

EMC TEST REPORT



PRODUCT: NAIS300 Class B AIS Transponder
Serial No: PP001
Tested by: David Sheekey

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Date: 15/12/07
Test Report: EMC055

Introduction:

This test report contains all of the relevant documented information following testing carried out on the NAIS300 Class B AIS transponder, in accordance with IEC60945, Fourth Edition 2002-08, Clause 1, Section C – for EMC only.

The Equipment under test (EUT) comprised of the NAIS300 in standalone mode. In all tests the NAIS300 power supply was provided from a 12VDC. Lead acid battery. The NAIS300 was fed with AIS data via a VHF antenna during all tests. GPS position was provided from a GPS simulator through a simple antenna coupling arrangement.

In all cases the units have been tested to the specifications listed in IEC60945 and comments on the relative performance are detailed in the results. All testing was carried out on the premises of Navico UK Ltd, within the R&D department. All tests were carried out between 29th November and 7th December 2007.

Note that this EMC report covers the complete transponder/display unit, including the OEM supplied PCB, and previously tested under report number 06R329CR by Hursley EMC Services.

Report prepared by:..... **Date:**.....

Report checked by:..... **Date:**.....

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Part A: Unwanted Electromagnetic Emissions

(Section 9 - EN60945 Edition 4)

A.1: Conducted Emissions

A.1.1: Test Method

Testing was carried out in accordance with IEC60945, clause 9.2.

The EUT was set-up on the ground plane inside the anechoic chamber and connected to the LISN via the supplied length of cable, Power was provided by a 12VDC Lead Acid Battery. Excess cable was laid across the groundplane. Additional cables for serial data and the Simrad network, 'SimNet', were bundled adjacent to the EUT. The VHF and GPS antennas were connected, but placed outside the chamber.

The test layout is shown on page 11, figure A.1.1. Testing was carried out in the normal mode of operation, with the transmitter enabled.

With the EMI receiver and software control PC outside the chamber an initial measurement scan was carried out to determine the ambient signal level with the EUT disconnected. A measurement scan was then carried out on the EUT set up as described and the results recorded. Quasi-peak measurements were then made at the identified frequencies.

Equipment Used:

PC - Running Esxs k1 software (Nav 1232)
LISN (Nav 282)
ESHS10 EMI Test Receiver (Nav 283)
10dB Transient Limiter (TJ0133)
2m BNC to BNC Lead (TJ9136)
2m BNC to BNC Lead (TJ9137)
Anechoic Chamber (Nav 1307)
Lead Acid Battery

A.1.2: Results

Figures A.1.2 to A.1.4, pages 11 to12, show the measurement scans within the frequency range 10kHz to 30MHz. All levels are within the limits specified in IEC60945.

The EUT complies with the requirements of IEC60945, Clause 9.2 for Conducted Emissions.

A.2: Radiated emissions from enclosure port.

A.2.1: Test Method

Testing was carried out in accordance with IEC60945, clause 9.3, covering the frequency range 150KHz to 2GHz.

For measurements in the band 150KHz to 30MHz a magnetic loop antenna was used in conjunction with a R&S ESHS10 EMI Test Receiver, running under PC control. A correction factor of +51.5dB was included within the transducer factor of the magnetic loop antenna to convert the magnetic field strength to an equivalent electric field strength.

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For measurements in the band 30KHz to 1GHz a bi-log antenna was used in conjunction with a R&S ESVS10 EMI Test Receiver, running under PC control.

For measurements in the band 1GHz to 2GHz a horn antenna was used in conjunction with a R&S FPS30 Spectrum Analyser.

All measurements were carried out at a range of 3m, between the EUT and receive antenna.

The EUT was set-up at a height of 0.8m inside the anechoic chamber. Power was provided by a 12VDC battery connected via the supplied lengths of cable. During the testing the EUT was connected to an external VHF and GPS antenna. Interface cables were bundled and arranged on the table. The relative position of these cables to the EUT was maintained during the test.

The test layout is shown on page 13, figure A.2.1.

Scans were carried out for each face of the EUT so as to establish the worst case configuration. These were repeated with the receiving antenna both horizontally and vertically polarised for measurements in the Band 30MHz to 2GHz

Equipment Used:

PC - Running Esxs k1 software (Nav 1232)
ESVS10 EMI Test Receiver (Nav 284)
ESHS10 EMI Test Receiver (Nav 283)
R&S FSP30 Spectrum Analyser (Nav 2043)
R&S HF906 1-18GHz Horn Antenna (Nav 2045)
Chase Loop Antenna (Nav 1338)
Chase Battery Pack (Nav 1339)
Anechoic Chamber (Nav 1307)
Log Periodic Antenna (Nav 895)
3m N type cable (TJ0294)
10m N type cable (TJ0295)

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A.2.2: Results

All recorded measurement scans within the frequency range 150kHz to 30MHz, 30MHz to 1 GHz and 1GHz to 2GHz are shown on pages 13 to18, figures A.2.2 to A.2.12.
All measured levels were found to be within the limits specified in EN60945.

The EUT complies with the requirements of IEC60945, Clause 9.3, radiated emissions from enclosure port.

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Part B: Immunity to Electromagnetic Environment (Section 10 - EN60945 Document)

B.1: Immunity to conducted radio frequency interference.

B.1.1: Test Method

Testing was carried out in accordance with section 10.3 - EN60945 document.

The EUT was set-up on an insulating support 0.1m above a reference ground plane. Power was provided by a 12VDC battery connected via the supplied lengths of cable. Power line

The RS232 connection of the interface cable was connected to a PC and the NMEA output monitored for spurious data during the tests. In both case no adverse affects were noted.

The induced interference was swept over the range 10kHz to 80MHz at a level of 3Vrms, and at spot frequencies of 2MHz, 3MHz, 4MHz, 6.2MHz, 8.2MHz, 12.6MHz, 18.8MHz, 22MHz and 25MHz, at a level of 10Vrms, manually adjusted.

The test layout is shown on page 19, figure B.1.1.

Equipment Used:

IFR Signal Generator (Nav 1309)
Rohde & Schwarz FSEA Spectrum Analyser (Nav 1308)
Current Injection Clamp (Nav 1331)
IFR SMX 100 RF Amplifier (Nav 1401)
Coaxial Cable: (TJ0248)
PC Running Chase immunity software

B.1.2: Results

All recorded measurement scans for the tests are shown on pages 19 to 23, figures B.1.2 to B.1.19. Both during and after the above tests the EUT remained in a stable state and operated as intended, thus conforming to the required performance criterion A.

The unit complies with the requirements of EN60945, clause 10.3, immunity to conducted radio frequency interference.

B.2: Immunity to radiated radio frequencies.

B.2.1: Test Method

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Testing was carried out in accordance with section 10.4 - EN60945 document.

All measurements were carried out at a range of 3m, between the EUT and generating antenna.

The EUT was set-up at a height of 0.8m inside the anechoic chamber. Power was provided by a 12VDC battery connected using the supplied power lead. The unit was connected to an external VHF and GPS antenna. The indicator LEDs were monitored by a camera installed in the chamber and connected to an external monitor via fibre optic cable. The NMEA serial data was also monitored for anomalies on a PC mounted outside the chamber.

The test layout is shown in figure B.2.1.

The EUT was subject to interference radio frequencies with a field strength of 10v/m, swept over the range 80MHz to 2 GHz, with a modulation of 400Hz and 80% depth. Scans were carried out for each face of the EUT so as to establish the worst case configuration. These were repeated with the generating antenna both horizontally and vertically polarised.

Equipment Used:

PC Running Chase immunity software
IFR SMX 100w RF Amplifier (Nav 1401)
IFR S42-50 0.8 – 4.2GHz Amplifier
IFR Signal Generator (Nav 1309)
Chauvin Arnoux CA 43 Field meter (NAV1334)
Log Periodic Antenna (Nav 895)
R&S HF906 1-18GHz Horn Antenna (Nav 2045)
Anechoic Chamber (Nav 1307)
1m N type cable (TJ0293)
3m N type cable (TJ0294)
10m N type cable (TJ0295)

B.2.2: Results

All recorded measurement scans for radio tests are shown on pages 20-25, figures B.2.2 to B.2.5

Both during and after the above tests the EUT remained in a stable state and operated as intended, thus conforming to the required performance criterion A.

The unit complies with the requirements of EN60945, clause 10.4, immunity to radiated radio frequencies.

B.3: Immunity to fast transients on A.C power, signal and control lines.

B.3.1: Test Method

Testing was carried out on the control and signal lines only, in accordance with section 10.5 - EN60945 document.

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The EUT was set-up on an insulating support 0.1m above a reference ground plane. Power was provided by a 12VDC battery connected via the supplied lengths of cable.

This was repeated with both positive and negative transients with a time of 5 minutes for each test.

Before and after the test period, the unit was connected to a PC and the serial data monitored for correct operation

The layout of this test is shown on page 23, figure B.3.1.

Equipment Used:

Schaffner NSG 1025 Fast Transient / Burst Generator (Nav 278)
Schaffner CDN125 Coupling Clamp (Nav 277)
Schaffner SL402-3796dB Attenuator (Nav 902)

B.3.2: Results

Both during and after the above tests the EUT remained in a stable state and operated as intended with no degradation of performance, thus conforming to the required performance criterion B.

The unit complies with the requirements of EN60945, Clause 10.5, immunity to fast transients on A.C, power, signal and control lines.

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B.4: Immunity to surges on A.C power lines

Note: This test applies to A.C power ports only. The EUT is DC only and is therefore exempt from this test.

The unit is exempt from the requirements of EN60945, clause 10.6, immunity to surges on A.C power lines.

B.5: Immunity to power supply short - term variation

Note: This test applies to A.C power ports only. The EUT is DC only and is therefore exempt from this test.

The unit is exempt from the requirements of EN60945, clause 10.7, immunity to power supply short - term variation.

B.6: Immunity to power supply failure

B.6.1: Test Method

Testing was carried out in accordance with section 10.8 - EN60945 document. The EUT was initially connected to the 12 VDC battery, a supply interruption was then made for a duration of 60 seconds. The power was then restored and the EUT checked for any degradation or loss of software / data.

This test was repeated with the EUT in various operating modes.

B.6.2: Results

No of loss of software or data was noted after each test. The EUT powered down when power was interrupted and reset to the normal power on state when power was restored after 60 seconds. The EUT fully complies with performance criterion C.

The unit complies with the requirements of EN60945, clause 10.8, immunity to power supply failure.

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B.7: Immunity to electrostatic discharge

B.7.1: Test Method

The test was carried out in accordance with section 10.9 - EN60945 document.

The EUT was set-up on, but insulated from, a reference ground plane. Power was provided by a 12VDC battery connected via the supplied lengths of cable.

During the tests the indicator LEDs was monitored for adverse affects and operation tested periodically during the testing to ensure that correct operation was maintained.

The ESD generator was held perpendicular to the EUT surface and the specified discharges applied to the points and surface which are accessible during normal use, and to points on the reference plane.

Both positive and negative air discharges, at 6KV, and contact discharges, at 8KV, were used, with a minimum of 10 discharges at each point. The positions of the test discharges are shown on page 24, figures B/4/1 and B.4.2. Discharges were applied to the reference ground plane at positions on each side of, and 0.1m from, the EUT.

Equipment Used:

Haefely ESD Tester (Nav 279)

B.10.2: Results

After the test period, the EUT was found to be unaffected by the ESD being applied, thus the EUT fully complies with performance criterion B of EN60945.

The unit complies with the requirements of EN60945, clause 10.9, immunity to electrostatic discharge.

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Annex A: Results of emission tests

A1. Results for conducted emissions

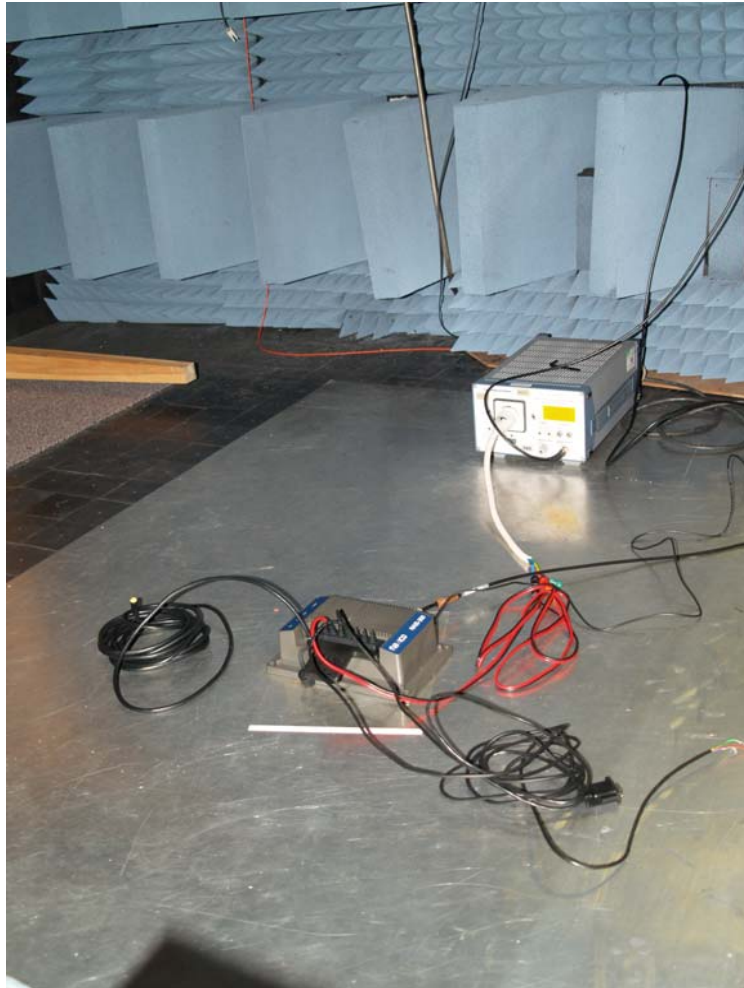


Figure A.1.1: Layout for conducted emissions

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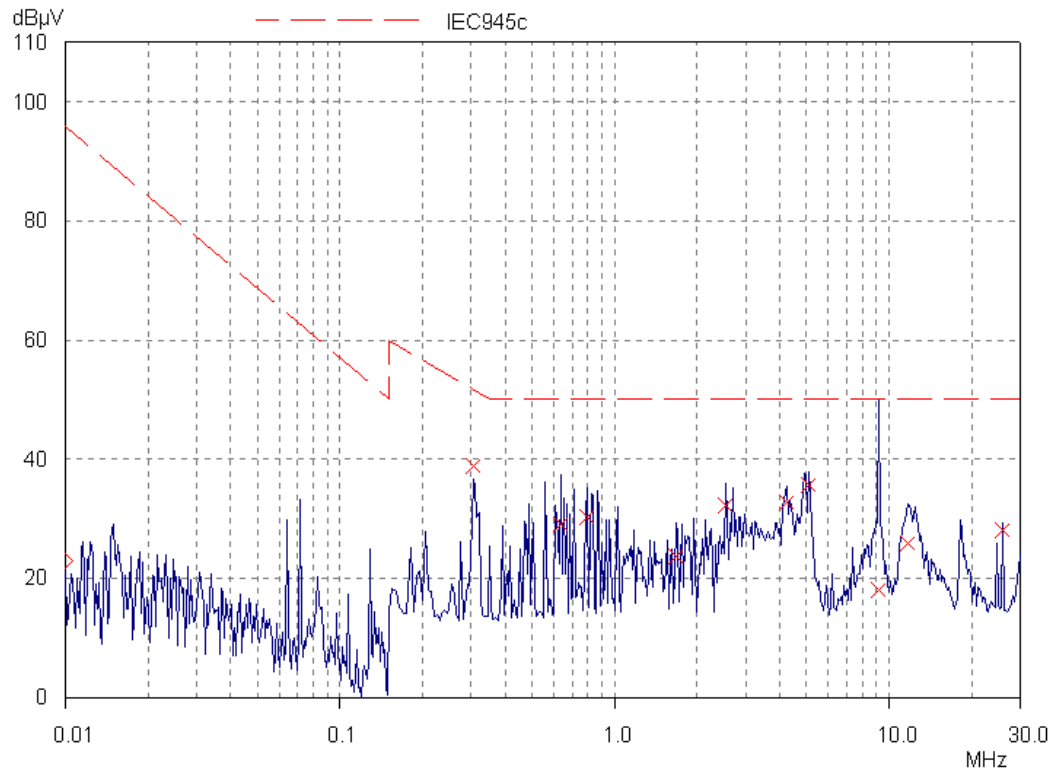


Figure A.1.2: Conducted emissions (150KHz to 30MHz), NAIS300 power lines (File: cond10.dat)

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A2. Results for radiated emissions

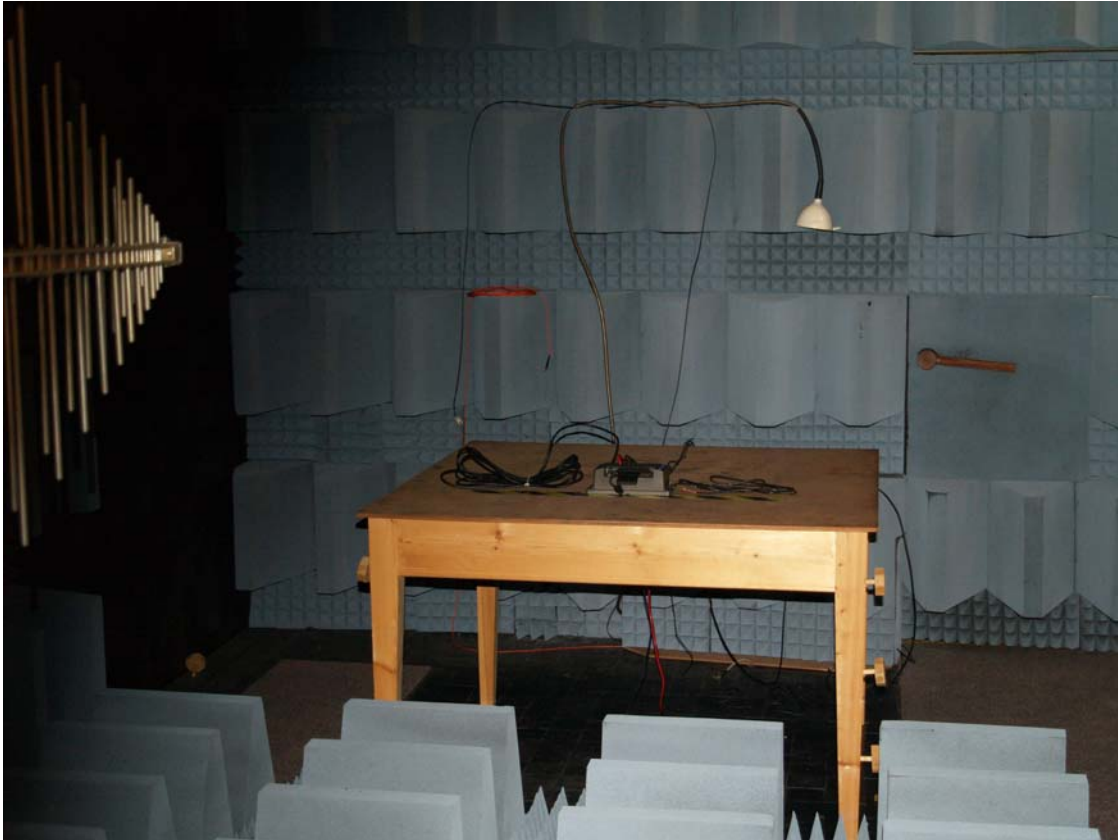


Figure A.2.1: Layout for radiated emissions in the band
(Showing horn used above 1GHz)

Radiated Emissions 150KHz to 30MHz

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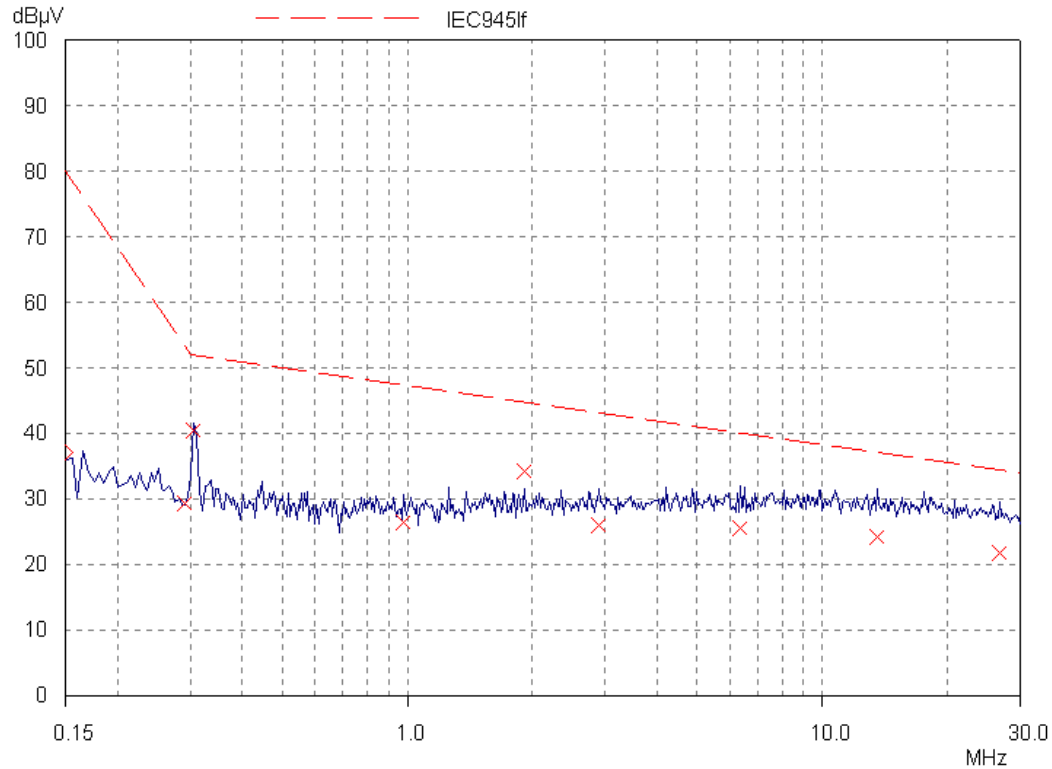


Figure A.2.2: Radiated emissions, front view (150KHz to 30MHz) (File: re_001.dat)

Radiated Emissions 30MHz to 1GHz
Vertical Polarisation

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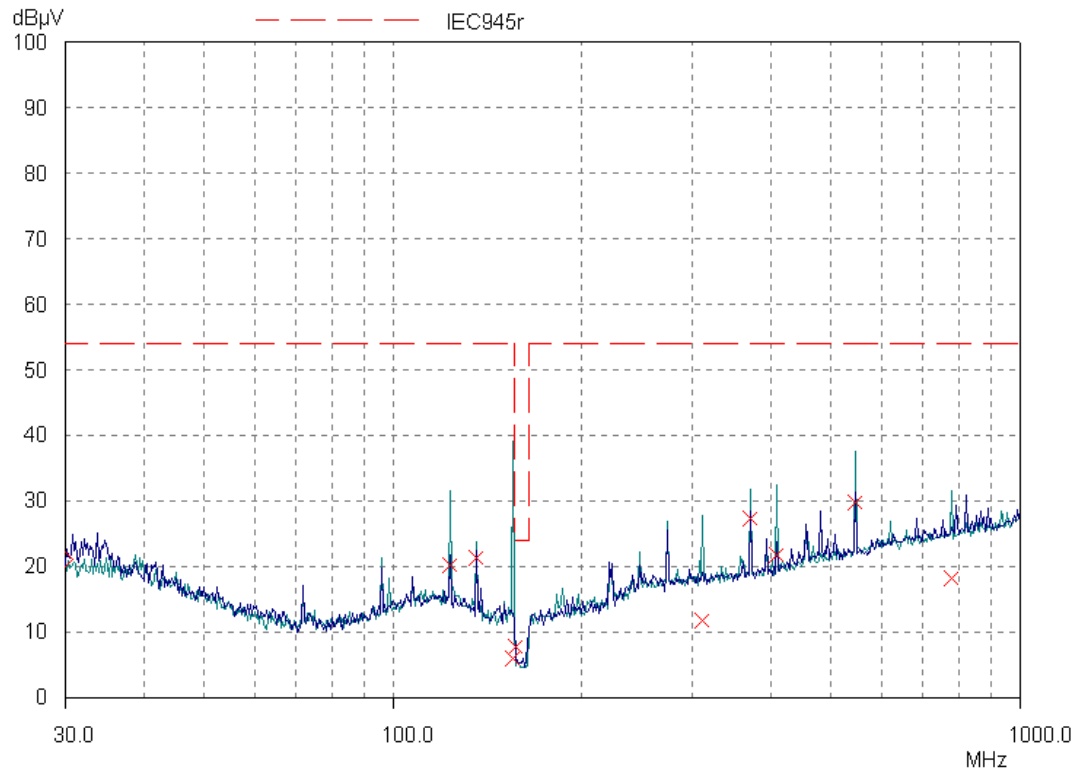


Figure A.2.3: Radiated emissions, front, vertical polarisation (30MHz to 1GHz) (File: RE_000.dat)

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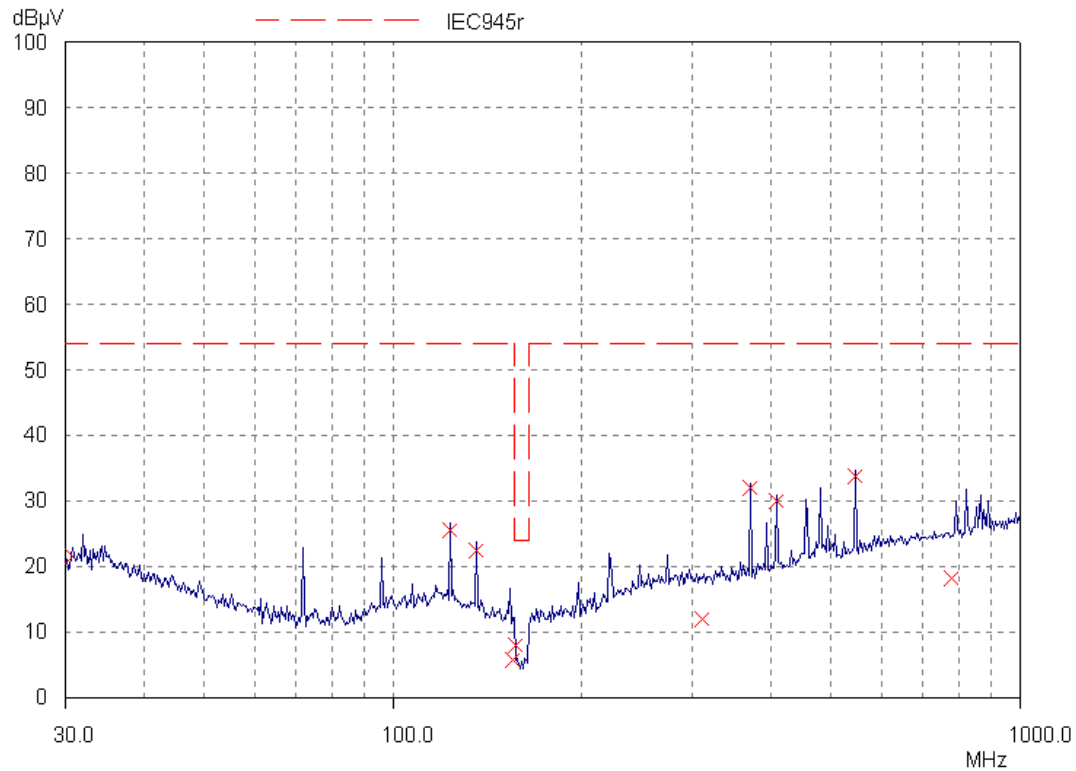


Figure A.2.4: Radiated emissions, Left side, vertical polarisation (30MHz to 1GHz)
(File: RE_001.dat)

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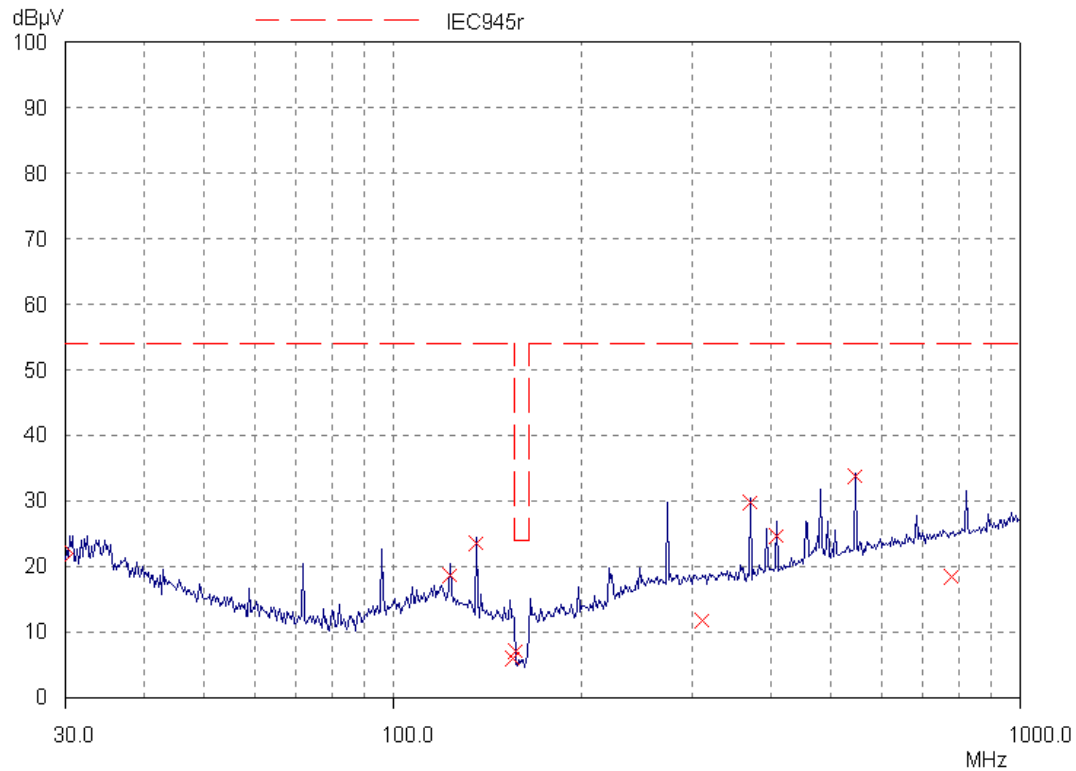


Figure A.2.5: Radiated emissions, rear, vertical polarisation (30MHz to 1GHz) (File: RE_002.dat)

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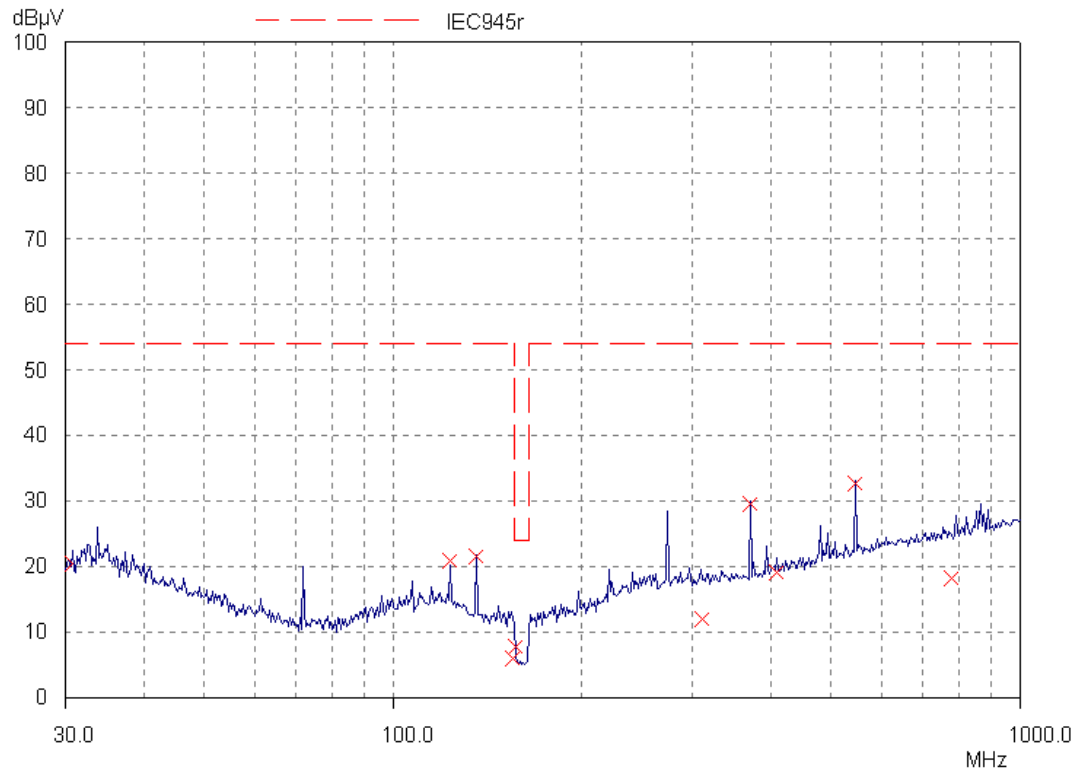


Figure A.2.6: Radiated emissions, right side, vertical polarisation (30MHz to 1GHz)
(File: RE_003.dat)

Horizontal Polarisation

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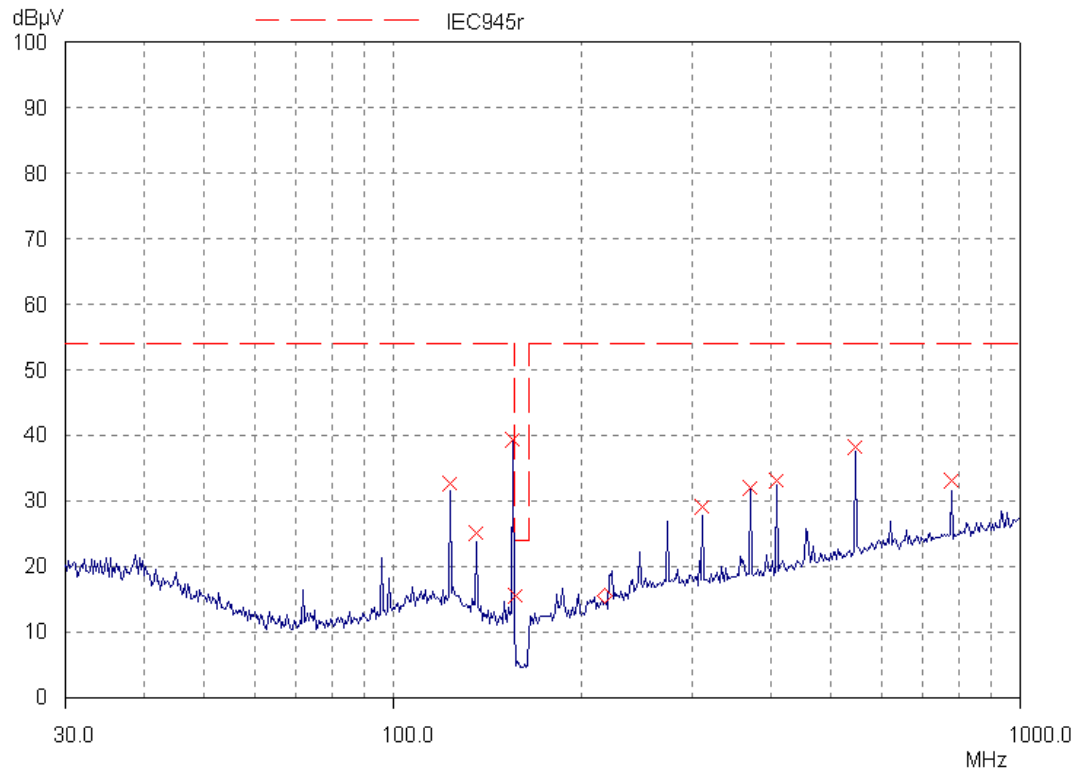


Figure A.2.7: Radiated emissions, front, horizontal polarisation (30MHz to 1GHz)
(File: RE_004.dat)

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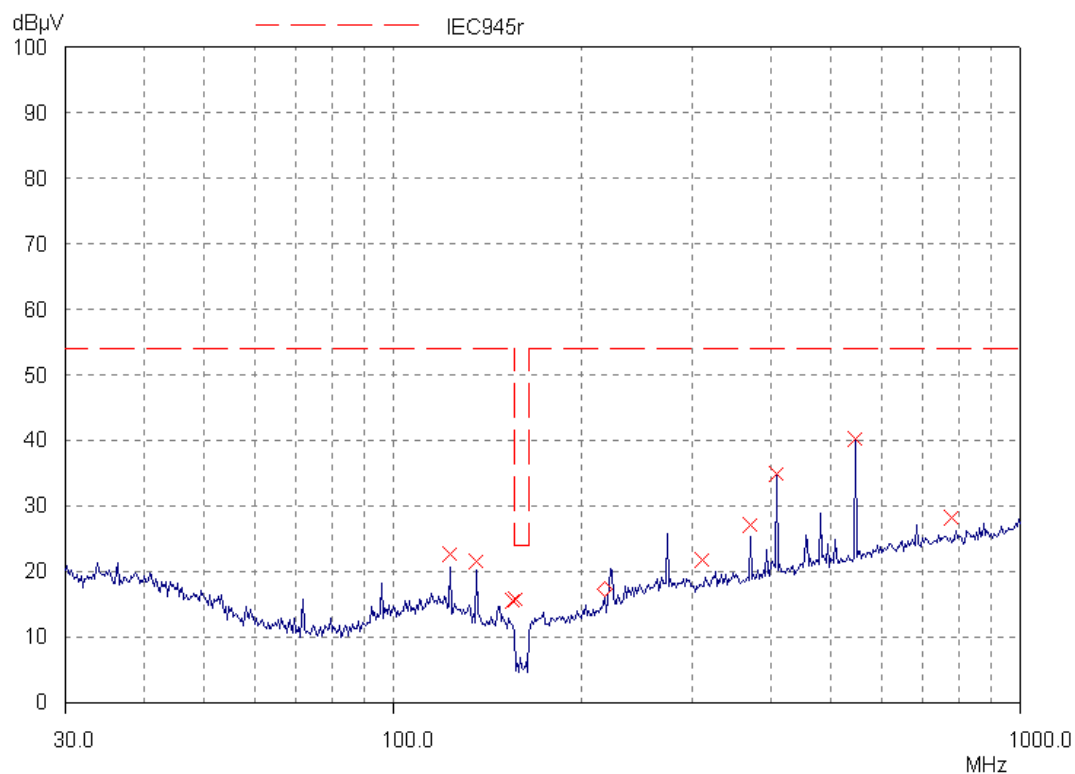


Figure A.2.8: Radiated emissions, left side, horizontal polarisation (30MHz to 1GHz)
(File: RE_005.dat)

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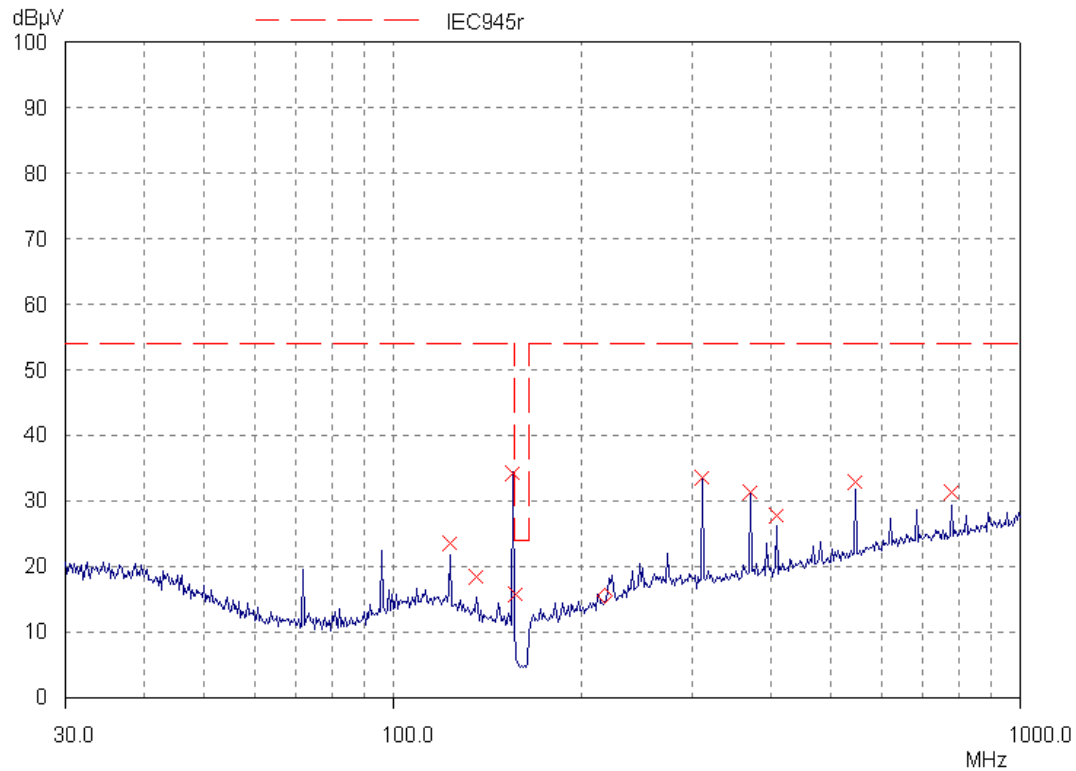


Figure A.2.9: Radiated emissions, right side, horizontal polarisation (30MHz to 1GHz)
(File: RE_006.dat)

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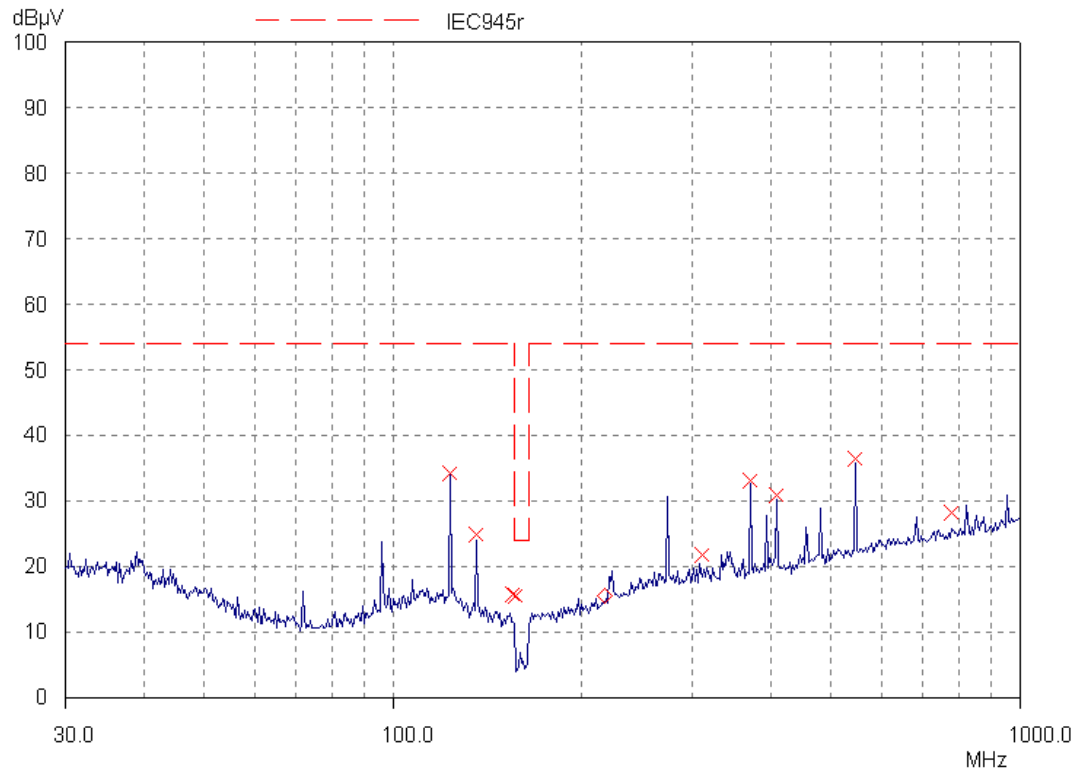


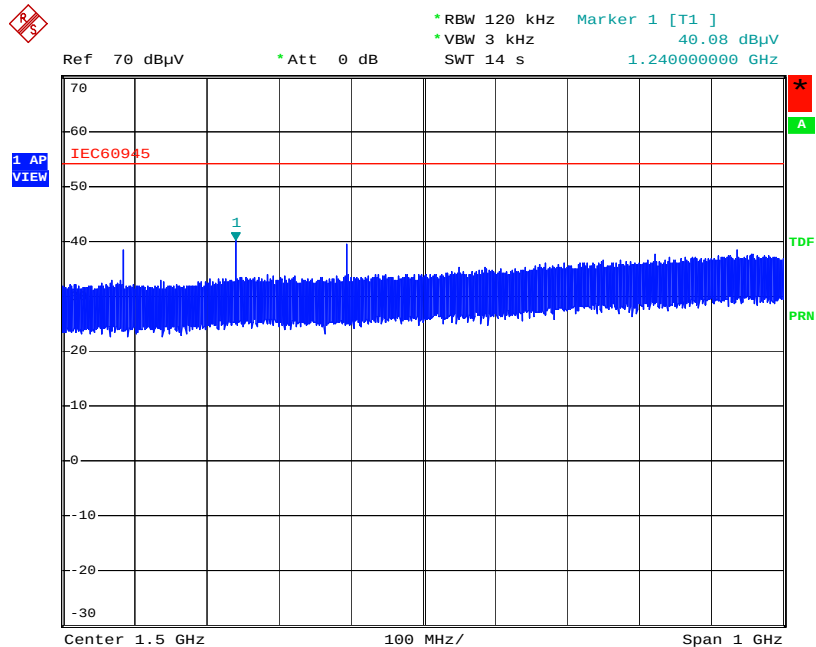
Figure A.2.10: Radiated emissions, rear, horizontal polarisation (30MHz to 1GHz)
(File: RE_07.dat)

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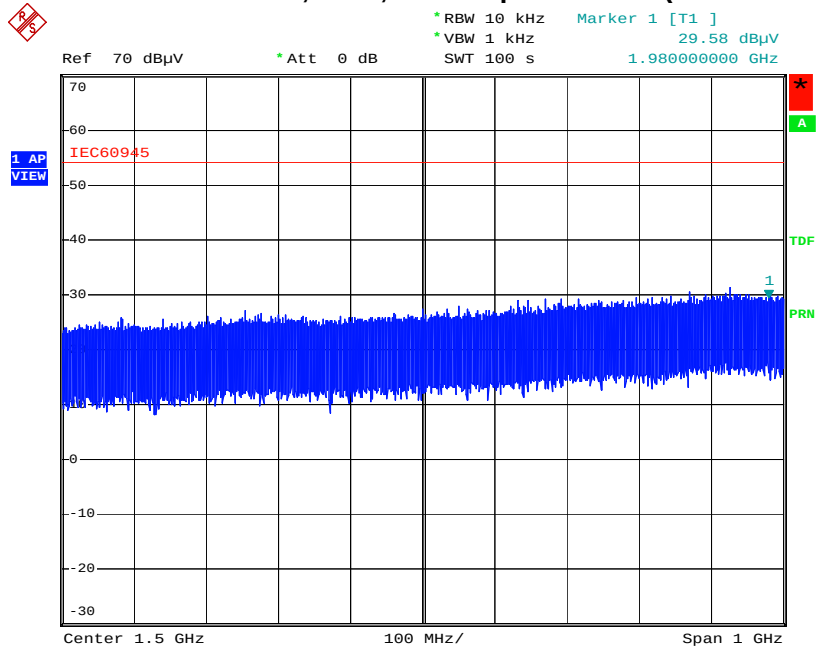
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Radiated Emissions 1GHz to 2GHz



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Figure A.2.11: Radiated emissions, front, vertical polarisation (1GHz to 2GHz)



Date: 19.MAR.2007 15:09:04

Figure A.2.12: Radiated emissions, front, horizontal polarisation (1GHz to 2GHz)

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Annex B: Immunity interfering signals

B1. Results of conducted immunity radio interference tests

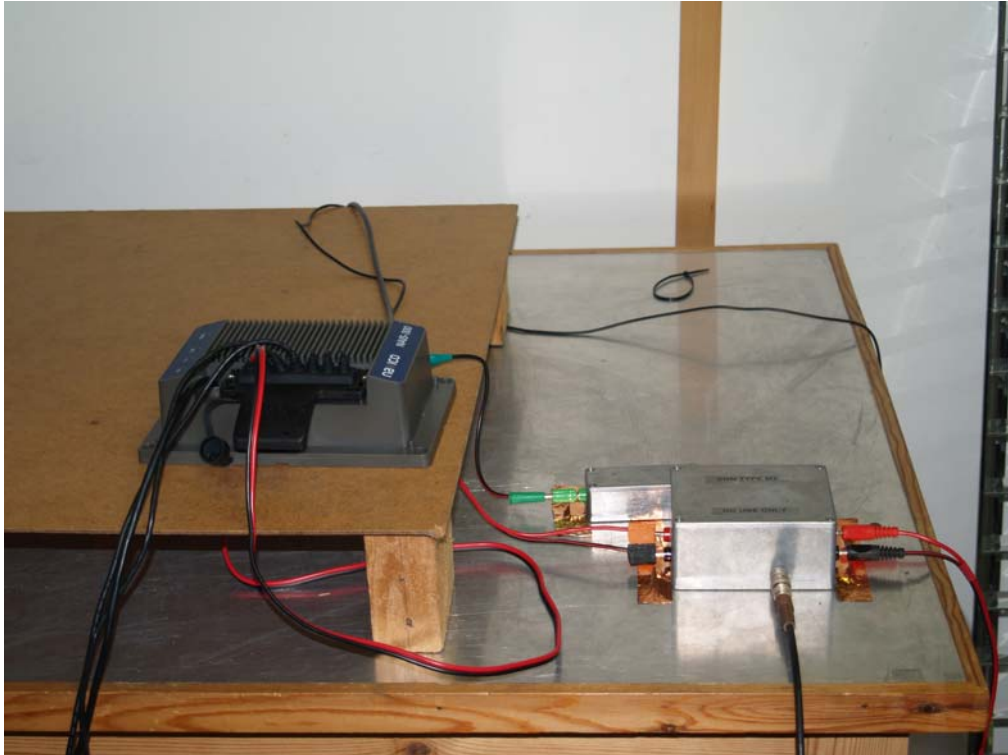


Figure B.1.1: Layout for immunity to conducted radio frequency interference

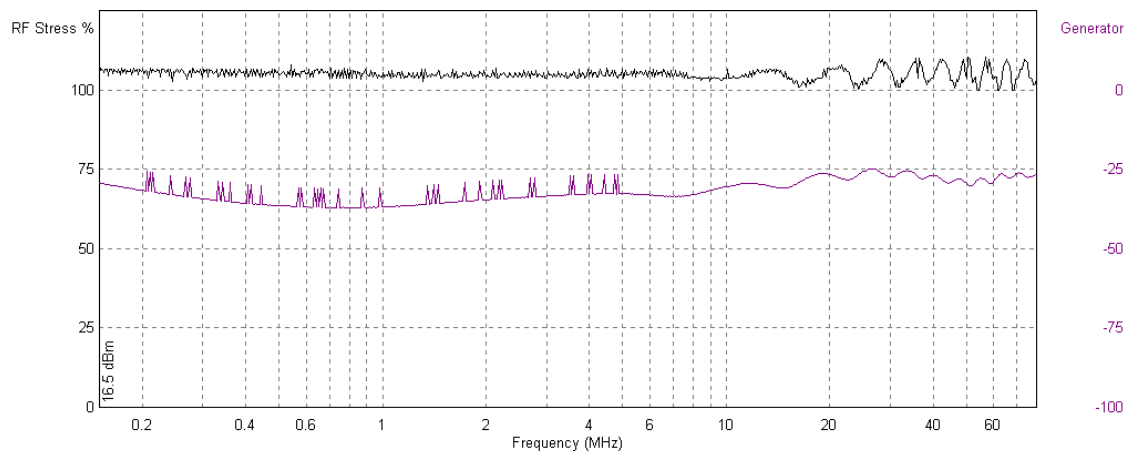


Figure B.1.2: Generator levels for conducted immunity in the range 150kHz to 80MHz

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B2. Immunity to radiated radio frequencies

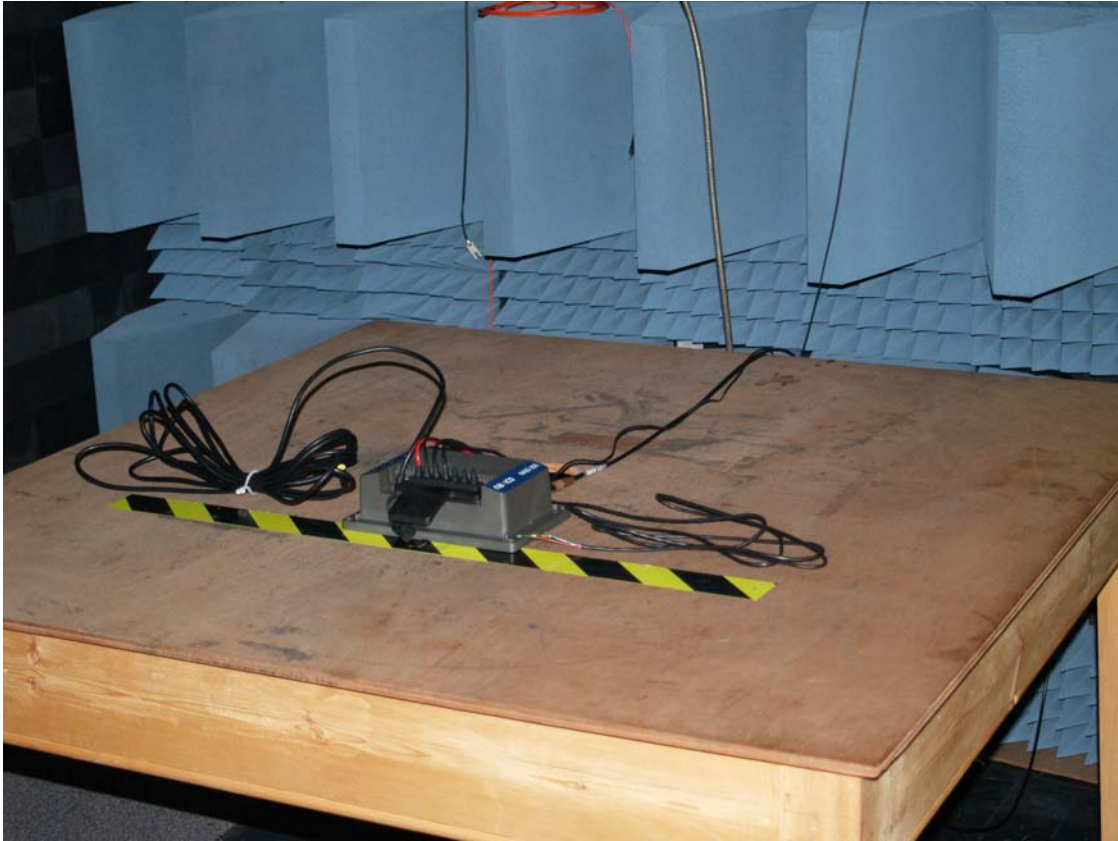


Figure B.2.1: Layout for immunity to radiated radio frequencies

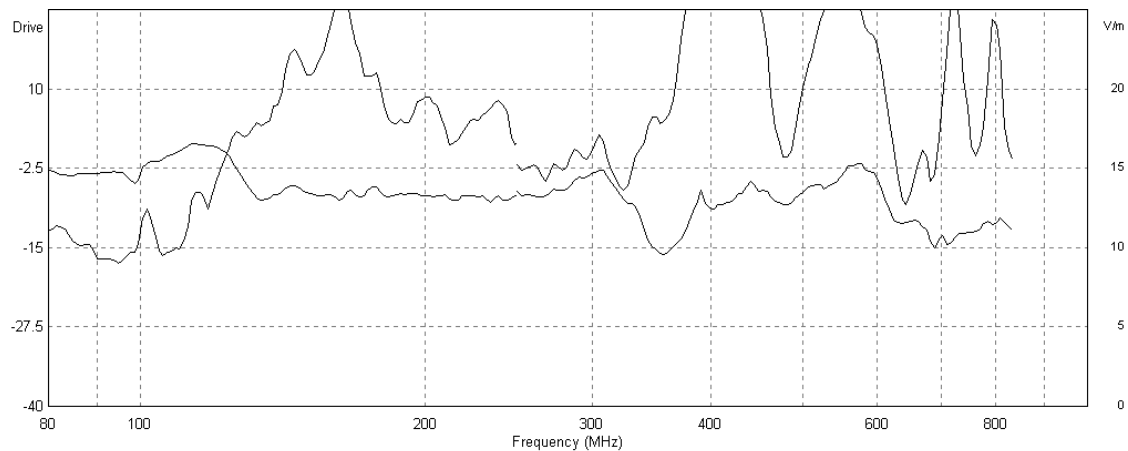


Figure B.2.2: Plot of field strength from 80MHz to 1GHz, during radiated immunity test with the Antenna vertically polarised.

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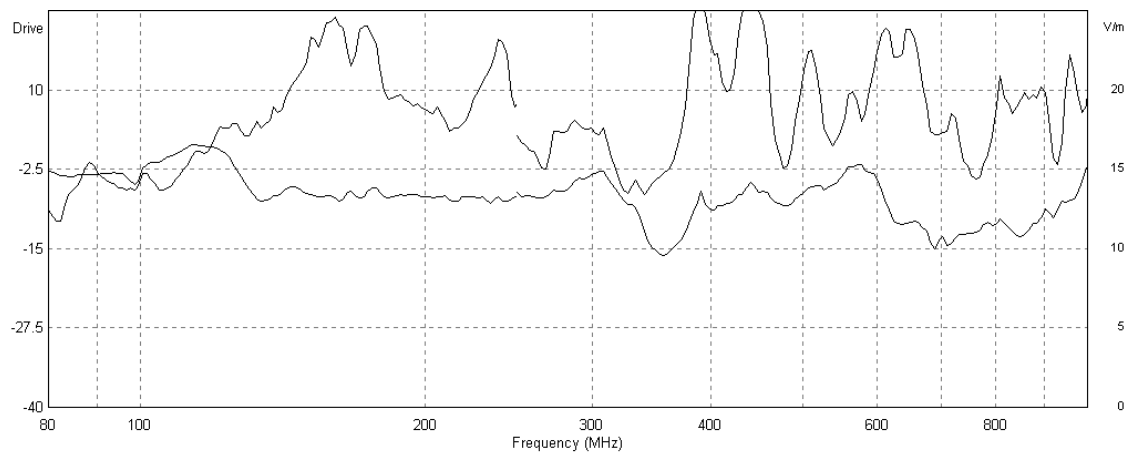


Figure B.2.3: Plot of field strength from 80MHz to 1GHz during radiated immunity test with the antenna horizontally polarised.

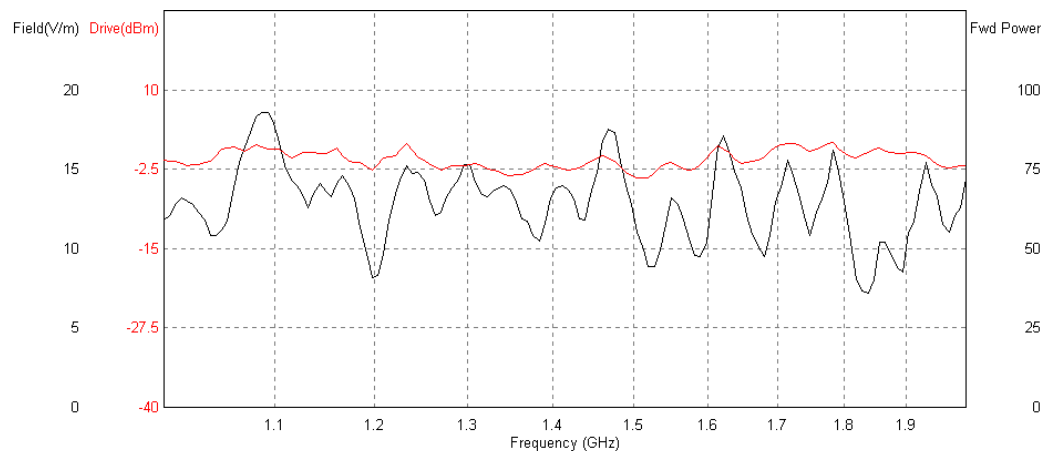
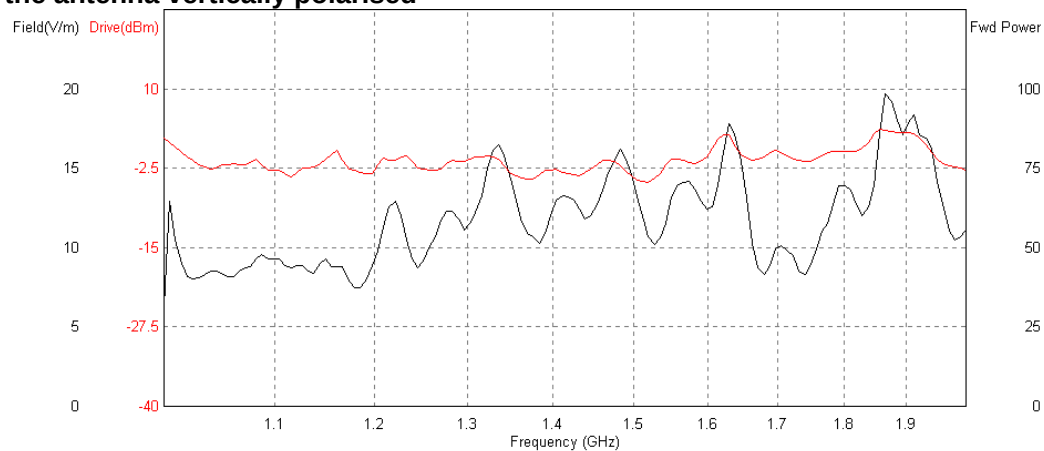


Figure B.2.4: Scan of field strength from 1GHz to 2GHz during radiated immunity with the antenna vertically polarised



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Figure B.2.5: Scan of field strength from 1GHz to 2GHz during radiated immunity with the antenna vertically polarised

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B3. Immunity to transients



Figure B.3.1: Layout for immunity to fast transients on A.C power, signal and control lines

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B4. Electrostatic discharge (ESD)



Figure B4.1: Front of EUT showing position of test discharges