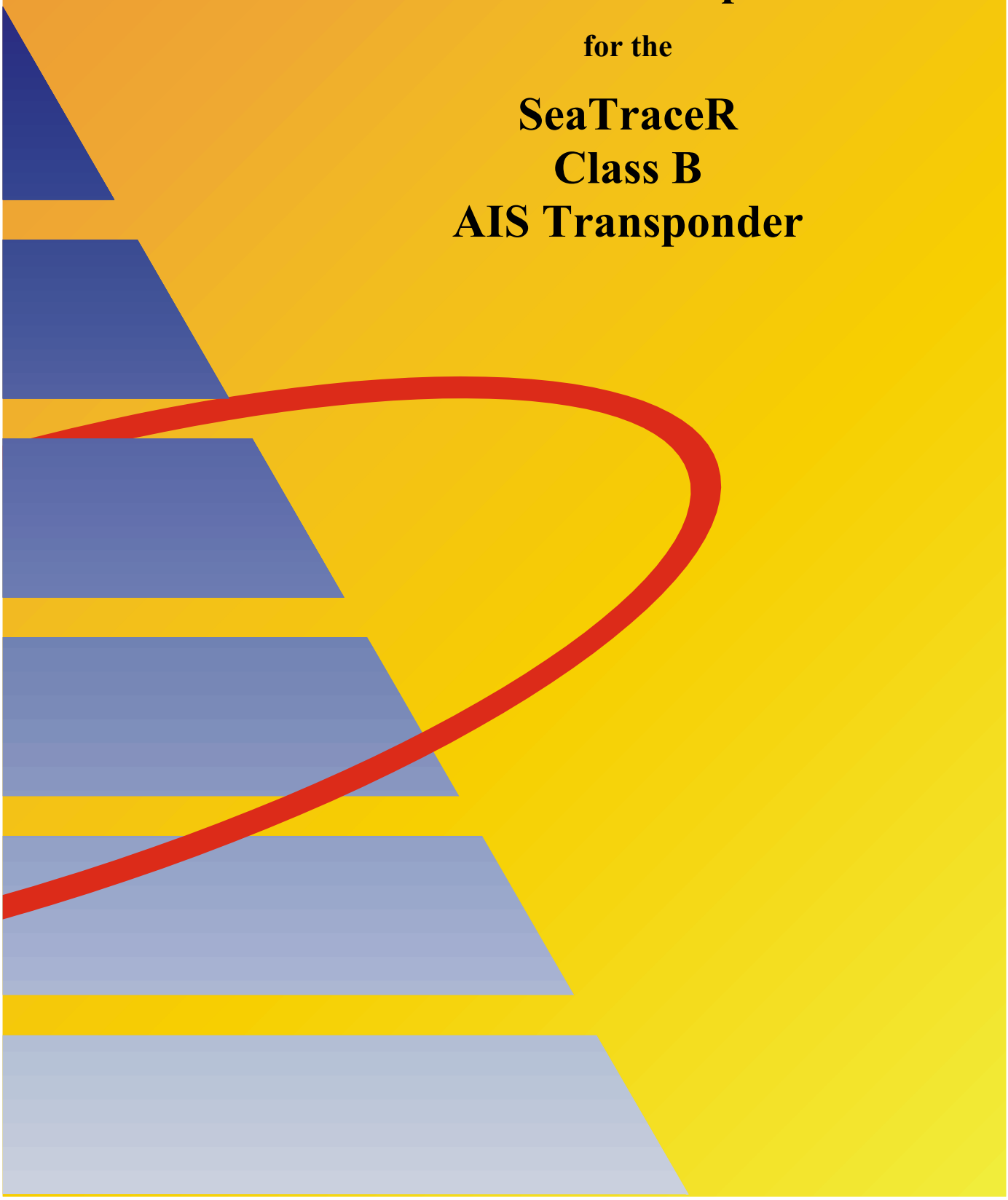
Appendix 7 - EMC Test Report

EMC Test Report

for the

SeaTraceR
Class B
AIS Transponder



EMC Test Report

for the

SeaTraceR
Class B
AIS Transponder

Project Engineer: R. P. St John James

Approval Signatory

Approved signatories: S. M. Connolly ☑ I. P. Kenney ☐ J. A. Jones ☐

The above named are authorised Hursley EMC Services engineers.

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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

None to samples 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 samples tested and may not represent the entire population.

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 was also tested to the ETSI EN 301 843-1 test standard for marine radio equipment and services.

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

Description	General Standard	Referenced Standard
Radiated disturbance	EN 60945:2002 † & ETSI EN 301 843-1:2004 †	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:

Description	General Standard	Referenced Standard
Electrostatic discharge	EN 60945:2002 † & ETSI EN 301 843-1:2004 †	IEC 61000-4-2:1995
Radiated RF interference		IEC 61000-4-3:1995
Fast transient bursts		IEC 61000-4-4:1995
Conducted RF Interference		IEC 61000-4-6:1996
Power interrupts		IEC 61000-4-11:1994

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

† The 2004 version of ETSI EN 301 843-1 and the 2002 version of EN 60945 are not currently included in the UKAS Accreditation Schedule for Hursley EMC Services but the reference standards are included in the schedule.

2.2 Test Deviations

None.

2.3 EMC Test Lab Reference

Hursley EMC Services file: 06R487.

3.0 EQUIPMENT & TEST DETAILS

3.1 General

EUT:	Class B Automatic Identification System (AIS) Transponder Make: SevenStar Electronics Limited Model: SeaTraceR, s/n 1001
EUT build level:	Production sample
EUT manufacturer:	SevenStar Electronics Limited
Customer:	Mr Colin R Watts SevenStar Electronics Limited 7 Richards Close Wootton Bassett Wiltshire SN4 7LE United Kingdom Tel: +44 (0) 1793 852829
Test commissioned by:	Mr Colin R Watts
Date EUT received:	7th December 2006
Test date(s):	7th – 11th December 2006
EMC measurement site(s):	Hursley EMC Services Limited • Unit 16, Brickfield Lane, Chandlers Ford, Hampshire • Hursley Park, Winchester, Hampshire

3.2 EUT Description

The EUT is an AIS Transponder for maritime use. The AIS Transponder transmits and receives position, bearing and other key data from surrounding shipping fitted with a similar AIS Transponder. The AIS Transponder is also fitted with a GPS receiver to give its own position. The AIS data is transposed into electronic nautical charts to provide key information on surrounding shipping.

3.3 EUT Support

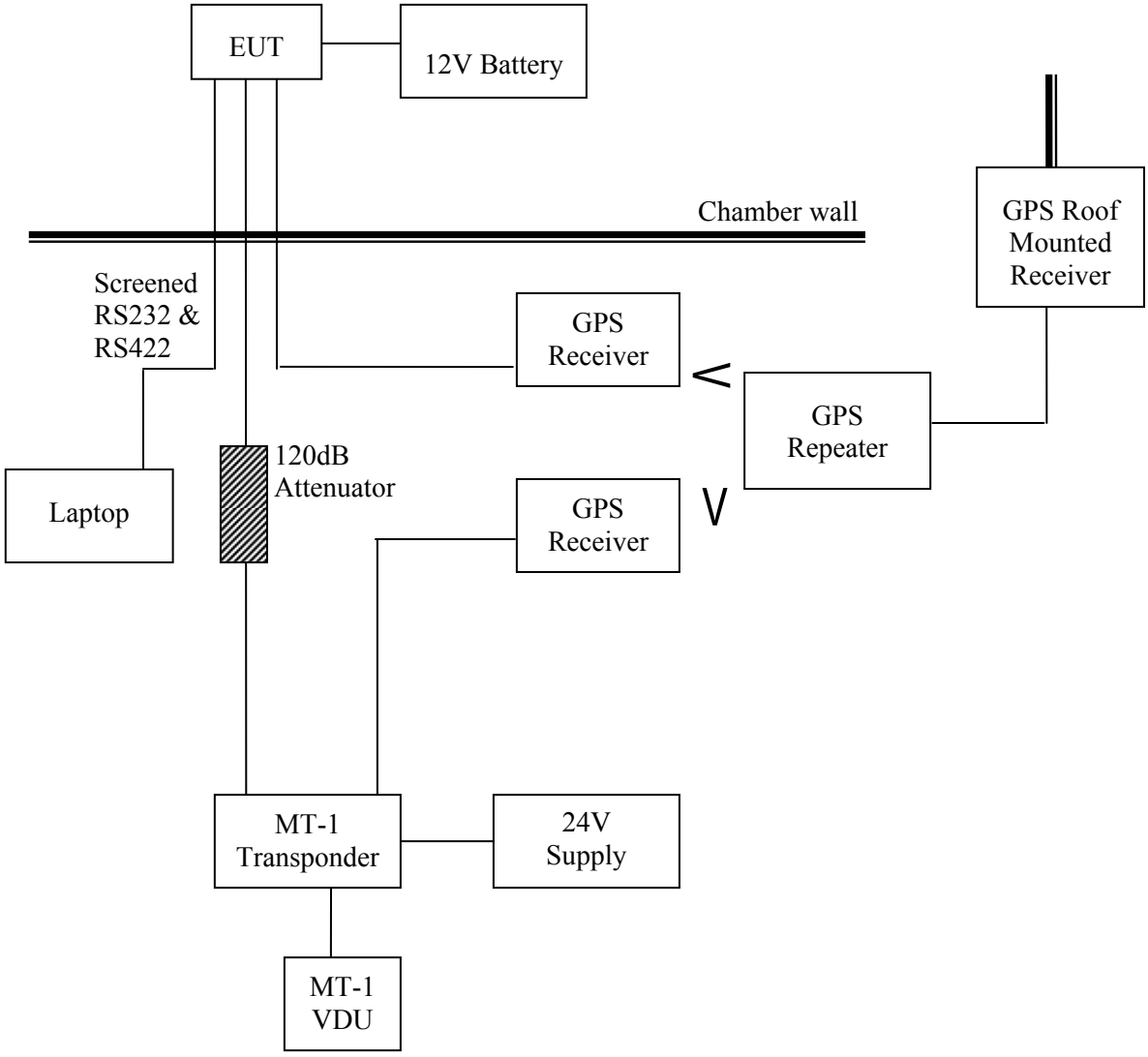
- 12V lead acid battery
- GPS antenna SM-66, s/n 7094123
- 24V power supply EHQ Model PS3003L, s/n 10001
- McMurdo MT-1 Display (VDU) , s/n 89072013
- McMurdo MT-1 Class A Transponder, s/n 89072013
- HP Vectra PC, s/n NL20522944
- 120dB attenuator
- HEMCS GPS receiver
- Universal Mouse K19353, s/n A0410003849
- IBM Keyboard 7953, s/n 0192087
- HP LCD Display, LP2065, s/n CNG63303T1
- Data communication USB to Serial Interface, s/n VT130200
- ACE Technology GA-1575N GPS Antenna, s/n 04000251

3.4 EUT Test Exerciser

The hp PC continuously monitored the activity of the Class B AIS Transponder over the RS232 and RS422 interface. Once every 180 seconds the message changed to indicate a transmission had occurred. The McMurdo MT-1 VDU displayed a message had been received from the Class B AIS Transponder and displayed a counter in seconds for the time to the next message; the count between each message was 180 seconds.

The RS232 or RS422 activity was recorded in a Tera Term Windows on the hp Laptop. Both the Tera Term Windows and the MT-1 VDU were monitored for data interruption or unintended transmissions.

3.5 EUT Test Configuration



Note: Cables connecting to the EUT were 20m long.
A screened RS232/422 cable was used for all testing.

3.6 Environmental Test Conditions

Temperature	20-22º Celsius
Relative Humidity	38-47%
Atmospheric Pressure	988-1001 millibars

3.7 EMC Test Equipment

#ID	Manufacturer	Type	Serial Nø	Description	Calibration status
004	Rohde Schwarz	ESH-3	893607/002	Test receiver 9kHz-30MHz	Calibrated
006	HP	8568B	2841A04350	Spectrum analyser	Calibrated
013	Chase	CB/6121A	1012 yel	Bilog antenna	Internal
014	Rohde Schwarz	HL223*	831465-005	ARP958 1m + F/space	Calibrated
030	KeyTek	MZ-15/EC	9205380	ESD Minizap /pink	Calibrated
072	Chase	CBL6112	2005(Green)	Bilog antenna 30-1000MHz	Calibrated
099	HP	8596-EM	3911A00146	12.8GHz Spectrum analyser	Calibrated
102	Amp research	AT4002A	---	0.8-5GHz horn	Internal
115	KeyTek	CE Master	9703374	Immunity simulator	Calibrated
116	Rohde Schwarz	ESH-3 Z2	M458	Pulse Limiter BNC type	Calibrated
118	KeyTek	Pro CCL	9711291	Capacitive clamp	Internal
120	Kalmus	7250LC-CE	8672-1	RF Power amp & pulse opt.	Internal
121	EM	CWS500A	0898-02	Conducted immunity simulator	Calibrated
122	Sucoflex	106	25156/6	Cable 18GHz SMA	Calibrated
125	Rohde Schwarz	SMHU	---	Signal generator 0.1-4230MHz	Internal
126	Schaffner	NSG1007	55090	5KW Power Source	Calibrated
129	Rohde Schwarz	HK116*	835291/001	ARP958 1m + F/space	Calibrated
135	Bird	100AMFN06	9639	100W 6dB attenuator (ref 121)	Calibrated
139	Rohde Schwarz	ESVP	861743/015	Test receiver (30-1300MHz)	Calibrated
145	Bird	4421/4022	4624/0103	Power meter & probe (145a)	Calibrated
147	Rohde Schwarz	ESH3 Z5	846695/011	AMN - single phase	Calibrated
152	Fischer	801-M2-16	9867	CDN 2xwire	Calibrated
170	Fischer	FCC150-50	336	100Ω adapter	Calibrated
187	Fischer	F-203I-23	379	EM Injectn Clamp 10k-1GHz	Calibrated
190	Milmega	AS0840	---	1-4GHz RF amplifier	Internal
202a	Diamond Antenna	DL-30N	---	50Ω 15W DC-500MHz terminator	Calibrated
219	DARE	RadiSense	IV	4GHz RF field probe	Calibrated

Note: 'Calibration status' means that the instrument is certified with a UKAS or traceable calibration certificate. 'Internal' denotes regular internal calibration against HEMCS procedures.

4.0 EMISSION RESULTS

4.1 Radiated Disturbance

4.1.1 Data, 30-156MHz & 165-2000MHz

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. Tests were carried out with the transmitter ready to transmit but not transmitting.

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
123.120	24.8	54	Pass
135.970	31.8	54	Pass
147.458	30.5	54	Pass
172.032	31.0	54	Pass
196.608	35.3	54	Pass
393.158	30.3	54	Pass

Uncertainty of measurement: +/-3.7dBµV 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: Rob St John James

4.1.2 Data, 156 - 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 measured with a 9kHz quasi-peak detector, are presented here.

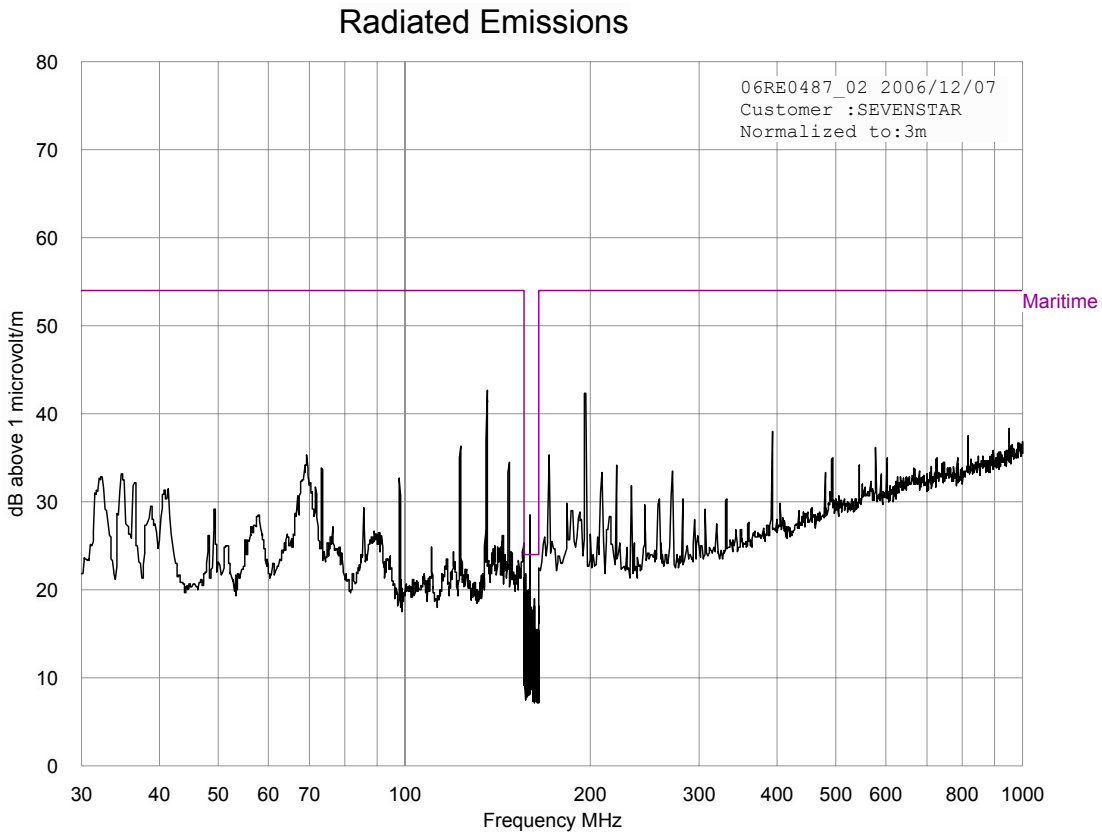
Emission frequency (MHz)	Measured quasi-peak value (dBµV/m)	Specified quasi-peak limit (dBµV/m)	Status
159.743	12.3	24	Pass

Uncertainty of measurement: +/-3.7dBµV 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: Rob St John James

4.1.3 Radiated Emission Plot, 30MHz – 1GHz



4.1.4 Radiated H-Field, 150kHz – 30MHz

4.1.5 Data

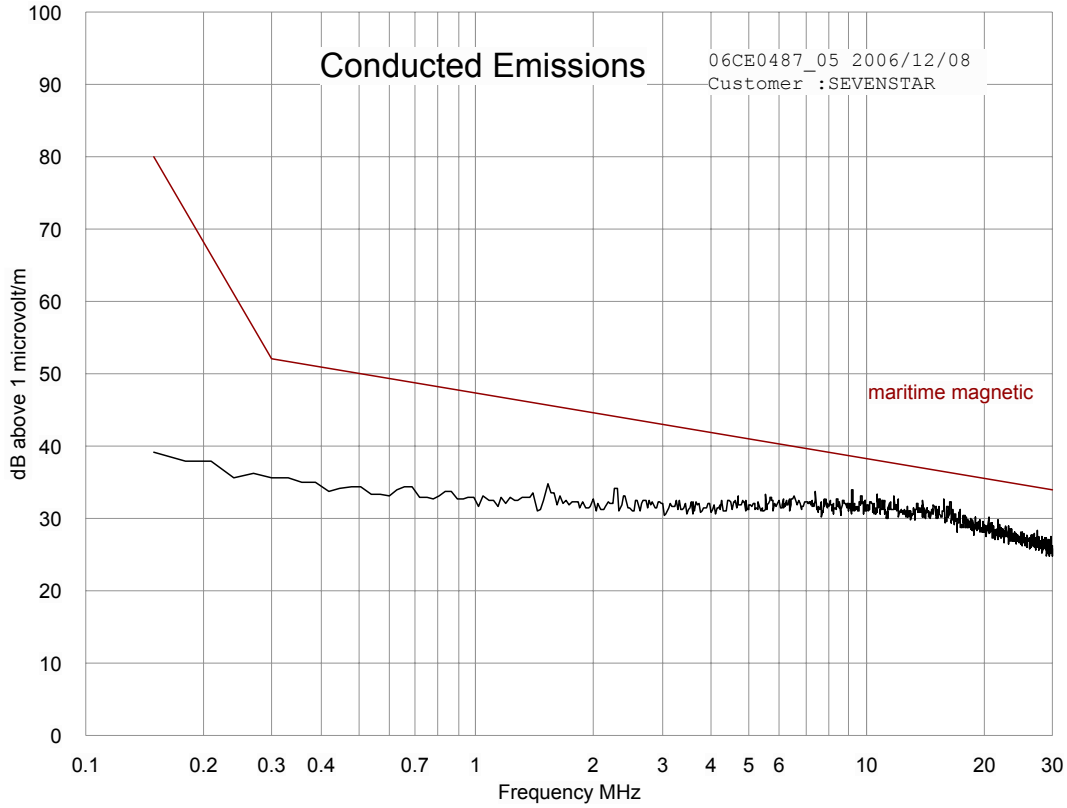
A profile scan was taken at a distance of three metres with a 360^{o} azimuth scan of the EUT in a semi-anechoic chamber. The tests were repeated for three orientations of the loop antenna.

In this case, no emissions were detected above the noise floor of the measuring system, a typical emissions profile is shown on the next page.

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: Rob St John James

4.1.6 Profile


Conducted Emissions
06CE0487_05 2006/12/08
Customer :SEVENSTAR
maritime magnetic
dB above 1 microvolt/m
Frequency MHz
100
90
80
70
60
50
40
30
20
10
0
0.1
0.2
0.3
0.4
0.7
1
2
3
4
5
6
10
20
30

4.2 Conducted Disturbance

4.2.1 Data

A filtered 12V DC 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. Measurements made according the EN 60945 test standard and Hursley EMC Services test procedure CON-02. The worst-case results are shown here.

0V DC

Frequency (MHz)	Quasi-peak value (dBµV)		Status
	Measured	Limit	
0.904	43.9	50.0	Pass
1.805	41.3	50.0	Pass

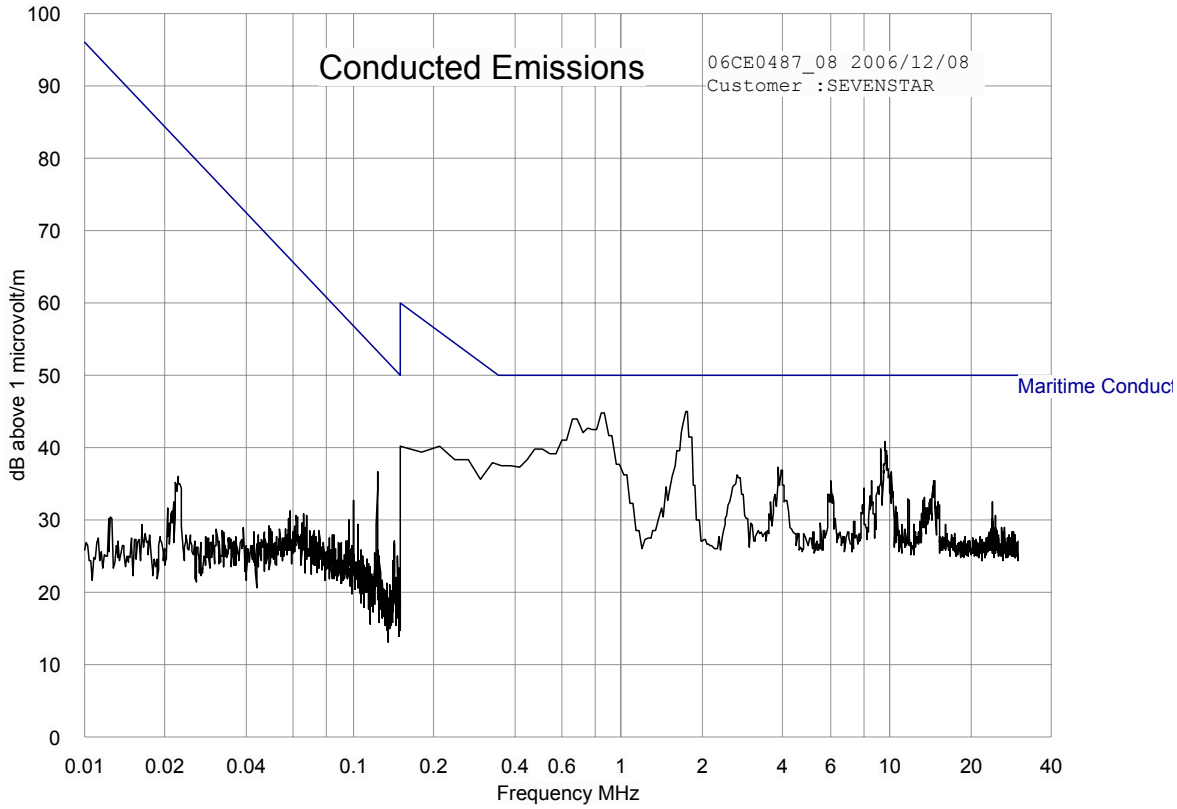
12V

Frequency (MHz)	Quasi-peak value (dBµV)		Status
	Measured	Limit	
0.307	44.4	51.5	Pass

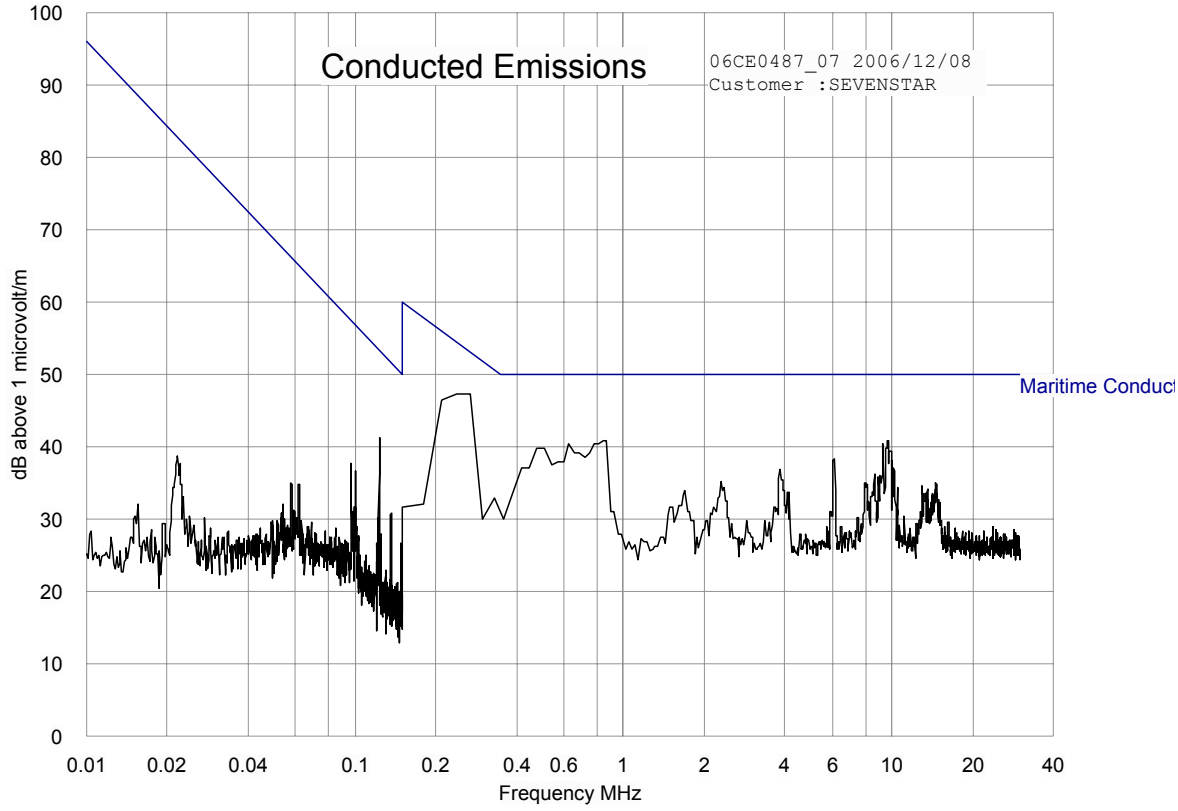
Uncertainty of measurement: +/-3.22dBµV for a 95% confidence level.

TEST ENGINEER: Rob St John James

4.2.2 Profile (0V)



4.2.3 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.

5.2 Electrostatic Discharge

TEST METHOD	EN 61000-4-2 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 3.4
Specified test criterion	Criterion 'B'
EUT performance criterion	Criterion 'B'

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	See test points on next page	PASS
± 4.0kV		PASS
± 6.0kV		PASS

Air Discharge (Insulating, Slots & Apertures)

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

UNCERTAINTY: It has been demonstrated that the ESD simulator met the specified requirements in the standard with at least a 95% confidence.

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

TEST ENGINEER: Rob St John James

5.2.1 Electrostatic discharge – Test points

Arrows indicate Discharge points

Contact Discharge
Air Discharge

5.3 Radiated RF Interference

TEST METHOD	EN 61000-4-3 REFERENCING PROCEDURE: RES-02

TEST DETAILS

Test severity levels, 80-2000MHz swept frequency	• **10.0V/m** • **80% amplitude modulation 400Hz** • **1% increment, 3 seconds dwell time and 9 seconds dwell time from 1GHz**
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**	**10.0V/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 field level has been applied at level higher than that specified to give a greater confidence that the EUT meets the specified level.

COMMENT: The exclusion band was +/-5% of the GSM frequency (1570MHz) and +/-5% of the AIS frequency band (156.025 to 162.025MHz). In test no exclusion bands was used for the AIS frequency but a 50MHz exclusion band (1550 to 1600MHz) was applied to the GSM receiver because of interference during testing. At the beginning of the test the GPS signal was lost, the unscreened RS232 cable was replaced with a screened RS232 cable and the problem was resolved. The screened RS232 cable was used for all other tests. The EUT met the specified test criterion.

TEST ENGINEER: Rob St John James

5.4 Fast Transient Bursts

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

TEST DETAILS

Test severity	• **+/- 1.0kV Signal Port** • **+/- 1.0kV DC Port** **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

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 leads & RS232/422	**+1.0kV**	**PASS**
Antenna coax leads & RS232/422	**- 1.0kV**	**PASS**

UNCERTAINTY: It has been demonstrated that the transient simulator met the specified requirements in the standard with at least a 95% confidence.

COMMENT: The EUT met the specified test criterion.

TEST ENGINEER: Rob St John James

5.5 Conducted RF Field

TEST METHOD	EN 61000-4-6 REFERENCING PROCEDURE: CES-02

TEST DETAILS

Test severity level	• **3.0V rms, 80% amplitude modulation 400Hz 0.15 to 80MHz** • **10V rms spot frequencies at: 2, 3, 4, 6.2, 8.2, 12.2, 12.6, 16.5, 18.8, 22, 25MHz, 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 Port**	**CDN**	**PASS**

RESULTS – Signal Port

TEST VOLTAGE	TEST POINTS	COUPLING METHOD	STATUS
3.0V & 10.0V	**Coax ports**	**100 ohm resistor to screen**	**PASS**
3.0V & 10.0V	**RS232/422**	**100 ohm resistor to screen**	**PASS**

UNCERTAINTY: It has been demonstrated that the conducted immunity simulator met the specified requirements in the standard with at least a 95% confidence.

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

TEST ENGINEER: Rob St John James

5.6 Power Line Disturbance

TEST METHOD	**EN/IEC 61000-4-11** **REFERENCING PROCEDURE: PLD-01**

TEST DETAILS

Test severity level	**Interrupt >95% for 60s**
Exerciser program during test	**Referencing section 3.4**
Specified test criterion for –100% x 60s	**Criterion 'B'**
EUT performance criterion	**Criterion 'B'**

RESULTS – RF COMMON MODE

TEST POINTS	LEVEL	STATUS
12V DC input	**-100% x 60s**	**PASS**

UNCERTAINTY: It has been demonstrated that the power line disturbance simulator met the specified requirements in the standard with at least a 95% confidence.

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

TEST ENGINEER: Rob St John James

6.0 PHOTO LOG

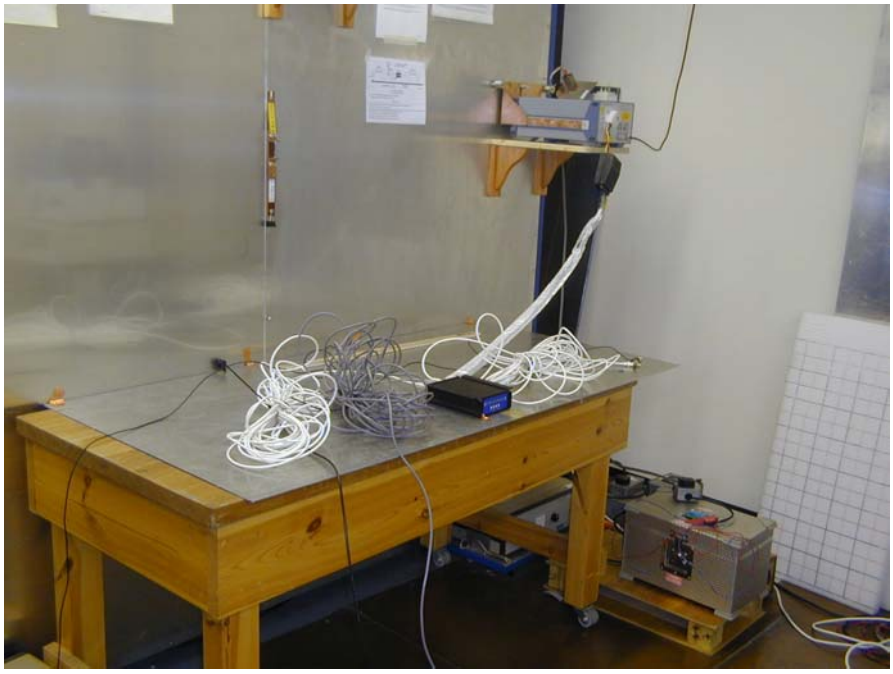
6.1 Typical Emission Setup

Radiated disturbance

Photo Log (continued)

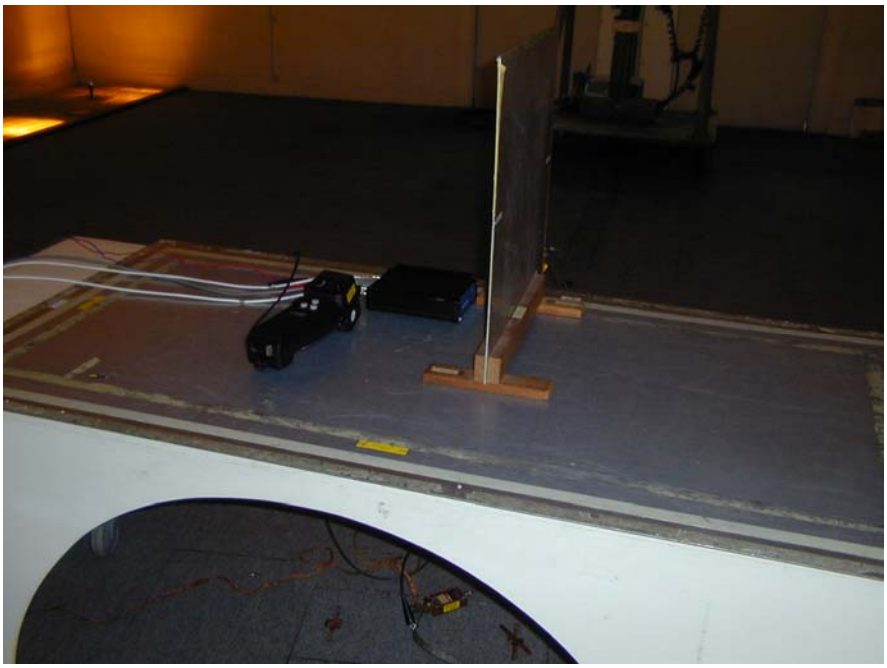
Typical emission set-up

Conducted disturbance



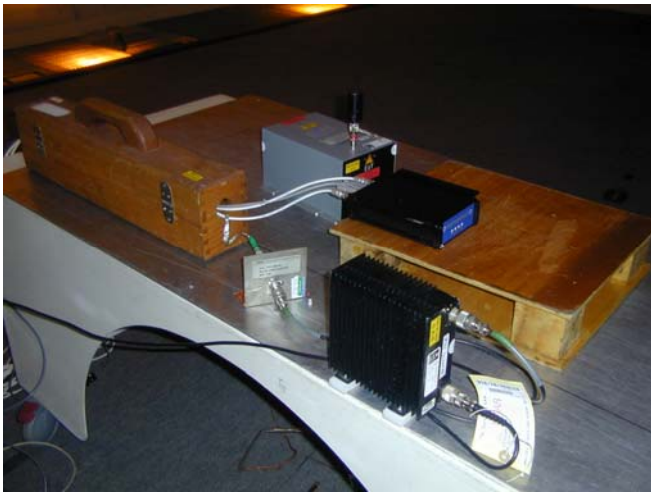
6.2 Typical Immunity Setup

Electrostatic discharge

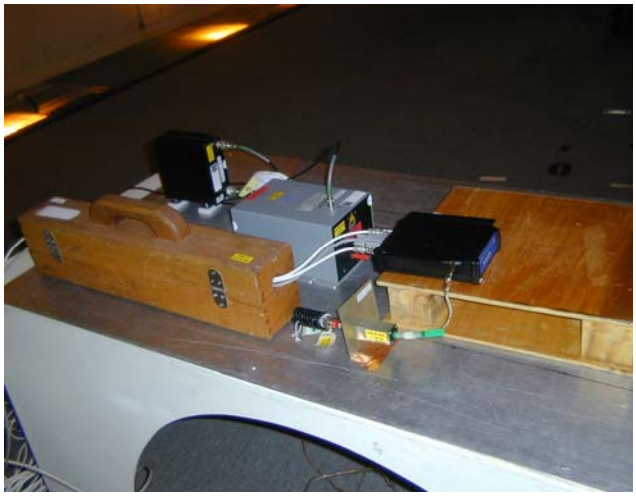


Typical immunity set-up (continued)

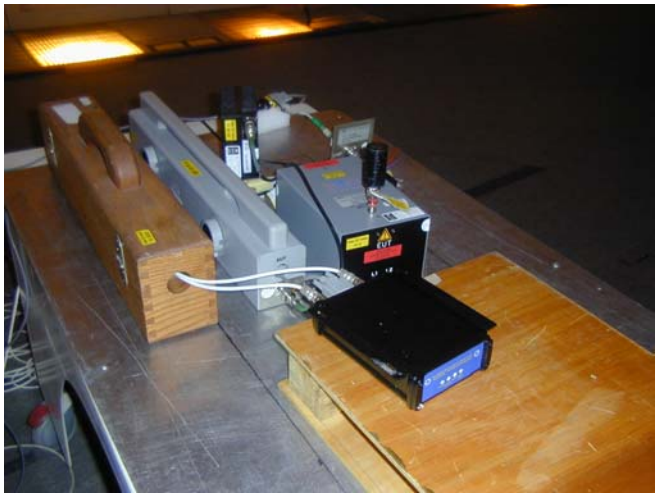
Conducted RF field



Coax



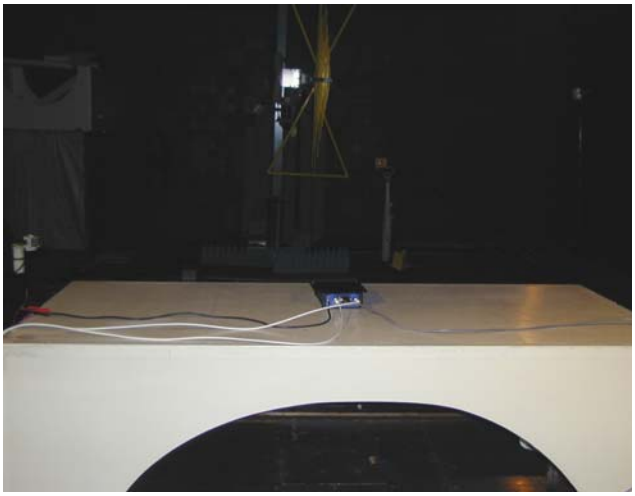
DC

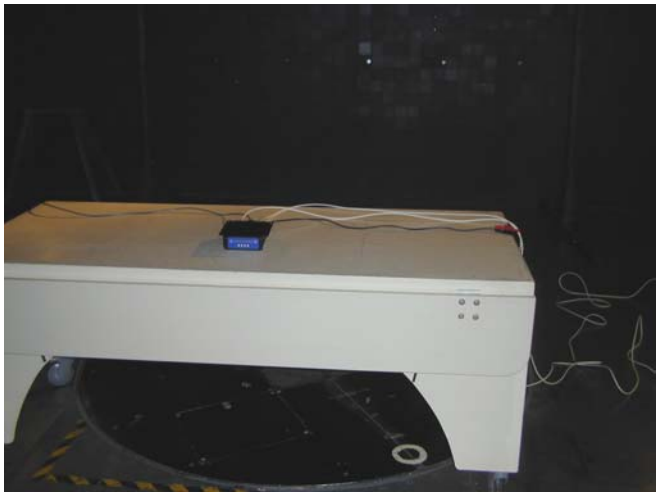


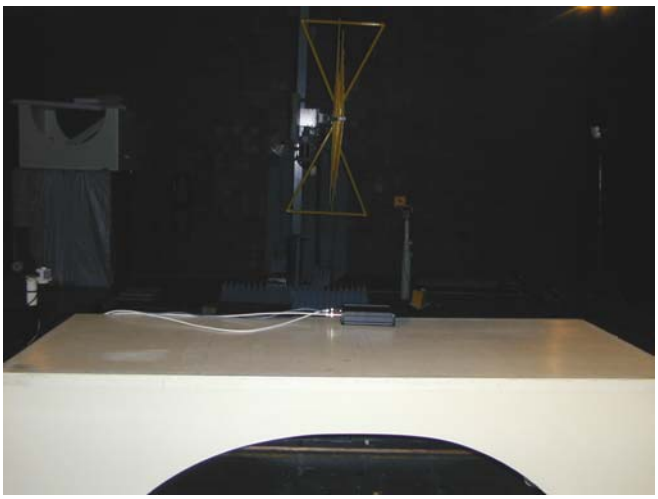
RS232

Typical immunity set-up (continued)

Radiated interference



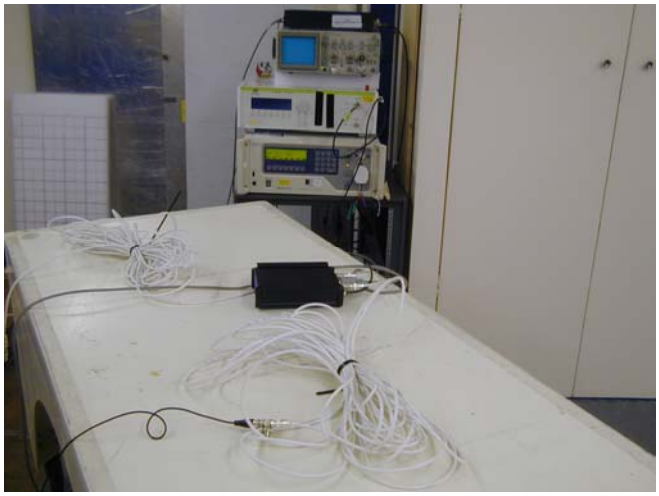




Typical immunity set-up (continued)

Fast transient bursts

RS232



DC

Coax