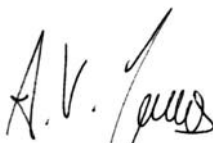


EMC Test Report

for the

SRT Marine Technology Ltd

**SRT SO TDMA Class B AIS Transceiver
Model: Iris AIS700**



Project Engineer: A. V. Jones



Approval Signatory

Approved signatories: R. P. St John James ☒ J. A. Jones ☐

The above named are authorised Hursley EMC Services signatories.

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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

None to sample submitted:

1.4 Conclusion

The EUT 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. It is valid only for the product identified, either in part or in full, to the relevant electromagnetic requirements necessary for compliance with the EMC Directive 2014/30/EU.

2.0 TEST SUMMARY

2.1 Summary

The EUT was tested to the EN 60945 test 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 IEC 60945 (Fourth edition – 2002) & EN 301 843-1 v2.1.1*	CISPR 16-1-1:2006
Radiated H-Field		CISPR 16-1-1:2006
Conducted disturbance		CISPR 16-1-1:2006

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

Description	General Standard	Referenced Standard
Electrostatic discharge	EN 60945:2002 IEC 60945 (Fourth edition – 2002) & EN 301 843-1 v2.1.1*	EN / IEC 61000-4-2:2009
Radiated RF immunity		EN / IEC 61000-4-3:2006 inc A1: 2008 & A2:2010
Fast transient bursts		EN / IEC 61000-4-4:2012
Conducted immunity		EN / IEC 61000-4-6:2014
Power line disturbance		EN / IEC 61000-4-11:2004

Compass Safe Distance:

EN 60945:2002 / IEC 60945

Section 11.2 - 0.3 Deg of deflection = 200mm (powered)

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

Note: Standard marked * are not with the UKAS schedule of this laboratory.

2.2 Test Deviations

None.

2.3 EMC Test Lab Reference

Hursley EMC Services file: 17R514.

3.0 EQUIPMENT & TEST DETAILS

3.1 General

EUT:	SRT SO TDMA Class B AIS Transceiver Make: SRT Marine Technology Ltd Model: Iris AIS700 Serial number: EP1 #05
EUT power rating:	12 to 24V DC
EUT manufacturer:	SRT Marine Technology Ltd
EUT build level:	Engineering Prototype
Customer:	SRT Marine Technology Ltd Wireless House Westfield Industrial Estate Midsomer Norton Bath BA3 4BS United Kingdom Tel: +44 (0) 1761 409 500
Test commissioned by:	Mr Shaun Horan
Date EUT received:	25 th September 2017
Test date(s):	25 th September to the 3 rd October 2017
EMC measurement site:	Hursley EMC Services Limited Hursley Park, Winchester, Hampshire

3.2 EUT Description

The Iris AIS700 is a Class B AIS transceiver with a built-in VHF splitter, used to display real-time information on local vessels, land based stations or aids to navigation that are equipped with either Class A or Class B AIS transceivers

3.3 EUT Support

- GPS antenna, Model MA-700 s/n 0020862
- GPS antenna, Model 260-0002, s/n 0007899
- Apollo AIS class A transceiver s/n 42500021660006
- 3x 30dB Attenuators
- Laptop HP Probook 44530 s/n 000209

3.4 EUT Test Exerciser & Configurations

There were two operating modes that were used, one was for Emission and the other for Immunity Testing.

Emission Testing:

The unit was in receive mode, The GPS Antenna was Connected placed within the test chamber. The Antenna and VHF Radio ports were terminated by 50R RF Load.

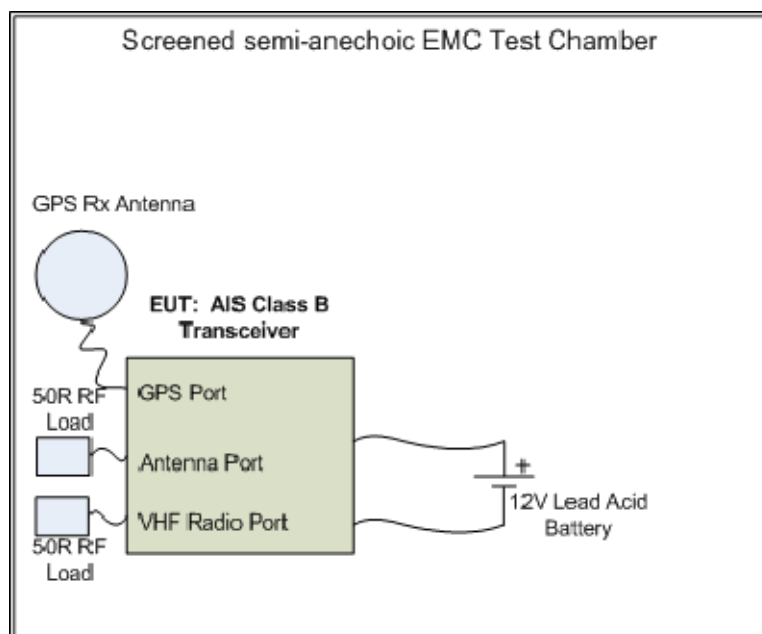
Immunity Testing:

The EUT was connected to an AIS Class A Unit located outside the Screened Test Chamber. The two units were connected via a coaxial cable with a total attenuation of 90dB between the two units.

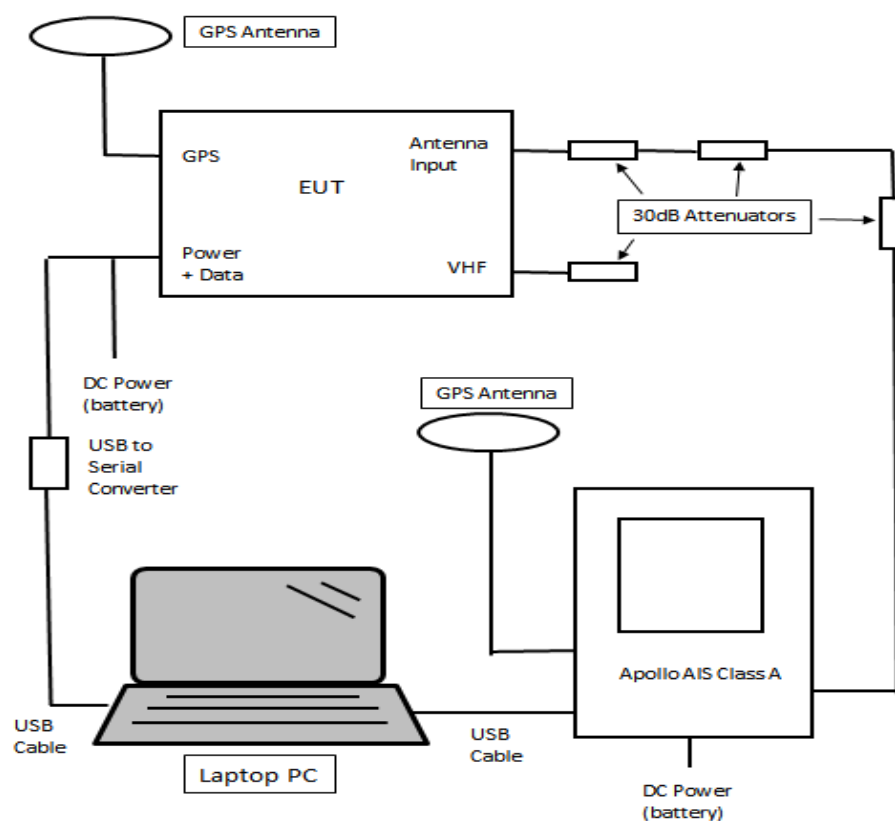
The EUT was in normal operating mode where information was exchanged between the EUT and an AIS Class A Transceiver via VHF Data Link (VDL). Consistent position report exchange was monitored on each unit.

EUT Test Exerciser and Configurations (continued)

Radiated Emission Test Setup



Immunity Test Setup



3.5 Environmental Test Conditions

Temperature	19 to 24° Celsius
Relative Humidity	50 to 65%
Atmospheric Pressure	998 to 1020 millibars

3.6 EMC Test Equipment

#ID	CP	Manufacturer	Type	Serial No	Description	Calibration due date
033	1	HP	8593EM	3726U00203	Spectrum analyser	11/12/2017
034	2	Rohde & Schwarz	SMT06	830004/0012	Signal generator (6GHz)	23/08/2018
047	3	Rohde & Schwarz	HFH2-Z2	879021/22	Loop antenna (9kHz-30MHz)	01/06/2019
121	1	EM	CWS500A	0898-02	Conducted immunity simulator	07/06/2018
121a	0	0	6dB pad	001	6dB pad for 121 generator	07/06/2018
157	1	Haefely Trench	PESD 3000	H907013	ESD gun (30kV)	04/07/2018
187	1	Fischer	F-2031-23	379	EM injection clamp (10k-1GHz)	26/05/2018
218	1	Boonton	4230	26603	Power meter/probe(a) (18GHz)	22/06/2018
235	1	MEB	M3	13-214	CDN 3W 16A	14/11/2017
243a/b	1	MEB	13008	13008A & B	Adaptor [pair] (50-100Ω)	Internal
250	1	HP	8449B	3008A01077	Pre-amplifier (1.0-26.5GHz)	31/08/2018
252	1	Rohde & Schwarz	ESH 3 Z2	08970	10dB pulse limiter	08/05/2018
390	0	Schwarzbeck	STLP9128D	9128D-060	RES antenna Saturn	Internal
407	1	Rohde & Schwarz	ESH3Z5	831887/019	LISN / AMN	12/01/2018
421	1	Schaffner	CDN126	446	Coupling Clamp	27/01/2018
456	1	Rohde & Schwarz	ESCI7	1144573407	EMI Test Receiver	30/05/2018
466	3	Schwarzbeck	BBHA 9120 571	571	1-10GHz Horn	24/02/2019
555	1	Milmega	500W Amp	0	80-1000 MHz	Internal
592	1	EMV	M2 + M3	A3011023	CDN	14/11/2017
600	1	HP	8447D	2944A07419	Amplifier	24/07/2018
601	1	EMC Partner	TRAEFT39	TRA1000-323	EMC Tester	27/01/2018
612	0	EMC Partner	TRA2000	562	EMC Tester	Internal
639	1	VectaWave	VBA3100-180	0	800-3100MHz	Internal
699	1	Gauss	TDEMI30M	1506001	Conducted Receiver	16/12/2017
740	1	Com-Power	CDN-USB-AE	521633	USB CDN	12/12/2017
746	3	Dare!	CTR1004	15100078SNO50	18GHz field Probe	01/06/2019

CP = Interval period [year] prescribed for external calibrations

Note: 'Calibration due date' means that the instrument is certified with a UKAS or traceable calibration certificate.
 'Internal' means internally calibrated using HEMCS procedures

4.0 EMISSION RESULTS

4.1 Radiated Emissions; 30 to 1000 MHz

Radiated emissions pre-scan profile measurements were taken at a distance of three metres on eight azimuths of the EUT in both horizontal and vertical antenna polarities in a semi-anechoic chamber.

The EUT was scanned in a chamber with the supply set to 12V DC.

Using the pre-scan results as a guide, each emission from the EUT was maximised. Measurements were carried out a distance of three metres in a CISPR 16-1-4 compliant semi-anechoic chamber. Cable positions were then finally adjusted to produce the maximum emission levels. The worst-case CISPR results are recorded below.

4.1.1 Data

Emission frequency (MHz)	Measured quasi-peak value (dB μ V/m)	Measured quasi-peak value including uncertainty budget	Specified quasi-peak limit (dB μ V/m)	Status
142.325	37.92	42.12	54.0	Pass
160.190	9.75	13.95	24.0	Pass
191.289	41.52	45.72	54.0	Pass
284.650	44.21	48.41	54.0	Pass
336.000	34.60	38.80	54.0	Pass
426.960	39.92	44.12	54.0	Pass
573.840	35.18	39.38	54.0	Pass
853.930	40.55	44.75	54.0	Pass
956.400	38.14	42.34	54.0	Pass
996.250	41.35	45.55	54.0	Pass

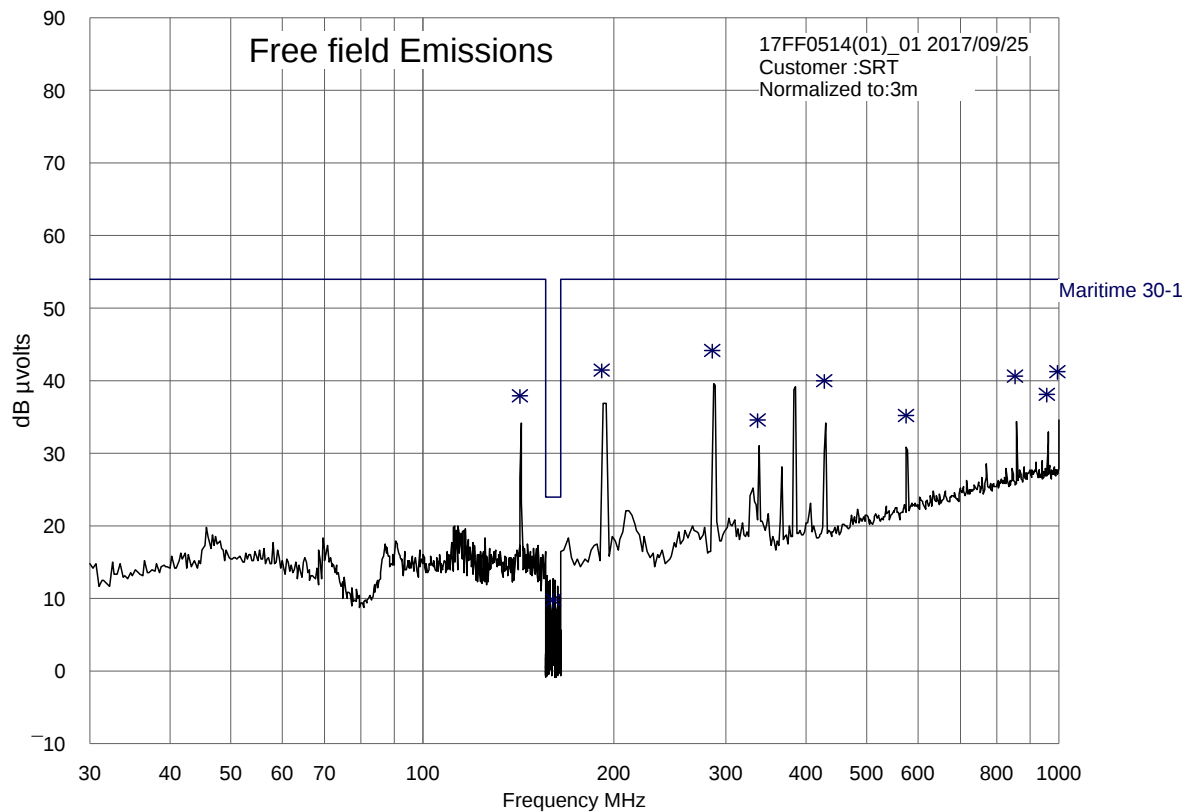
The uncertainty of measurement: ± 4.2 dB μ V for a 95% confidence level has been added to the measured result.

The measurements reported are the highest emissions relative to the EN / IEC 60945 limit and take into account the antenna and cable loss factors. Measurements were made with a 9 kHz quasi-peak detector between 156 and 165 MHz; at all other frequencies a 120 kHz quasi-peak detector was used. Measurements made according to the EN/IEC 60945 test standard and Hursley EMC Services test procedure RAD-01

TEST ENGINEER: Andy Jones

4.1.2 Profile

Maximum peak hold trace with quasi-peak values (*)



4.2 Radiated Emissions; 1.0 to 2.0 GHz

Radiated emissions pre-scan profile measurements were taken at a distance of three metres with the EUT turned through 360°, with both horizontal and vertical antennae polarities in an anechoic chamber. This pre-scan profile was made from 1.0 to 2.0 GHz and evaluated against the EN 60945 limit.

The sample was then re-measured in an anechoic chamber; the pre-scan results were used as a guide at three metre. Each emission from the EUT was maximised. Cable positions were then finally adjusted to produce the maximum emission levels. There were no frequencies found within the laboratory's ≤ 12 dB criterion and so no further measurements were necessary.

4.2.1 Data

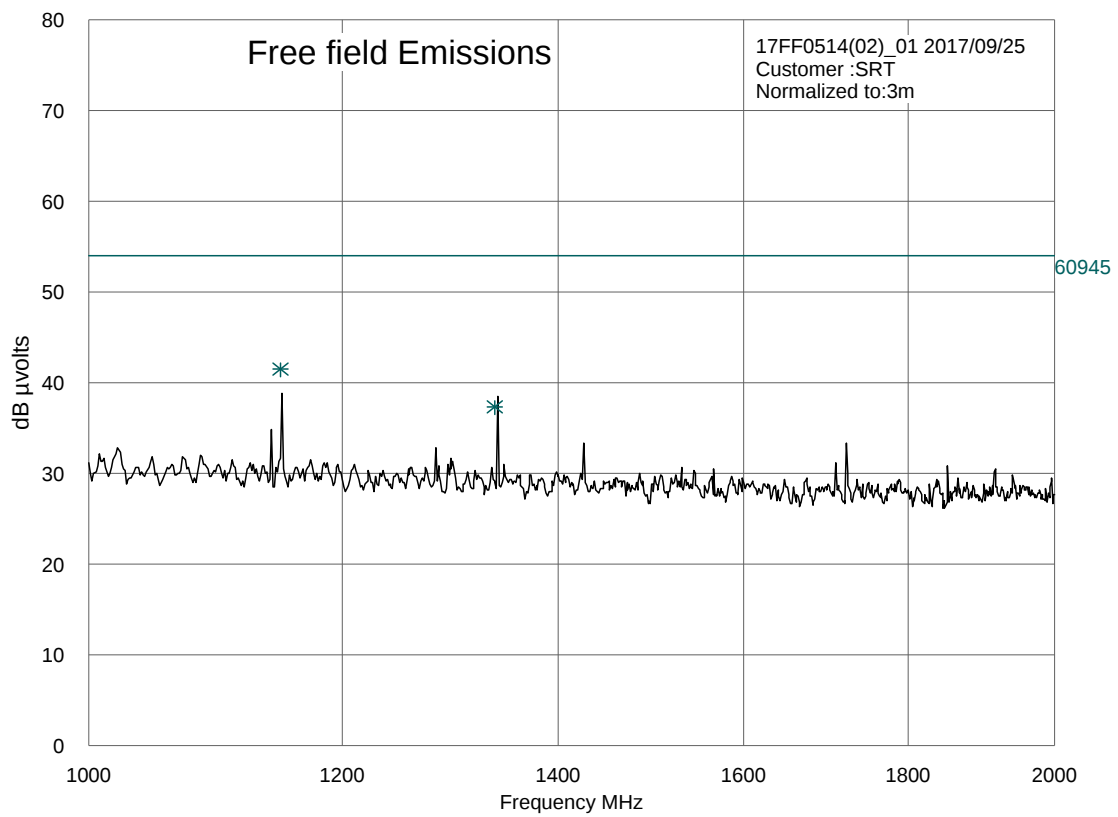
Emission frequency (GHz)	Measured quasi-peak value (dB μ V/m)	Measured quasi-peak value including uncertainty budget	Specified quasi-peak limit (dB μ V/m)	Status
No significant peaks found within the specified limit.				Pass

Uncertainty of measurements: ± 5.1 dB μ V for a 95% confidence level for >1.0 GHz.

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

TEST ENGINEER: Andy Jones

4.2.2 Profile



4.3 Radiated H-Field, 150 kHz to 30 MHz

A profile scan was taken at a distance of three metres with a 360° azimuth scan of the EUT in a semi-anechoic chamber. The tests were repeated for three orientations of the loop antenna.

4.3.1 Data; 90 degrees and 180 degrees

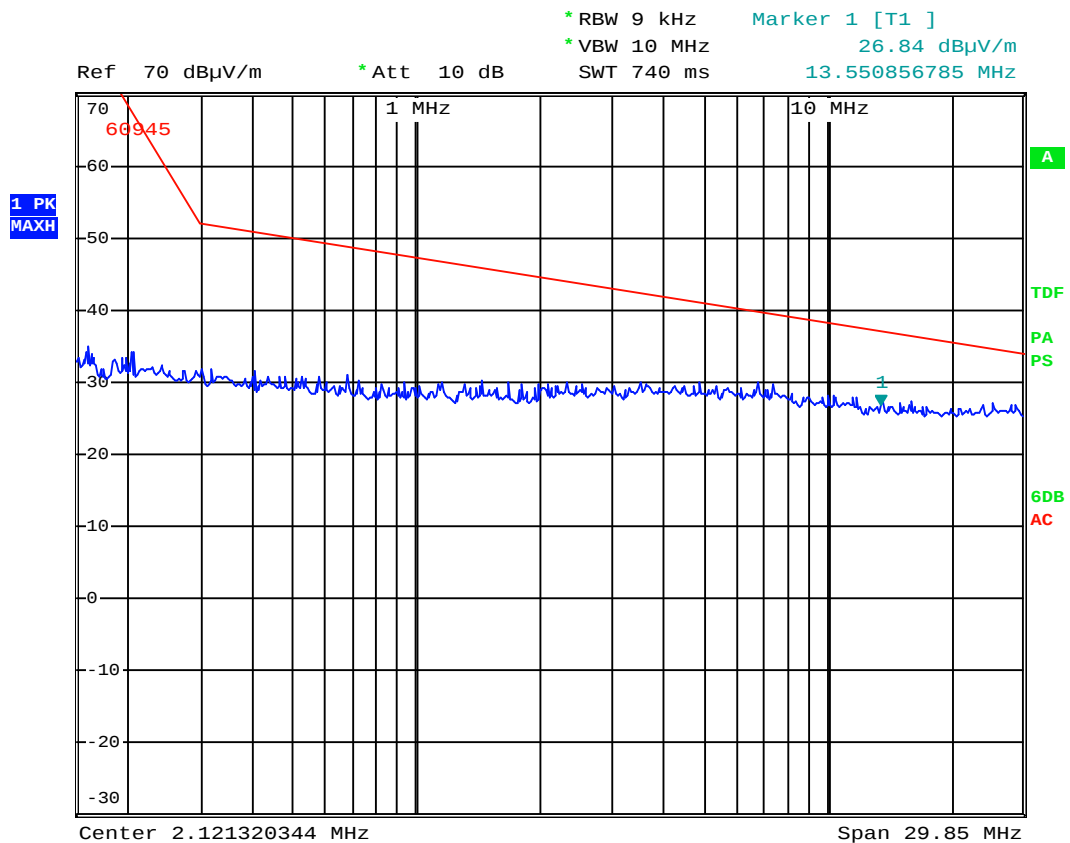
Quasi-peak value (dBμV)				
Frequency	Measured	Measured quasi-peak value including uncertainty budget	Limit	Status
No significant peaks found within the specified limit.				Pass

The uncertainty of measurement: $\pm 3.22\text{dB}\mu\text{V}$ for a 95% confidence level has been added to the measured result.

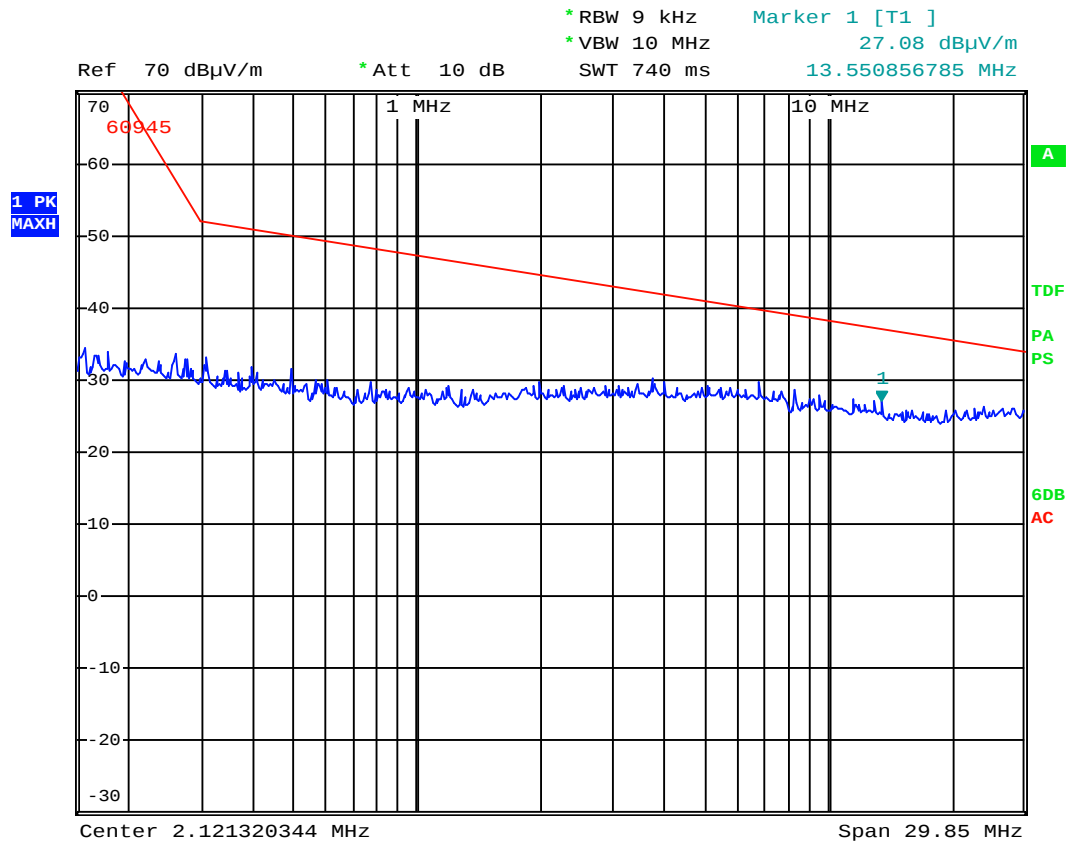
The measurements reported are the highest emissions relative to the EN 60945 limit and take into account the antenna, cable loss factors and uncertainty budget. Measurements made according to the EN 60945 test standard and Hursley EMC Services test procedure MAR-01.

TEST ENGINEER: Andy Jones

4.3.2 Profile; 0 degrees



4.3.3 Profile; 90 degrees



4.4 Conducted Emissions

A filtered power supply from 12V DC battery 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 10 kHz and 30 MHz to record the peak emission profiles. The worst-case peaks were then measured using a quasi-peak receiver and compared to the EN 60945 limit. Measurements made according the EN 60945 test standard and Hursley EMC Services test procedure CON-02. The worst-case results are shown here.

4.4.1 Data

0V

Frequency	Quasi-peak value (dBμV)			
	Measured	Measured quasi-peak value including uncertainty budget	Limit	Status
32.783 kHz	12.62	15.84	75.83	Pass
46.690 kHz	20.25	23.47	69.82	Pass
66.360 kHz	29.79	33.01	63.85	Pass
93.480 kHz	16.24	19.46	58.03	Pass
126.163 kHz	15.08	18.30	52.94	Pass
146.727 kHz	14.01	17.23	50.37	Pass
1.216 MHz	33.05	36.27	50.00	Pass
7.286 MHz	25.15	28.37	50.00	Pass
13.361 MHz	23.07	26.29	50.00	Pass
15.130 MHz	24.91	28.13	50.00	Pass
23.866 MHz	24.20	27.42	50.00	Pass
28.801 MHz	30.17	33.39	50.00	Pass

Uncertainty of measurement: ± 3.22 dBμV for a 95% confidence level has been added to the measured result.

Conducted emissions (continued)

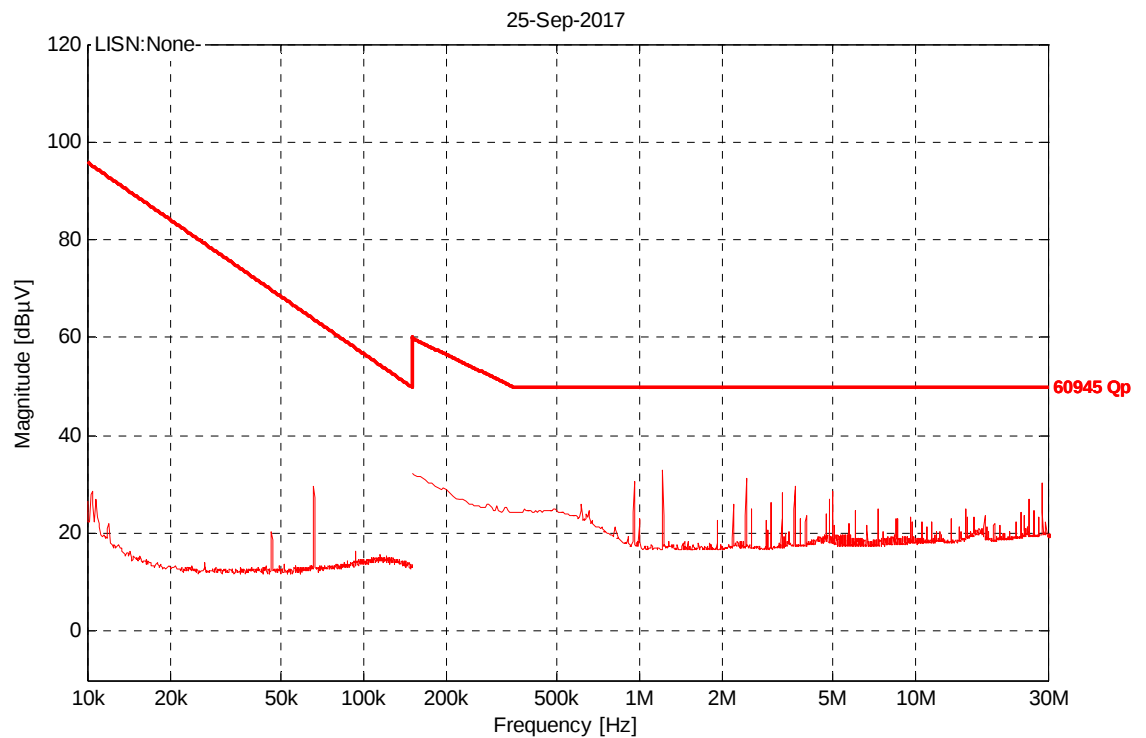
12V

Frequency	Quasi-peak value (dBμV)			
	Measured	Measured quasi-peak value including uncertainty budget	Limit	Status
33.180 kHz	12.45	15.67	75.63	Pass
46.690 kHz	19.82	23.04	69.82	Pass
66.360 kHz	29.55	32.77	63.85	Pass
101.328 kHz	14.98	18.20	56.66	Pass
125.766 kHz	15.15	18.37	52.99	Pass
148.018 kHz	14.02	17.24	50.23	Pass
1.216 MHz	32.68	35.90	50.00	Pass
5.126 MHz	27.66	30.88	50.00	Pass
13.366 MHz	23.99	27.21	50.00	Pass
15.130 MHz	25.48	28.70	50.00	Pass
21.000 MHz	27.64	30.86	50.00	Pass
28.801 MHz	26.95	30.17	50.00	Pass

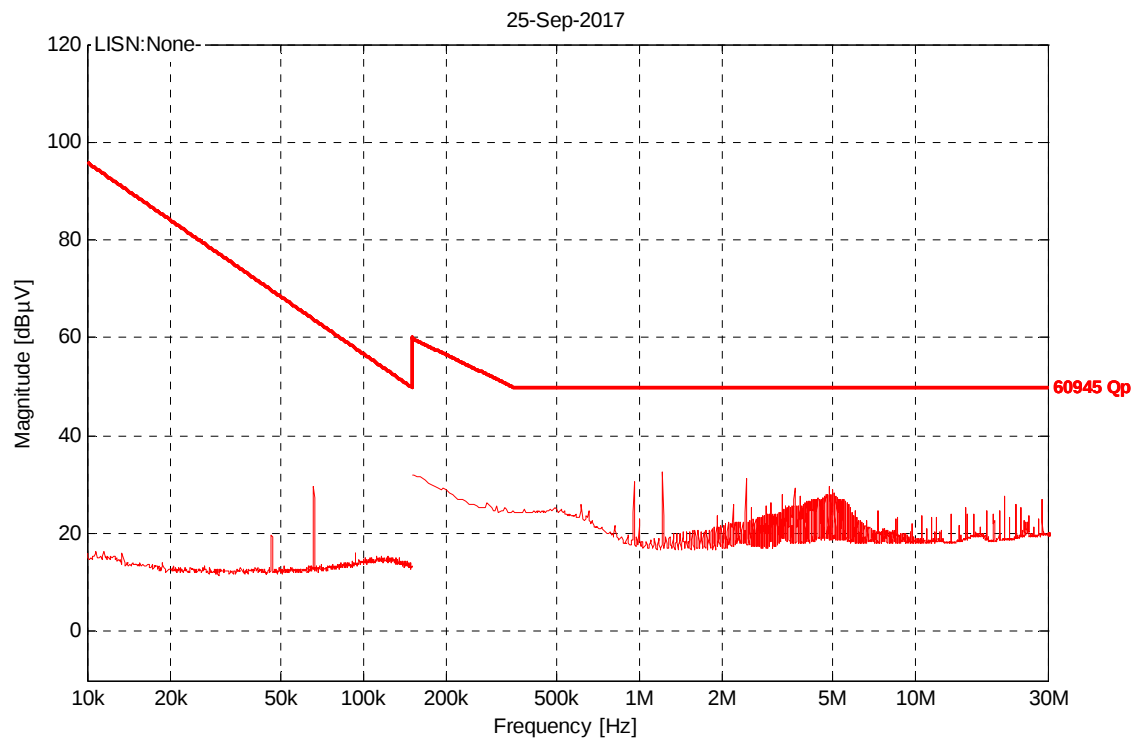
Uncertainty of measurement: ± 3.22 dBμV for a 95% confidence level has been added to the measured result.

TEST ENGINEER: Andy Jones

4.4.2 Profile; 0V



4.4.3 Profile; 12V



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.

Note: All immunity tests were applied above the specification level to include the uncertainty attributed to each test.

5.2 Electrostatic Discharge

TEST METHOD	IEC 61000-4-2 REFERENCING PROCEDURE: ESD-03
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TEST DETAILS

Test severity, <u>contact discharge</u>	± 6.0 kV, 50 strikes per point. Total of 200 strikes (minimum).
Test severity, <u>air discharge</u>	± 8.0 kV, 10 strikes for each selected point
Exerciser program during test	Referencing section 3.4
Specified test criterion	Criterion 'B'
EUT performance criterion	Criterion 'A'

RESULTS

Contact, Indirect

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

Contact, Direct To EUT

SPECIFIED VOLTS	TEST POINTS	STATUS
± 2.0 kV	Case and connector shells; see illustration on next page	PASS
± 4.0 kV		PASS
± 6.0 kV		PASS

Air Discharge (Insulating, Slots & Apertures)

SPECIFIED VOLTS	TEST POINTS	STATUS
± 2.0 kV	See illustration on next page	PASS
± 4.0 kV		PASS
± 8.0 kV		PASS

UNCERTAINTY: Specified as less than 5%. The level applied was 5% higher than the upper levels stated above to take into account the uncertainty for this test.

COMMENT: The customer has stated that the USB port on the top of the EUT would always have a plastic bung in the opening to make it waterproof so this point was not tested. The EUT therefore met the specified test criterion.

TEST ENGINEER: Andy Jones

5.2.1 Electrostatic Discharge Test Points



Arrow indicates Contact Discharge  /  Air discharge



5.3 Radiated RF Immunity

TEST METHOD	IEC 61000-4-3 REFERENCING PROCEDURE: RES-02
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TEST DETAILS

Test severity levels,	• 10.0 V/m; 80 to 2700 MHz swept frequency • 80% amplitude modulation 400 Hz • 1% increment, 3 seconds dwell time and 9 seconds dwell time from 1.0 GHz
Exerciser program during test	Referencing section 3.4
Specified test criterion	Criterion 'A'
EUT performance criterion	Criterion 'A'

RESULTS

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

UNCERTAINTY: Estimated uncertainty is 20%. The field level has been applied at level higher of 12 V/m to take into account uncertainties.

COMMENT: The exclusion band was $\pm 5\%$ of the GPS frequency (1570 MHz). In test no exclusion bands were used. The EUT met the specified test criterion.

TEST ENGINEER: Andy Jones

5.4 Fast Transient Bursts

TEST METHOD	IEC 61000-4-4 REFERENCING PROCEDURE: FTB-01
-------------	--

TEST DETAILS

Test severity	• ± 1.0 kV All Ports 5/50ns Tr/Td 5kHz Repetition Rate
Exerciser program during test	Referencing section 3.4
Specified test criterion	Criterion 'B'
EUT performance criterion	Criterion 'A'

RESULTS

Injection Via Clamp

PORT	TEST VOLTAGE	STATUS
All ports	± 1.0 kV	PASS

UNCERTAINTY: Specified as less than 10% but estimated as less than 5%. The level applied was 5% higher than the levels stated above to take into account the uncertainty for this test.

COMMENT: The EUT met the specified test criterion.

TEST ENGINEER: Andy Jones

5.5 Conducted Immunity

TEST METHOD	IEC 61000-4-6 REFERENCING PROCEDURE: CES-02
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TEST DETAILS

Test severity level	• 3.0V rms, 80% amplitude modulation 400 Hz 0.15 to 80 MHz • 10V rms spot frequencies at: 2, 3, 4, 6.2, 8.2, 12.2, 12.6, 16.5, 18.8, 22, 25 MHz, the dwell at each frequency was 60 seconds.
Exerciser program during test	Referencing section 3.4
Specified test criterion	Criterion 'A'
EUT performance criterion	Criterion 'A'

RESULTS

TEST VOLTAGE	TEST POINTS	COUPLING METHOD	STATUS
3.0V & 10.0V	DC Input	CDN	PASS

RESULTS – Signal Port

TEST VOLTAGE	TEST POINTS	COUPLING METHOD	STATUS
3.0V & 10.0V	AIS & GPS	150-50 ohm Adapter	PASS
3.0V & 10.0V	All other signal ports	EM-Clamp	PASS

UNCERTAINTY: Estimated uncertainty is < 5%. The applied voltage has been applied at higher level of 4 or 12V to take into account uncertainties.

COMMENT: The EUT met the performance criterion.

TEST ENGINEER: Andy Jones

5.6 Power Line Disturbance

TEST METHOD	IEC 61000-4-11 REFERENCING PROCEDURE: PLD-01
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TEST DETAILS	Specified test types & levels (voltage shift @ zero phase crossing)	Specified criteria
	Interrupt: 100% reduction for 60s	C
Exerciser program during test	Referencing section 3.4	

RESULTS

Applied test types & levels	Test point	Nominal operation frequency / voltage	Performed criteria	Status
-100% x 60s	DC Input	12V DC	C	PASS

UNCERTAINTY: Specification level is 5% but estimated as less than 1%.

COMMENT: The EUT reset and continued after the test. The EUT met the performance criteria.

TEST ENGINEER: Andy Jones

6.0 PHOTO LOG (TYPICAL)

Emissions:

Radiated emissions; below 1.0 GHz



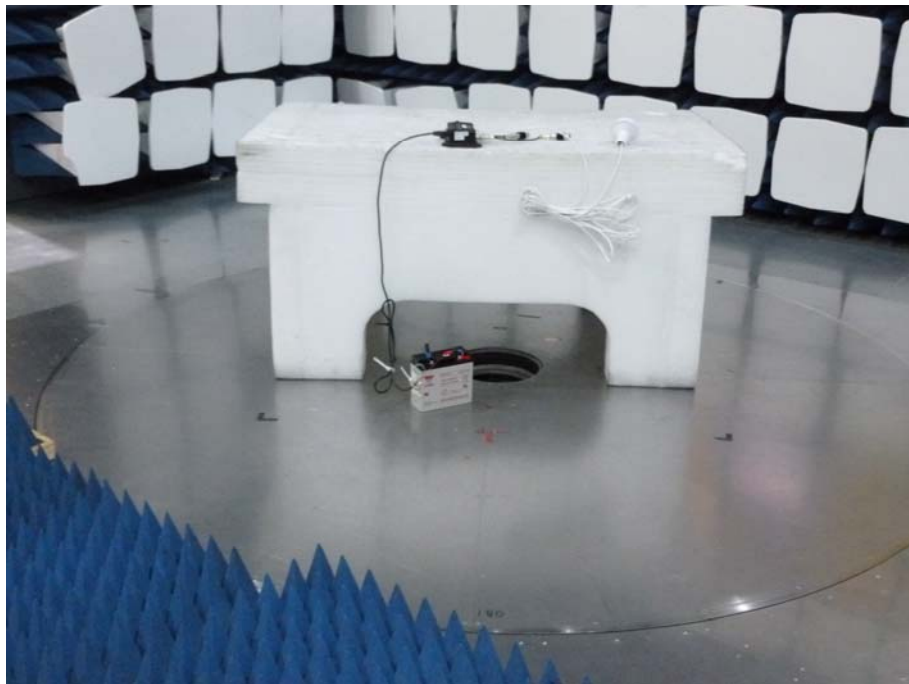
Photo Log (continued)**Emissions:****Radiated emissions; above 1.0 GHz**

Photo Log (continued)

Emissions:

Conducted emissions



Photo Log (continued)

Immunity:

Electrostatic discharge (set-up)



Photo Log (continued)

Immunity:

Radiated RF immunity



Photo Log (continued)

Immunity:

Fast burst transients

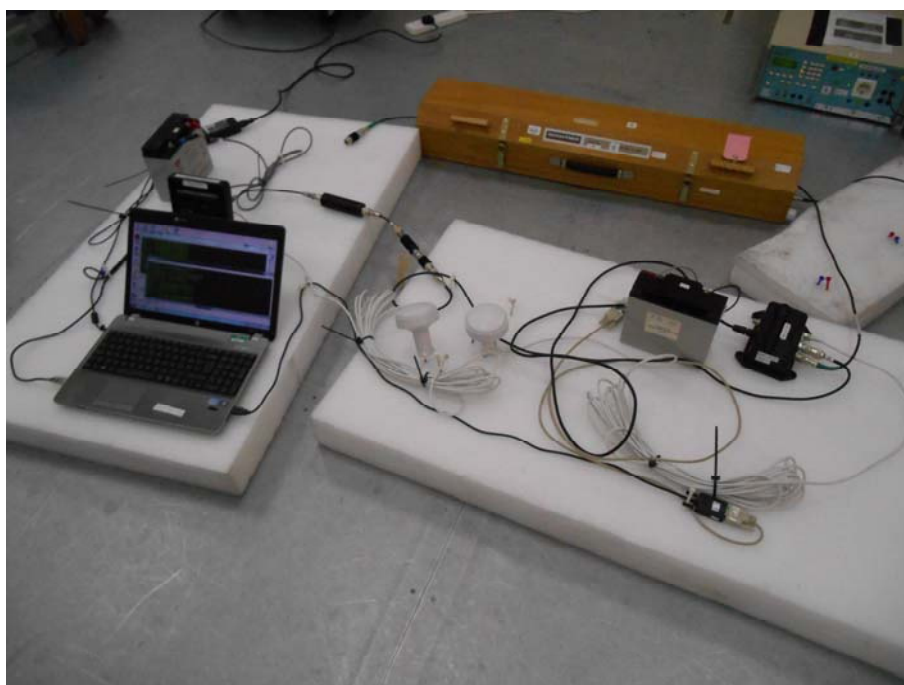
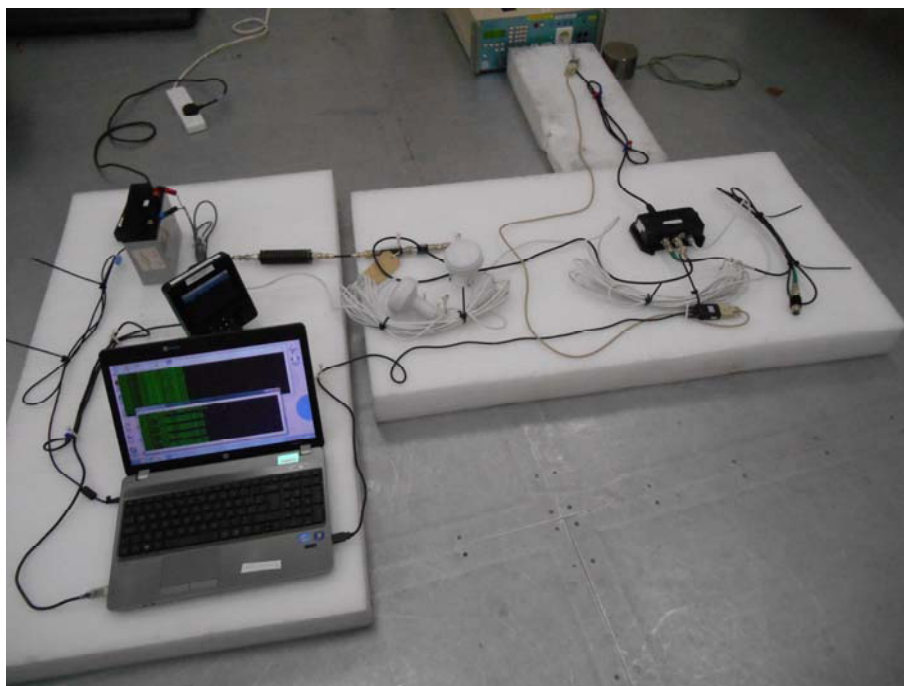


Photo Log (continued)

Immunity:

Conducted immunity

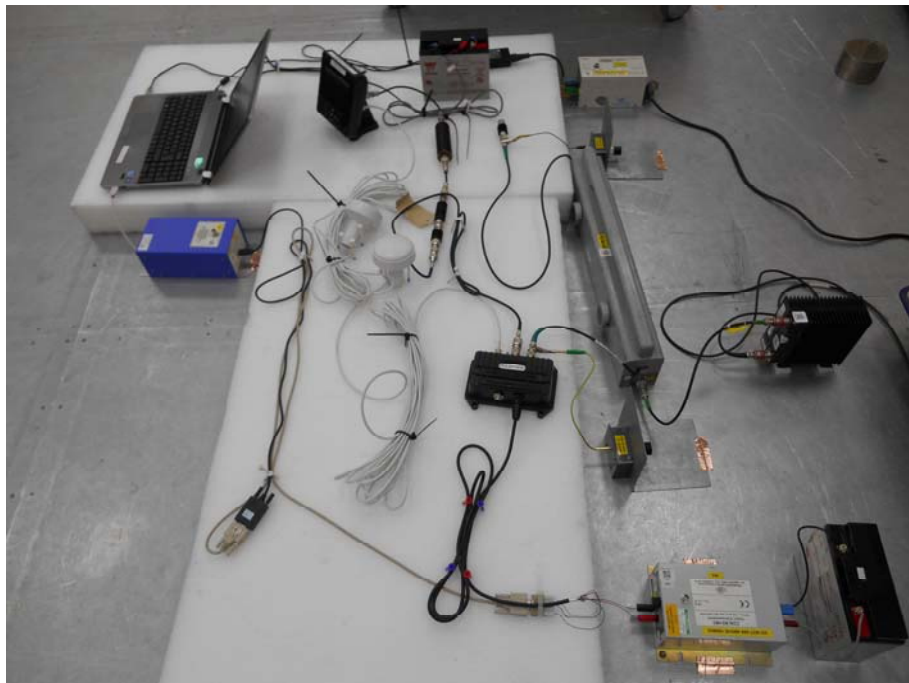
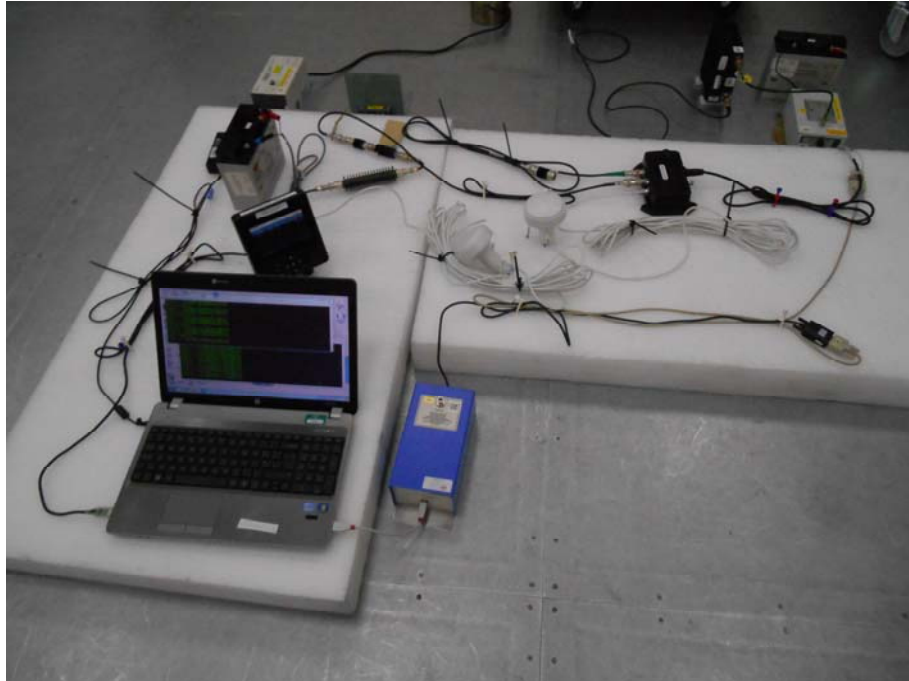
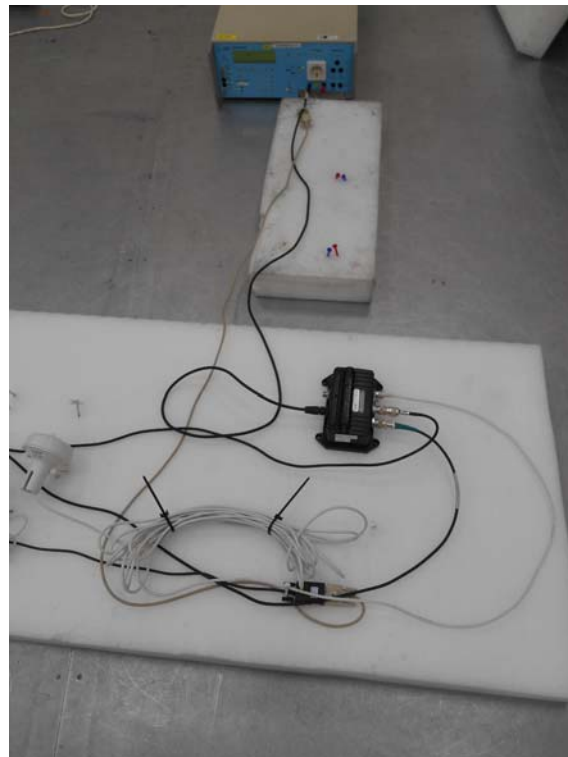
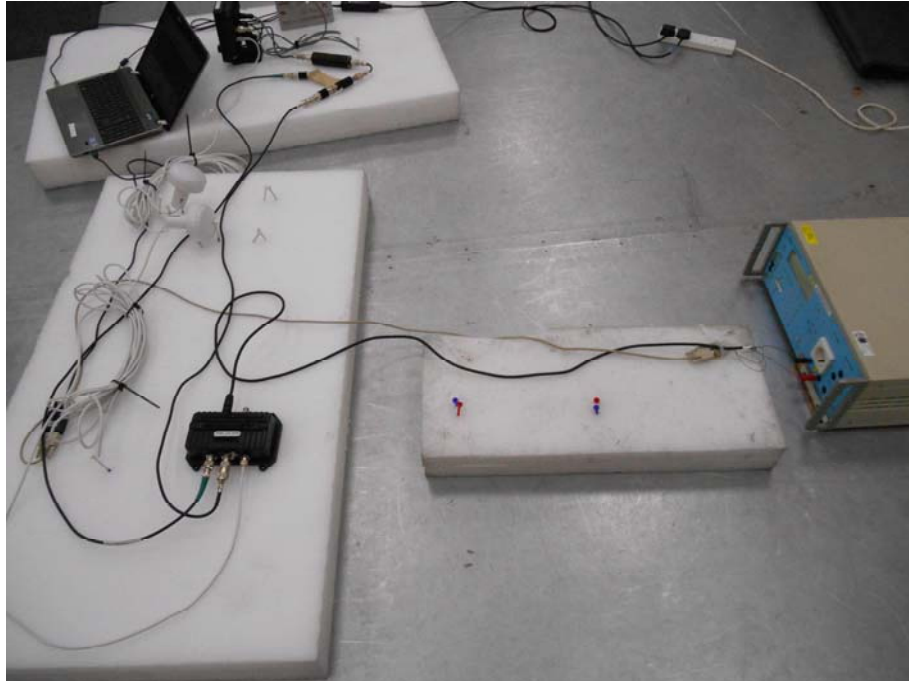


Photo Log (continued)

Immunity:

Power line disturbance



7.0 COMPASS SAFE DISTANCE

TEST METHOD EN60945: 2002	REFERENCING PROCEDURE: CSD-01A
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TEST DETAILS

CUSTOMER	COBOLT II
TEST LIMIT	STANDARD COMPASS
MAX COMPASS DEFLECTION	
MAX DEVIATION (μT)	0.33°(0.09 μT)
MODE OF OPERATION	EUT UNPOWERED EUT POWERED EUT NORMALISED
EUT	AIS
EUT COMPASS SAFE DISTANCE	50MM
DATE OF TEST	3RD OCTOBER 2017
TEMPERATURE °C 19	% RH 50
ENGINEER(S)	NJC

RESULTS

EUT MODE	FRONT	REAR	LEFT	RIGHT	TOP	BOTTOM
OFF	5CM	5CM	5CM	5CM	5CM	5CM
ON	5CM	5CM	5CM	5CM	5CM	5CM
NORMALISED	5CM	5CM	5CM	5CM	5CM	5CM

Notes;

All distances rounded up to the nearest 5cm or 10cm.

The EUT was measured before after being normalized, it was normalised by placing it in a Helmholtz coil and applying a d.c. field of $1 \times 1000 / 4\pi$ A/m with a superimposed stabilizing a.c. field of 50 Hz of $18 \times 1000 / 4\pi$ A/m r.m.s.

TEST ENGINEER: Neil Constance

7.1 Compass Safe Distance - Photo Log

Compass Safe Distance Test Set-ups



Photo Log (continued)

Compass Safe Distance Test Set-ups (continued)



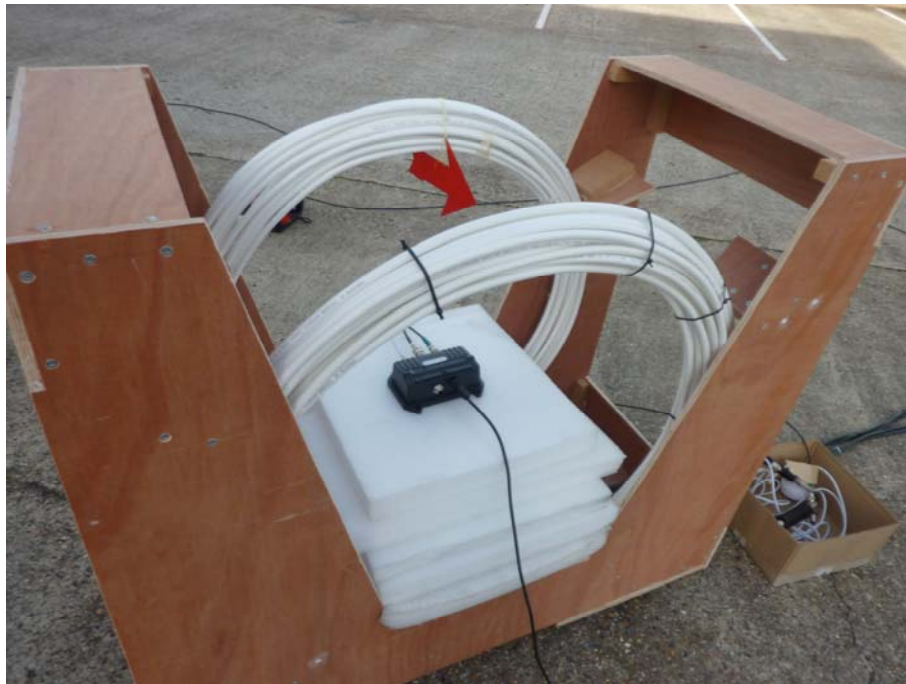
Photo Log (continued)

Compass Safe Distance Test Set-ups (continued)



Photo Log (continued)

Compass Safe Distance Pre-conditioning Set-ups (continued)



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