedure RAD-01.

TEST ENGINEER: Andy Jones

# 4.2 Radiated H-Field, 150kHz – 30MHz

## 4.2.1 Data, Vertical Loop

A profile scan was taken at a distance of three metres with a 360° azimuth scan of the EUT in a semi-anechoic chamber.

Using the data obtained, the EUT was then retested and the loop antenna was also rotated to maximise emission levels. Quasi-peak measurements were then made with the band width at 9kHz. The results were the maximum recorded. The highest emissions are presented here.

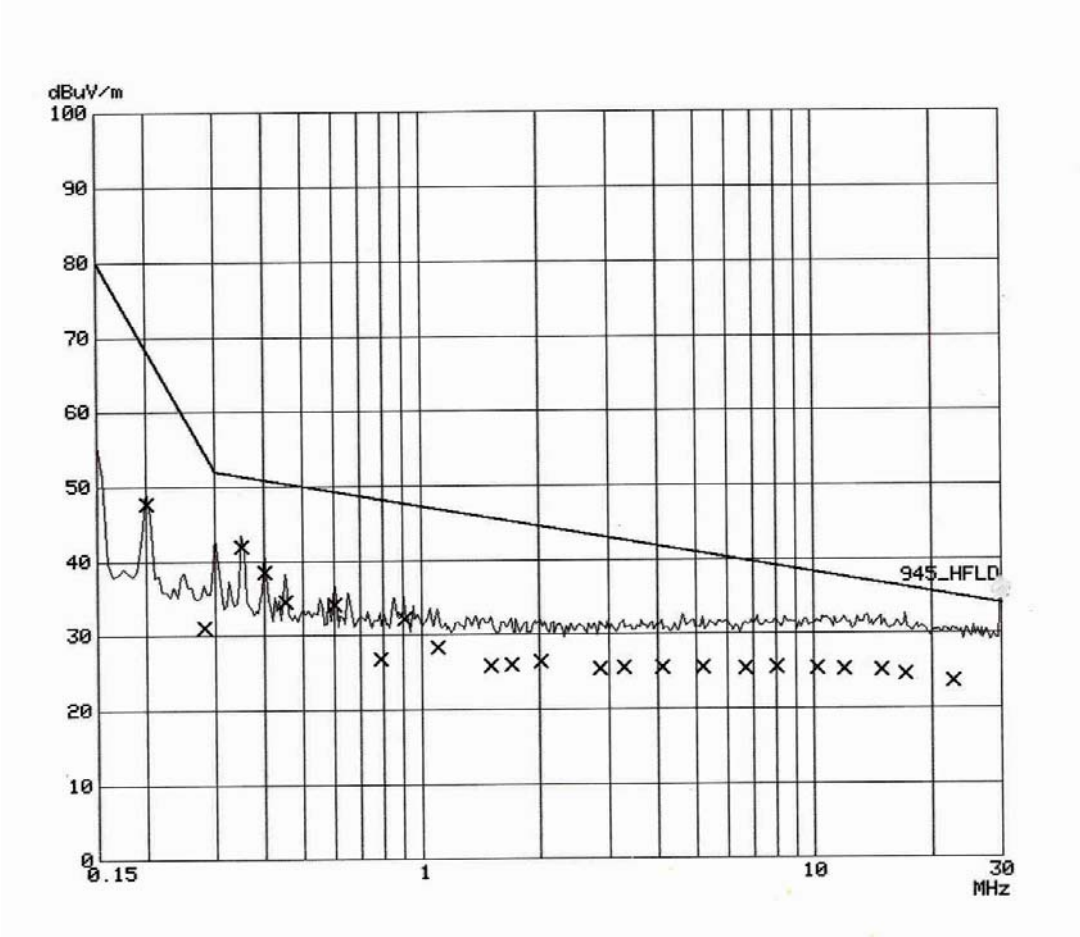
| Emission frequency (MHz) | Measured quasi-peak value (dBµV/m) | Specified quasi-peak limit (dBµV/m) | Status |
|---|---|---|---|
| 0.200 | 47.8 | 68.7 | Pass |
| 0.280 | 31.1 | 54.8 | Pass |
| 0.350 | 42.0 | 51.4 | Pass |
| 0.400 | 38.5 | 50.8 | Pass |
| 0.600 | 34.1 | 49.3 | Pass |
| 0.905 | 32.3 | 47.7 | Pass |
| 4.090 | 25.6 | 41.8 | Pass |
| 10.150 | 25.5 | 38.2 | Pass |
| 17.090 | 24.6 | 36.2 | Pass |

Uncertainty of measurement: +4.3/-4.1dBuV for a 95% confidence level.

The measurements reported are the highest emissions relative to the EN 60945 limit and take into account the antenna and cable loss factors. Measurements made according to the EN 60945 test standard and Hursley EMC Services test procedure MAR-01.

TEST ENGINEER: Andy Jones

## 4.2.2 Profile, Vertical Loop



## 4.2.3 Data, Horizontal Loop

A profile scan was taken at a distance of three metres with a 360° azimuth scan of the EUT in a semi-anechoic chamber.

Using the data obtained, the EUT was then retested and the loop antenna was also rotated to maximise emission levels. Quasi-peak measurements were then made with the band width at 9kHz. The results were the maximum recorded. The highest emissions are presented here.

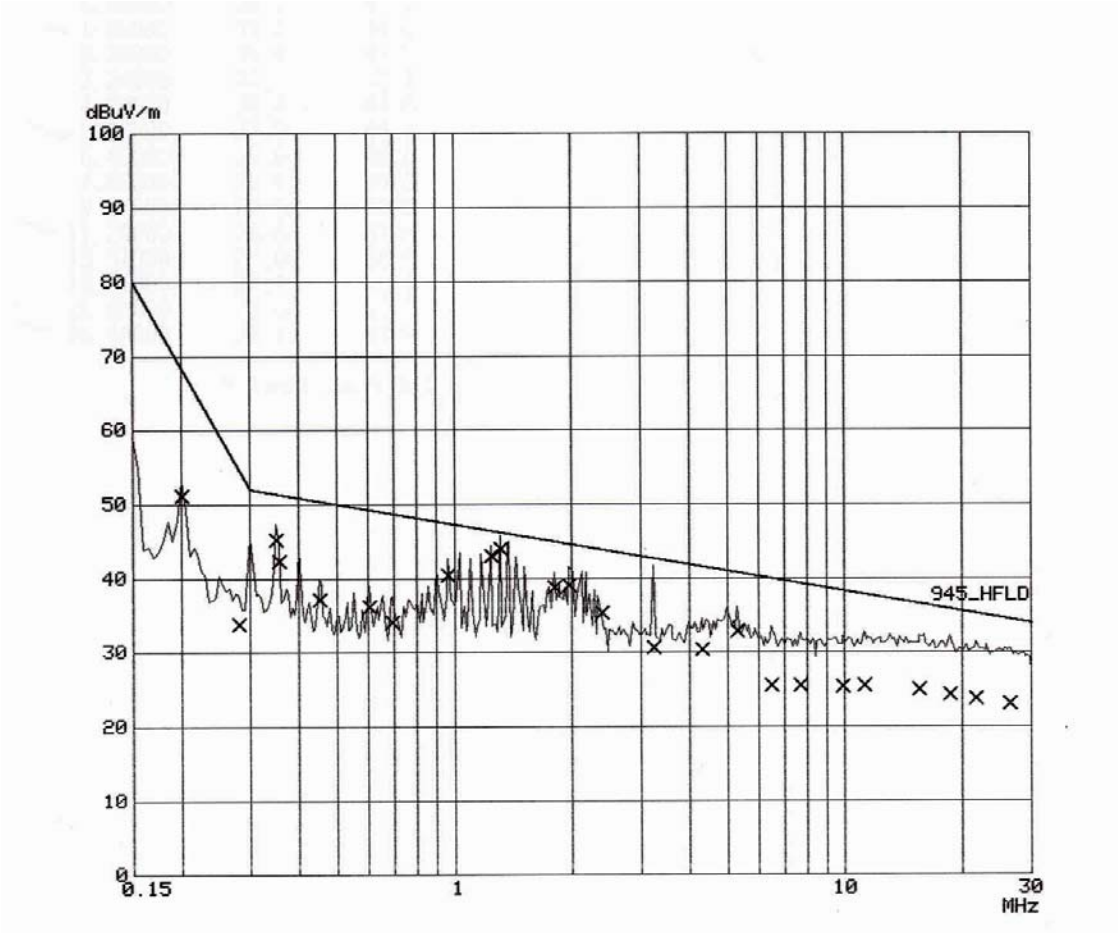
| Emission frequency (MHz) | Measured quasi-peak value (dBµV/m) | Specified quasi-peak limit (dBµV/m) | Status |
|---|---|---|---|
| 0.200 | 51.3 | 68.7 | Pass |
| 0.350 | 45.3 | 51.4 | Pass |
| 1.240 | 43.1 | 46.4 | Pass |
| 1.960 | 39.0 | 44.6 | Pass |
| 5.300 | 32.9 | 40.7 | Pass |
| 11.254 | 25.6 | 37.8 | Pass |
| 26.480 | 23.1 | 34.5 | Pass |

Uncertainty of measurement: +4.3/-4.1dBuV for a 95% confidence level.

The measurements reported are the highest emissions relative to the EN 60945 limit and take into account the antenna and cable loss factors. Measurements made according to the EN 60945 test standard and Hursley EMC Services test procedure MAR-01.

TEST ENGINEER: Andy Jones

## 4.2.4 Profile, Horizontal Loop



# 4.3 Conducted Disturbance, DC Port

## 4.3.1 Data

A filtered 230V/50Hz supply was fed to the EUT via a 50Ω/50µH Artificial Mains Network (AMN). The AMN was bonded to a conductive ground plane. Line and neutral phases were measured separately.

A spectrum analyser was set to scan between 10kHz and 30MHz to record the peak emission profiles. The worst-case peaks were then measured using an average and/or quasi-peak receiver and compared to the EN 60945 limit. The worst-case results are shown here.

**0V DC**

| Frequency (MHz) | Quasi-peak value (dBµV) | | Status |
|---|---|---|---|
| | Measured | Limit | |
| 0.301 | 30.4 | 51.8 | Pass |
| 0.350 | 32.9 | 50.0 | Pass |
| 1.050 | 28.3 | 50.0 | Pass |
| 2.470 | 33.4 | 50.0 | Pass |
| 4.140 | 40.7 | 50.0 | Pass |
| 9.830 | 39.8 | 50.0 | Pass |
| 14.750 | 45.1 | 50.0 | Pass |

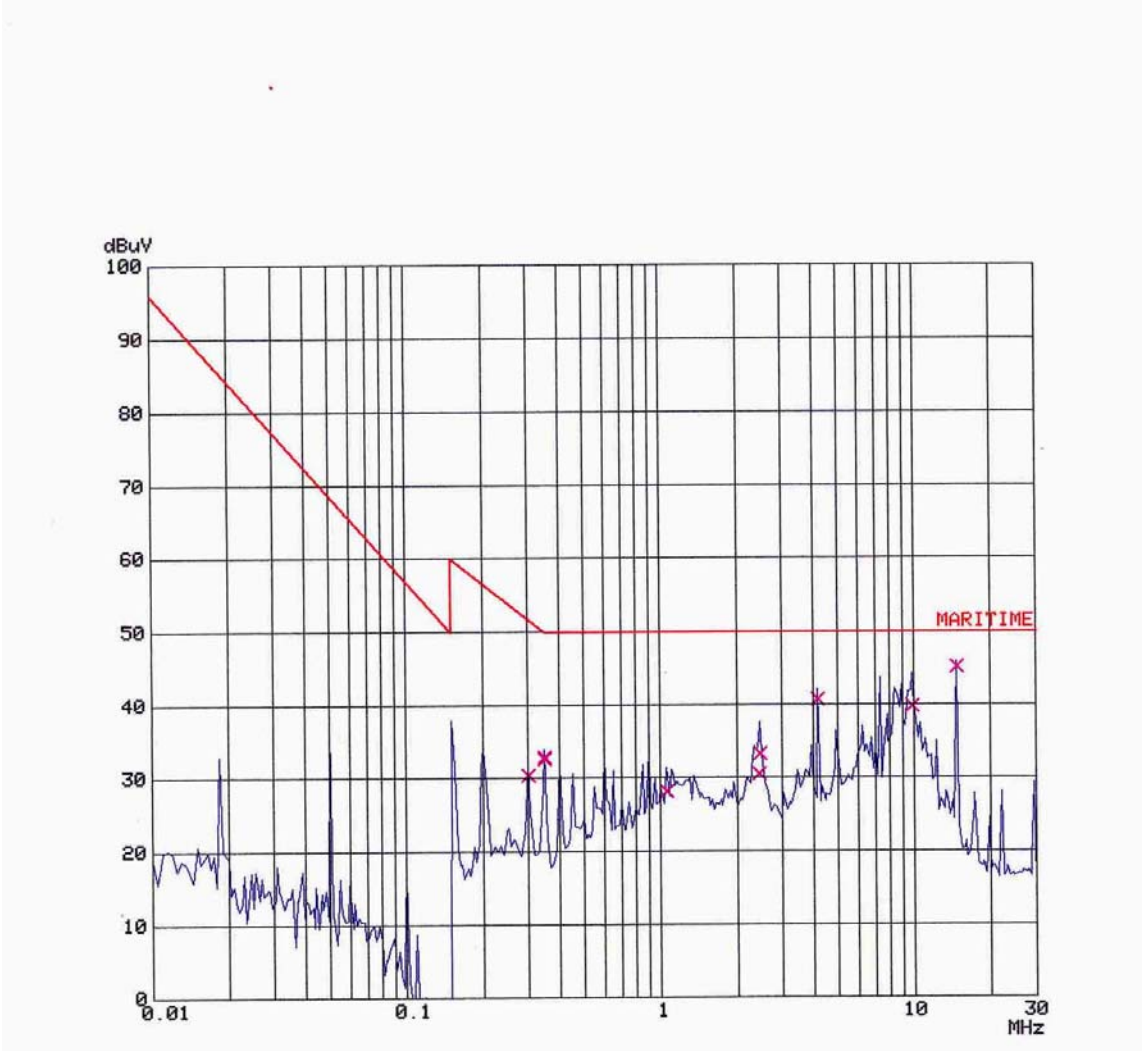
**24V**

| Frequency (MHz) | Quasi-peak value (dBµV) | | Status |
|---|---|---|---|
| | Measured | Limit | |
| 0.150 | 40.5 | 50.0 | Pass |
| 0.301 | 32.5 | 51.8 | Pass |
| 0.350 | 32.4 | 50.0 | Pass |
| 2.470 | 33.3 | 50.0 | Pass |
| 4.140 | 40.9 | 50.0 | Pass |
| 9.840 | 40.2 | 50.0 | Pass |
| 14.750 | 41.4 | 50.0 | Pass |
| 29.490 | 30.1 | 50.0 | Pass |

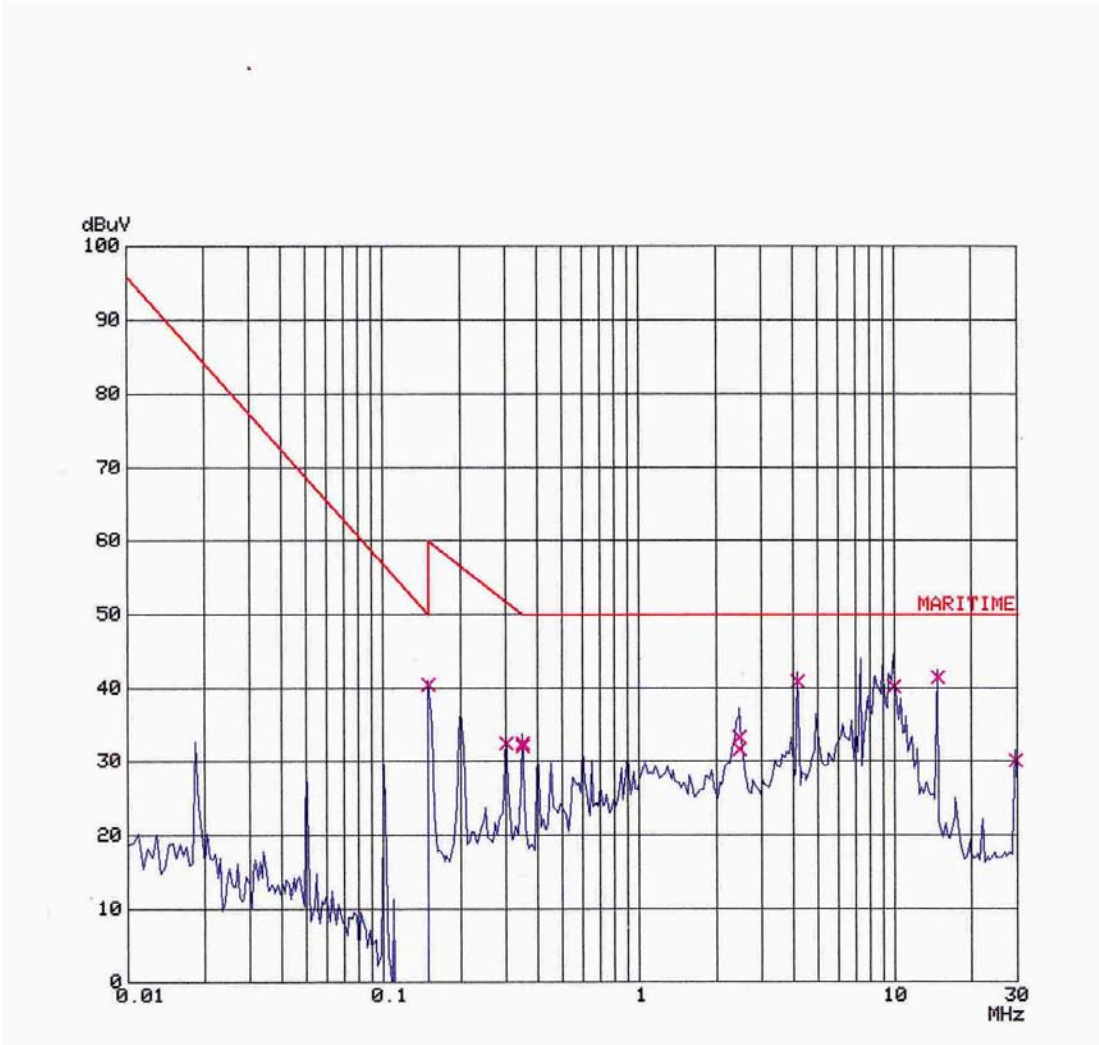
Uncertainty of measurement: +2.8/-1.8dBuV for a 95% confidence level. Measurements made according the EN 60945 test standard and Hursley EMC Services test procedure CON-02.

TEST ENGINEER: Julian Jones

## 4.3.2 Profile, 0V DC



### 4.3.3 Profile, 24V



# 5.0 IMMUNITY RESULTS

## 5.1 Performance Criteria

**General performance criteria for immunity testing are defined below:-**

| | |
|---|---|
| Criterion A: | The apparatus shall continue to operate as intended. 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. In some cases the performance level may be replaced by a permissible loss of performance. If the performance level or the permissible level is not specified by the manufacturer then either of these may be derived from the EUT description and documentation and what the user may reasonably expect from the apparatus if used as intended. |
| Criterion B: | The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. In some cases 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 level is not specified by the manufacturer then either of these may be derived from the EUT description and documentation and what the user may reasonably expect from the apparatus if used as intended. |
| Criterion C: | Temporary loss of function is allowed provided the loss of function is self-recoverable or can be restored by the operation of the controls, or by any operation specified in the instructions for use. |

**EUT performance specific criteria:**

| | |
|---|---|
| Criterion A: | Up to 4% error rate. |
| Criterion B: | Error during testing but rate returned to ≤ 4% once test finished. |

## 5.1.1 Electrostatic Discharge

| TEST METHOD | EN 61000-4-2<br>REFERENCING PROCEDURE: ESD-03 |
|---|---|

**TEST DETAILS**

| | |
|---|---|
| Test severity, contact discharge | ±6.0kV, 50 strikes per point. Total of 200 strikes (minimum). |
| Test severity, air discharge | ±8.0kV, 10 strikes for each selected point |
| Exerciser program during test | Referencing section 3.1.4 |
| Specified test criterion | Criterion 'B' |
| EUT performance criterion | Criterion 'A' |

**RESULTS**

**Contact, Indirect**

| SPECIFIED VOLTS | REFERENCE PLANE @ 10cm | STATUS |
|---|---|---|
| ± 4.0kV | Horizontal and vertical; front, rear and sides | PASS |
| ± 6.0kV | Horizontal and vertical; front, rear and sides | PASS |

**Contact, Direct To EUT**

| SPECIFIED VOLTS | TEST POINTS | STATUS |
|---|---|---|
| ± 2.0kV | • Rear earth point / case | PASS |
| ± 4.0kV | • Side screws<br>• Top middle | PASS |
| ± 6.0kV | • Front switch panel | PASS |

**Air Discharge (Insulating, Slots & Apertures)**

| SPECIFIED VOLTS | TEST POINTS | STATUS |
|---|---|---|
| ± 2.0kV | • Printer door | PASS |
| ± 4.0kV | • Membrane switches | PASS |
| ± 8.0kV | • Rear cable I/O connectors | PASS |

UNCERTAINTY: Taking account of the permissible tolerance of the applicable EMC test specification and the relevant UKAS calibration data of the equipment used to introduce the calculated disturbance for this test, the applied levels as reported provide a level of confidence of approximately 95%.

COMMENT: No deviations observed or measured. The printer door was kept closed during testing.

TEST ENGINEER: Andy Jones

## 5.1.2 Radiated RF Interference

| TEST METHOD | EN 61000-4-3<br>REFERENCING PROCEDURE: RES-02 |
|---|---|

**TEST DETAILS**

| | |
|---|---|
| **Test severity levels, 80-1000MHz swept frequency** | • **10.0V/m**<br>• **80% amplitude modulation 400Hz**<br>• **1% increment, 3 seconds dwell time** |
| **Exerciser program during test** | **Referencing section 3.1.4** |
| **Specified test criterion** | **Criterion 'A'** |
| **EUT performance criterion** | **Criterion 'A'** |

**RESULTS**

| TEST POINTS | ANTENNA POLARITIES | FIELD LEVEL SPOT FREQUENCY | STATUS |
|---|---|---|---|
| **Front** | **Horizontal & vertical** | **10.0V/m** | **PASS** |
| **Side, left** | **Horizontal & vertical** | **10.0V/m** | **PASS** |
| **Side, right** | **Horizontal & vertical** | **10.0V/m** | **PASS** |
| **Rear** | **Horizontal & vertical** | **10.0V/m** | **PASS** |

UNCERTAINTY: The test was performed at a level of 12.0V/m to take into account the uncertainties and be able to declare a pass at 10.0V/m for a 95% confidence level.

COMMENT: No deviations observed or measured. The EUT met the specified test criterion.

NOTE: Customer defined that the error rate 4% allowance to be spread over the entire spectrum from 80 to 2000MHz. The horizontal error rate total was 3.8% and the vertical was 2.2%.

TEST ENGINEER: Julian Jones / Ian Kenney

## 5.1.3 Fast Transient Bursts

| TEST METHOD | EN 61000-4-4<br>REFERENCING PROCEDURE: FTB-01 |
|---|---|

**TEST DETAILS**

| | |
|---|---|
| **Test severity** | • **+/- 1.0kV Signal Port**<br>• **+/- 1.0kV DC Port**<br>**5/50ns Tr/Td 5kHz Repetition Rate** |
| **Exerciser program during test** | **Referencing section 3.1.4** |
| **Specified test criterion** | **Criterion 'B'** |
| **EUT performance criterion** | **Criterion 'A'** |

**RESULTS**

**Direct Injection**

| PORT | TEST VOLTAGE | STATUS |
|---|---|---|
| **DC Power Port** | **+ 1.0kV** | **PASS** |
| **DC Power Port** | **- 1.0kV** | **PASS** |

**Injection Via Clamp**

| PORT | TEST VOLTAGE | STATUS |
|---|---|---|
| **Antenna coax lead** | **+1.0kV** | **PASS** |
| **Antenna coax lead** | **- 1.0kV** | **PASS** |

UNCERTAINTY: Taking account of the permissible tolerance of the applicable EMC test specification and the relevant UKAS calibration data of the equipment used to introduce the calculated disturbance used for this test, the applied levels as reported provide a level of confidence of approximately 95%.

COMMENT: No performance degradation was observed. The EUT met the specified test criterion.

TEST ENGINEER: Julian Jones

## 5.1.4 Conducted RF Field

| TEST METHOD | EN 61000-4-6<br>REFERENCING PROCEDURE: CES-02 |
|---|---|

**TEST DETAILS**

| | |
|---|---|
| **Test severity level** | • **3.0V rms, 80% amplitude modulation 400Hz 0.15 to 80MHz**<br>• **10V rms spot frequencies at: 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22, 25MHz, the dwell at each frequency was 60 seconds.** |
| **Exerciser program during test** | **Referencing section 3.1.4** |
| **Specified test criterion** | **Criterion 'A'** |
| **EUT performance criterion** | **Criterion 'A'** |

**RESULTS**

| TEST VOLTAGE | TEST POINTS | COUPLING METHOD | STATUS |
|---|---|---|---|
| **3.0V** | **DC Port** | **CDN** | **PASS** |

**RESULTS – Signal Port**

| TEST VOLTAGE | TEST POINTS | COUPLING METHOD | STATUS |
|---|---|---|---|
| **3.0V** | **Coax wire** | **CDN** | **PASS** |
| **3.0V** | **Earth wire** | **EM-Clamp** | **PASS** |

UNCERTAINTY: The test was performed at a level of 3.4V to take into account any uncertainties so as to be able to declare a pass at 3.0V for a 95% confidence level.

COMMENT: No performance degradation was observed. The EUT met the specified test criterion.

TEST ENGINEER: Andy Jones

# 6.0 PHOTO LOG

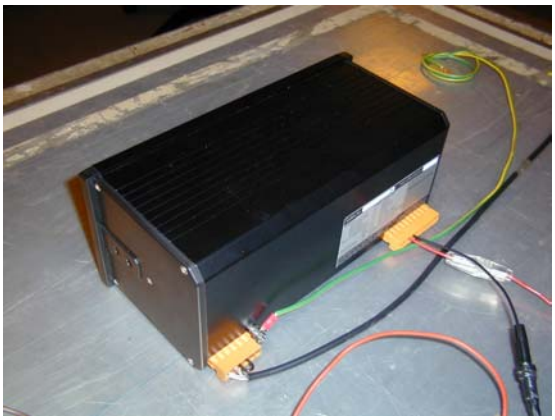
## 6.1 Typical Emission Setup

**RADIATED**

**CONDUCTED**

## 6.2 Typical Immunity Setup

**ELECTROSTATIC DISCHARGE**



**CONDUCTED**