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Saab AB

Support and Services

Aircraft Services

Bröderna Ugglas gata

581 88 Linköping

Arende *Subject*

EMC Test – Spidertracks S3

Fördelning *To*

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Document revision history

Edition	Date	Paragraph	Details
ETN-2012-005 (1)	2012-02-23	N/A	First Issue
ETN-2012-005 (2)	2012-03-07	2.4	Updated Table 2 with EUT p/n
ETN-2012-005 (3)	2012-03-12	N/A	Changed Info class from COMPANY RESTRICTED to COMPANY UNCLASSIFIED

Table 1: Revision history.

1 ABSTRACT

EMC test has been carried out on the Spidertracks S3 supplied by Saab AB Support and Services, Aircraft Services.

The test was performed according to RTCA/DO160F sections 15 (category Z) and 21 (category M).

1.1 Summarized result

The tested unit showed compliance with the requirement for the tests performed.

This report accounts for the procedures and detailed results of this test.



2 GENERAL

2.1 References

- [1] RTCA DO-160F, "ENVIRONMENTAL CONDITIONS AND TEST PROCEDURES FOR AIRBORNE EQUIPMENT". RTCA Inc. Issued December 6, 2007.

2.2 Abbreviations

A	Ampere
AUX	Auxiliary
CE	Conducted Emission
DC	Direct Current
EM	Electromagnetic
EMC	Electromagnetic Compatibility
EUT	Equipment Under Test
GP	Ground Plane
GPS	Global Positioning System
ID	Identification
LED	Light Emitting Diode
mA	Milliampere
mΩ	Milliohm
N/A	Not Applicable
PC	Personal Computer
p/n	Part Number
RBW	Resolution Bandwidth
RE	Radiated Emission
Rev.	Revision
SAC	Semi Anechoic Chamber
s/n	Serial Number
T&M	Test and Measurement
V	Volt
VDC	Volt Direct Current

EUT specific abbreviations are not covered in this list.

2.3 Scope

Qualification of the tested equipment's EM environment characteristics regarding conducted and radiated emission of EM-signals and also magnetic effect. This qualification shall ensure safe and interference free operation of the tested equipment when installed on its platform.



2.4 Test object

The test object is referred to as "EUT".

EUT	Unit	p/n	s/n
1	Spidertracks S3	6000.S3	56ZAU3P49Z

Table 2: Test object.

Supplier: Saab AB – Support and Services
 Aircraft Services
 Bröderna Ugglas gata
 581 88 Linköping
 Sweden

2.4.1 EUT firmware/software version

N/A

2.5 Auxiliary equipment

Equipment supplied by the customer used during the tests in order to power supply, connect, load or monitor the EUT.

AUX	Unit	Model	ID
1	GPS Repeater	GPS-Source p/n:GPSRKL1-A25-P230/5	A08285

Table 3: Auxiliary equipment.

2.6 Site and date

The test took place at Saab AB EMC-Test facility in Linköping Sweden on February 16, 2012.

Saab AB - Aeronautics
 Flight Test and Verification
 Gelbgjutaregatan 2
 SE-581 88 Linköping
 Sweden

Test Method Responsible EMC Lab
 Tomas Nilzon tomas.nilzon@saabgroup.com
 Phone +46 13 185669

2.7 Test environmental conditions

Temperature, controlled: 20 °C
 Humidity, ambient: 37 % relative
 Air pressure, ambient: 1012 hPa

2.8 Personnel

Contractor test engineer

Saab AB – Aeronautics Tomas Nilzon
Flight Test and Verification

Customer representatives

Saab AB Support and Services Anders Bergstrand
Aircraft Services

2.9 Miscellaneous

- There are only selected samples of pictures from the test in this report. All of the pictures can be supplied upon request.
- ASCII tables from emission result charts can be supplied if precise frequency and/or amplitude determination is desirable.
- The "EUT" identification (EUT 1, EUT 2 etc.) printed with date, time and file data in some of the charts are automatically generated by the T&M software and thus not always valid. Therefore always refer to document text and tables.
- A test logbook (written in Swedish) is also available.

3 PERFORMED TESTS

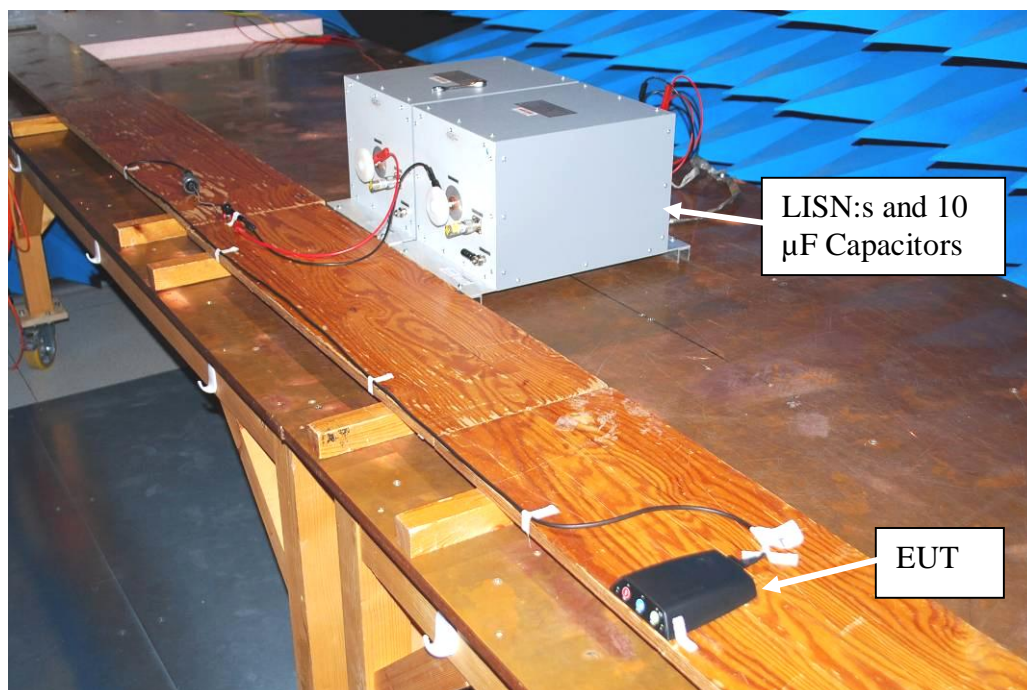
The test facility consists of an SAC with two adjoining shielded rooms, one of which is equipped with a ground plane table with the same ground reference as in the SAC, this accommodation is the customer control room. The other room houses the test equipment. See 4.1 Main characteristics of test facility.

3.1 Traceability

All tests are performed using calibrated instruments traceable to national/international standards and with parameters (e.g. RBW, Sweep- and Dwell- Time) set according to applicable reference documentation if nothing else noted.

3.2 General Test setup

The EUT with its power cable was placed on a ground plane test table in the SAC supported 5 cm above the ground plane. A GPS-repeater was also arranged in the SAC to provide a GPS-signal so that the EUT could operate in correct mode for the EMC-test. Power cable supplied for the test was the one intended for actual installation and was 2 m in length.



Picture 1: General test setup, SAC.

3.2.1 Bonding

There was no bonding to the ground plane of the EUT case.

3.2.2 Power

The EUT was supplied by 28 VDC nominal voltage. Current during normal operation was ≈ 60 mA.

<i>Equipment</i>	<i>Model</i>	<i>Reg. No.</i>	<i>Cal. Due</i>
Power Supply	DELTA Elektronika SM7020-D	NA02200	OPMON
LI SN	Solar 9233-50TS-50-N	UM03000	2013-01
LI SN	Solar 9233-50TS-50-N	UM03100	2013-01
Feed Through Capacitor 10 μ F	Solar 9146-1	UM01400	N/A

Table 4: Power supply equipment

3.2.3 EUT operation mode

The EUT was in mode 3 during the EMC test, see below.

Information provided by the EUT manufacturer.

The EUT has three basic modes as follows:

1. Power on initialisation, including GPS Fix acquisition.
2. Location monitoring (GPS fix established)
3. Location transmission (Iridium Session instigation).

Peak output (worst case regarding transmitting power) occurs in mode 3.

Testing the unit where connectivity with the Iridium system is not possible ensured that maximum power is used during this mode, when trying to establish contact with the Iridium satellites.

3.2.4 EUT monitoring

EUT operation was monitored by observing the indicator LED:s on the front panel.



3.3 RTCA DO160F

Reference [1].

3.3.1 Section 15

Magnetic Effect

3.3.1.1 Acceptance criteria

With the equipment operated in the steady state mode that produce the maximum magnet deflection and also oriented to produce maximum magnet deflection, the distance between the magnet pivot and the nearest part of the equipment at which a deflection of Dc (Deflection angle) is one degree.

Equipment Class Distance for a Deflection of Dc

Z ≤ 30 cm

3.3.1.2 Test equipment

Reg. No.	Equipment	Model	Cal. Due
N/A	Software	HMR 800-323-8295 Rev. C	
PC00400	Computer	Fujitsu ErgoPro	N/A
UA03600	Digital Compass Module	Honeywell HMR3000	2013-02

Table 5: Section 15, Magnetic effect, Test Equipment.

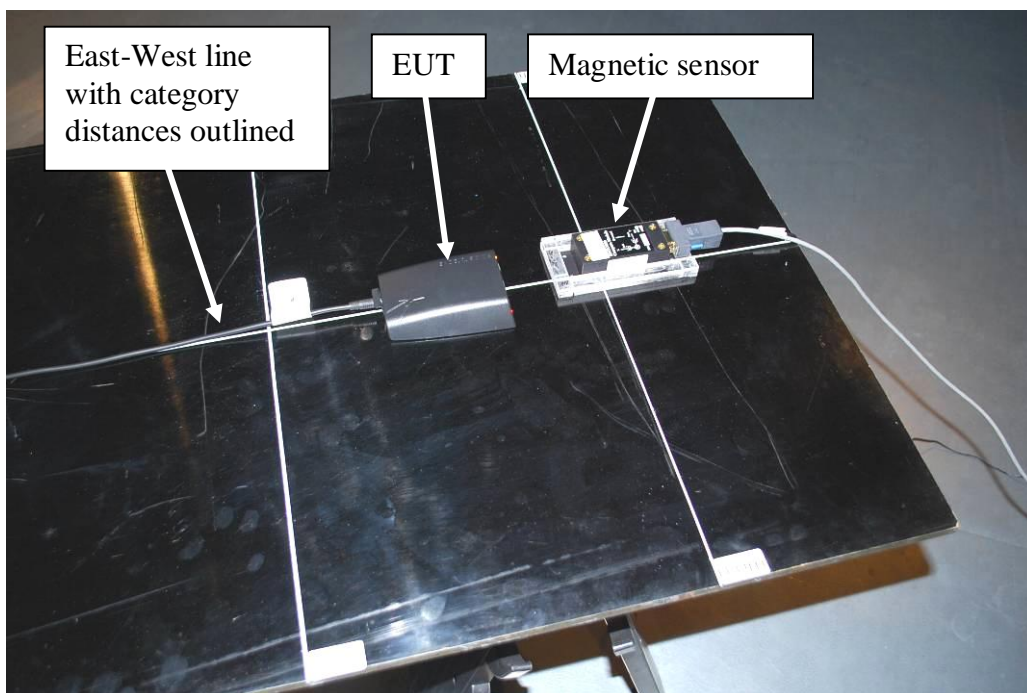
3.3.1.3 Test configuration

See 3.2 General Test setup.

Magnetic deflection was observed while bringing the EUT closer and further away to a fixed precision compass sensor lined up on an east-west line. See Picture 2.

Note: The horizontal component of the magnetic field produced by the earth on the test location¹⁾ requires +0.2° compensation. So Dc for this test is 1.2° [1].

¹⁾ *The horizontal component of the magnetic field produced by the earth in Linköping, Sweden is 12.4 A/m.*



Picture 2: Section 15, Magnetic effect, test setup.

3.3.1.4 Result

The EUT complied with the requirement. Distance to the compass sensor for a deflection of 1.2° was $\leq 30 \text{ cm}^1$ for all sides of the EUT.

¹⁾ Worst case with the EUT front facing the compass was 5 cm distance.

3.3.2 Section 21

Emission of Radio Frequency Energy.

3.3.2.1 Acceptance criteria

Category M. Emission (Conducted and Radiated) shall be within the limits according to Figure 1 and Figure 2.

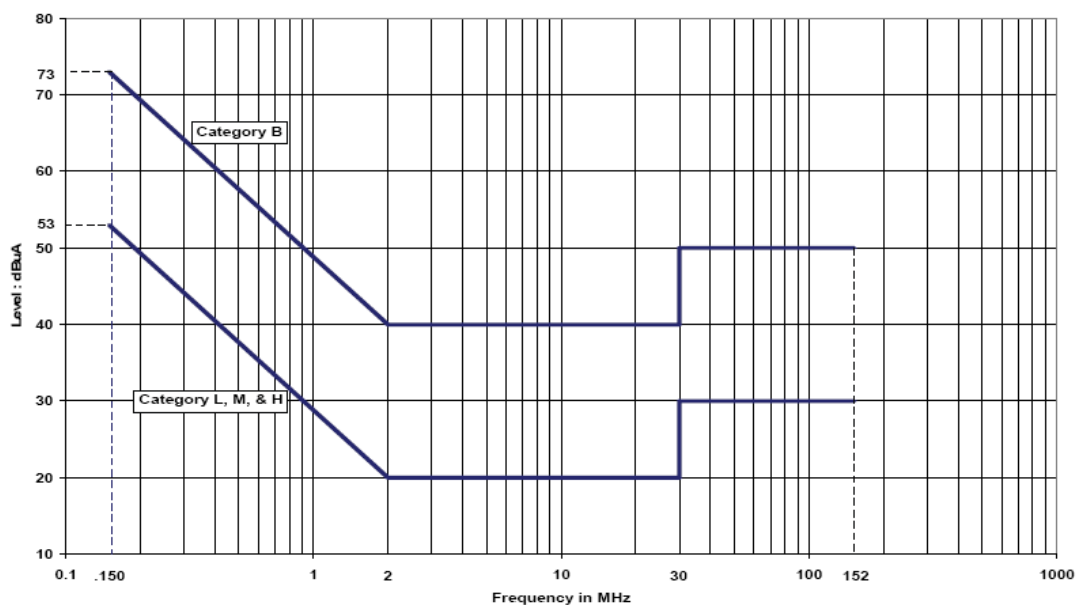


Figure 1: Section 21, Emission of Radio Frequency Energy, Conducted Emission Power Lines Category M applies.

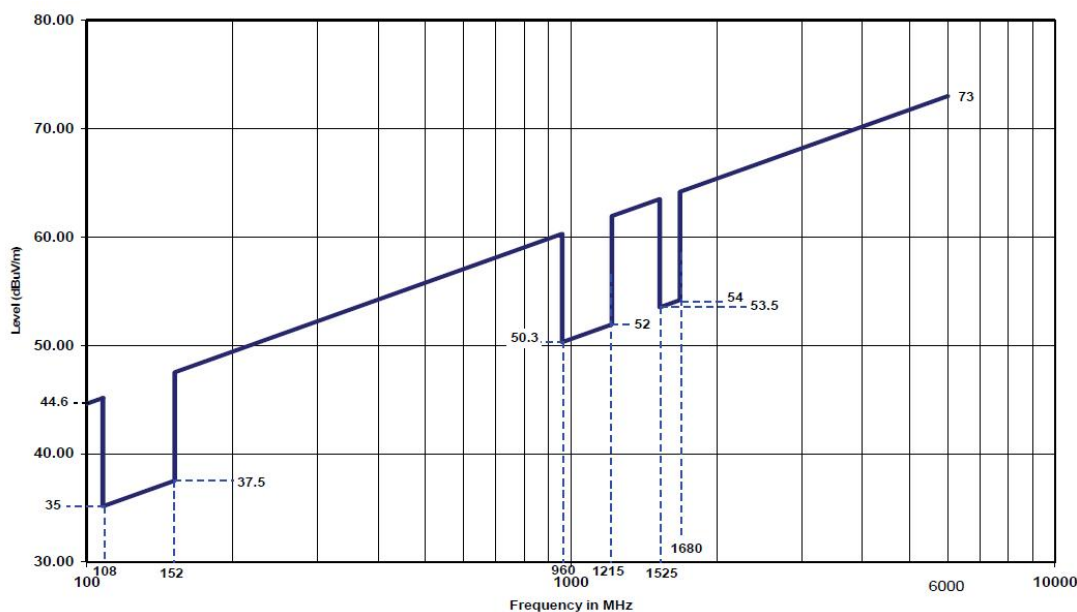


Figure 2: Section 21, Emission of Radio Frequency Energy, Radiated Emission Category M.

3.3.2.2 Test equipment

<i>Equipment</i>	<i>Model</i>	<i>Reg. No.</i>	<i>Cal. Due</i>
Software	REMI v2.134	N/A	N/A
Computer	DELL OPTIPLEX 780	PC00900	N/A
EMI Test Receiver	Rohde&Schwarz ESI 40	AN00500	2012-09
Biconical Antenna	EMCO 3110B	AT01600	2012-09
Horn Antenna	EMCO 3106	AT03000	2012-09
Horn Antenna	EMCO 3115	AT03600	2012-09
Preamplifier	HP 8449B	F002200	2013-11
Current Probe	Stoddart 91 550-1	PR00700	2013-10
Resistive load	AT-R1-(28)	UM02200	N/A

Table 6: Section 21, Emission of Radio Frequency Energy, Test Equipment.

3.3.2.3 Test configuration

See 3.2 General Test setup.

Conducted

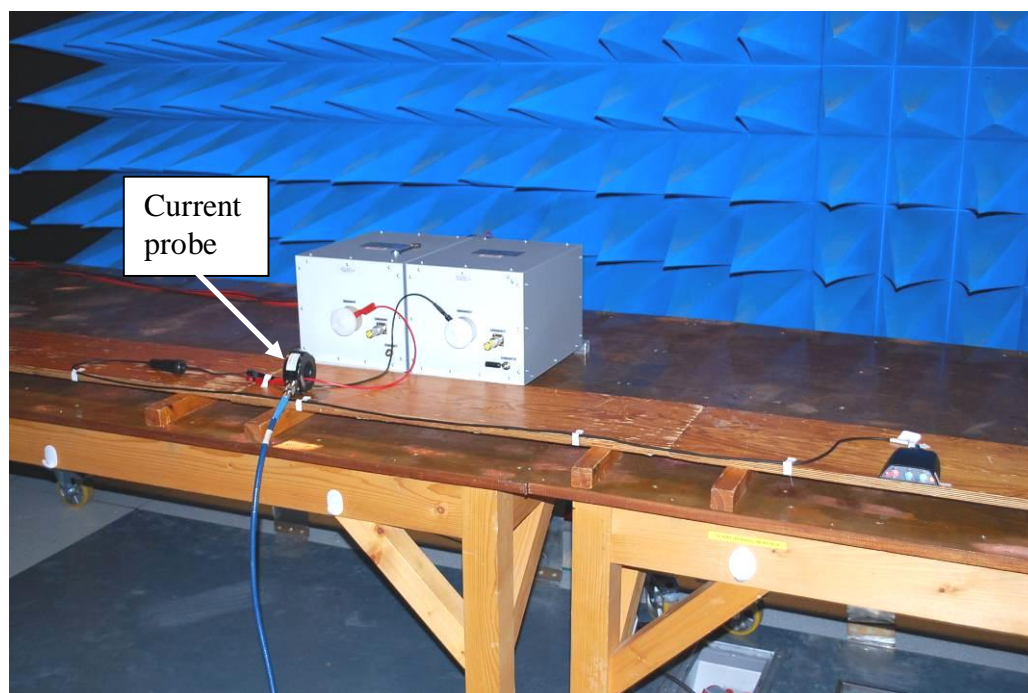
Conducted emission was measured with a current probe placed 2 m from the EUT connector¹⁾. See Picture 3.

¹⁾ Should have been 5 cm according to [1], but with the EUT cable configuration 2 m was the closest possible.

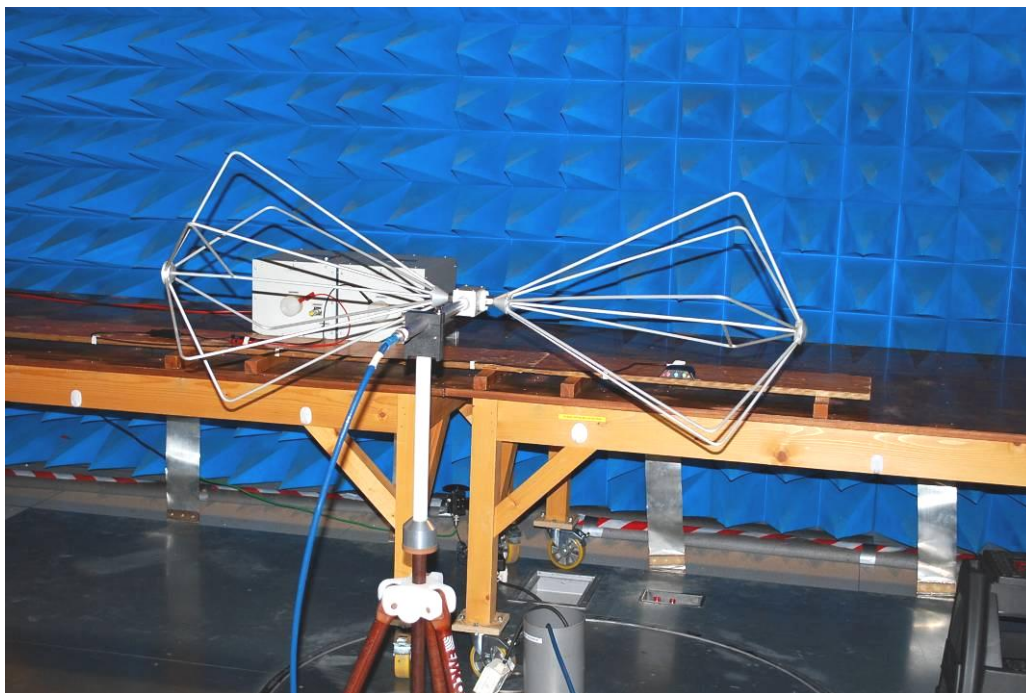
Radiated

Radiated emission was measured with antennas 1 m in front of the test setup boundary. See Picture 4.

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Picture 3: Section 21, conducted emission test setup.



Picture 4: Section 21, radiated emission test setup.

3.3.2.4 Result

The EUT complied with the requirement. No emission above limit was registered.

Note: Emission peak at 1625 MHz in Chart 5 is the EUT Iridium™ transmission. This transmission was intermittent and not captured in Chart 6, but manually observed in real time with the same amplitude in both antenna polarizations.

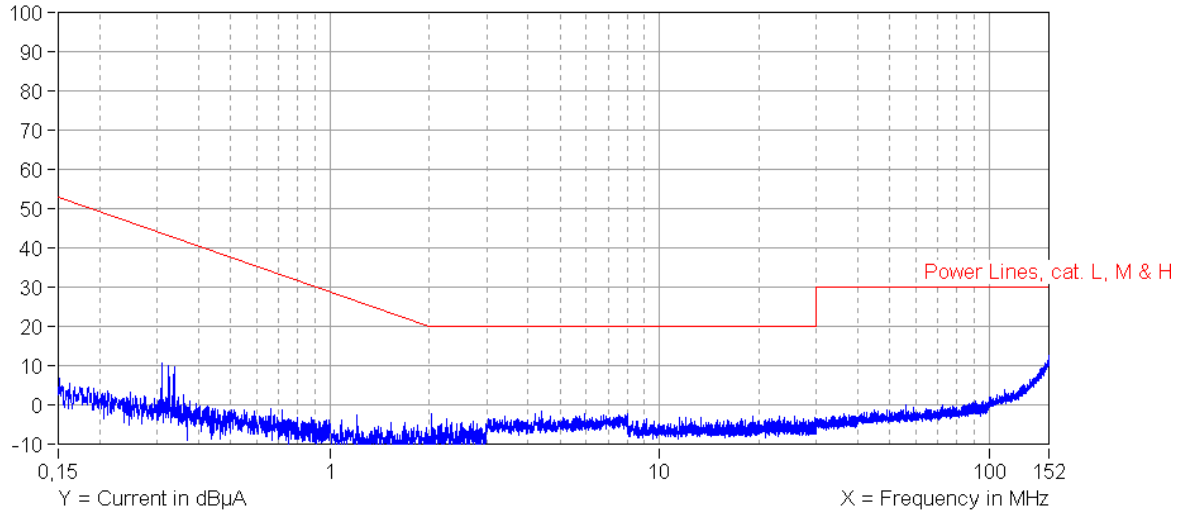
Chart 2 to Chart 3 display conducted emission.

Chart 5 and Chart 6 display radiated emission.

Chart 1 and Chart 4 display ambient noise.



RTCA DO160F Section 21 Conducted Emission



— 2012-02-16 09:26:25 File: CE01.TO1, EUT 1, Spidertracks S3 s/n:56ZAU3P49Z

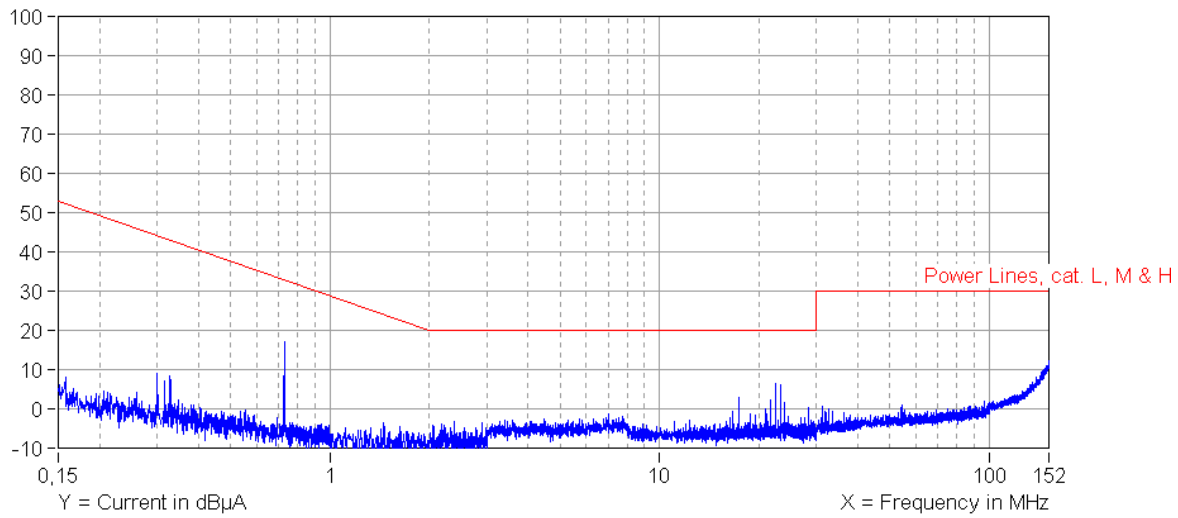
Ambient noise
EUT off, resistive load on power (40 ohm)
Mode of operation: N/A
Cable: +28 VDC

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OTTFGSZ-TN

Chart 1

RTCA DO160F Section 21 Conducted Emission



— 2012-02-16 10:47:51 File: CE02.TO1, EUT 1, Spidertracks S3 s/n:56ZAU3P49Z

EUT on
Mode of operation: Normal mode
Cable: +28 VDC

Saab AB Aeronautics, SE-581 88 Linköping, Sweden

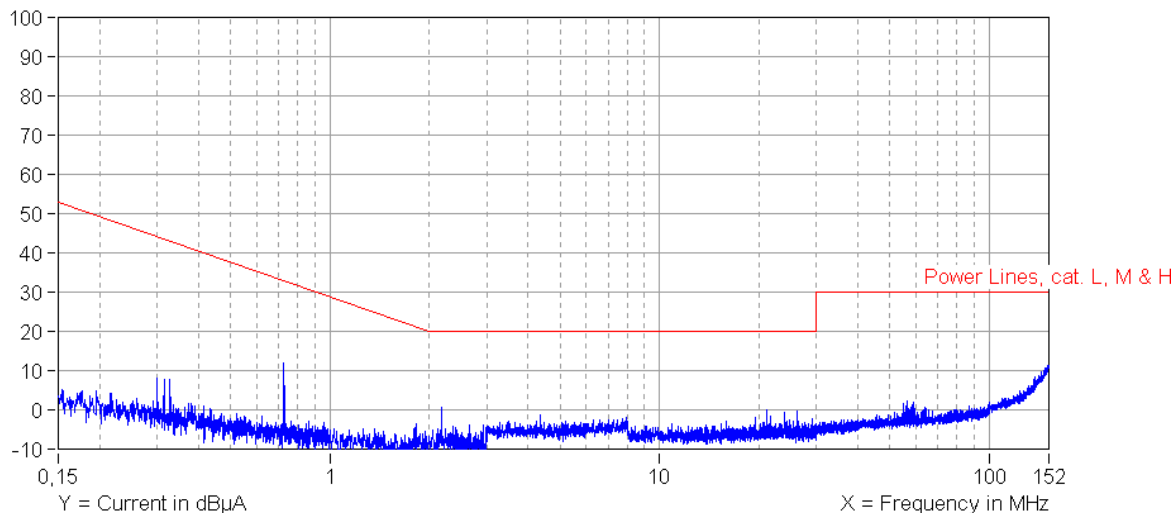
OTTFGSZ-TN

Chart 2

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RTCA DO160F Section 21 Conducted Emission



— 2012-02-16 12:16:31 File: CE03.TO1, EUT 1, Spidertracks S3 s/n:56ZAU3P49Z

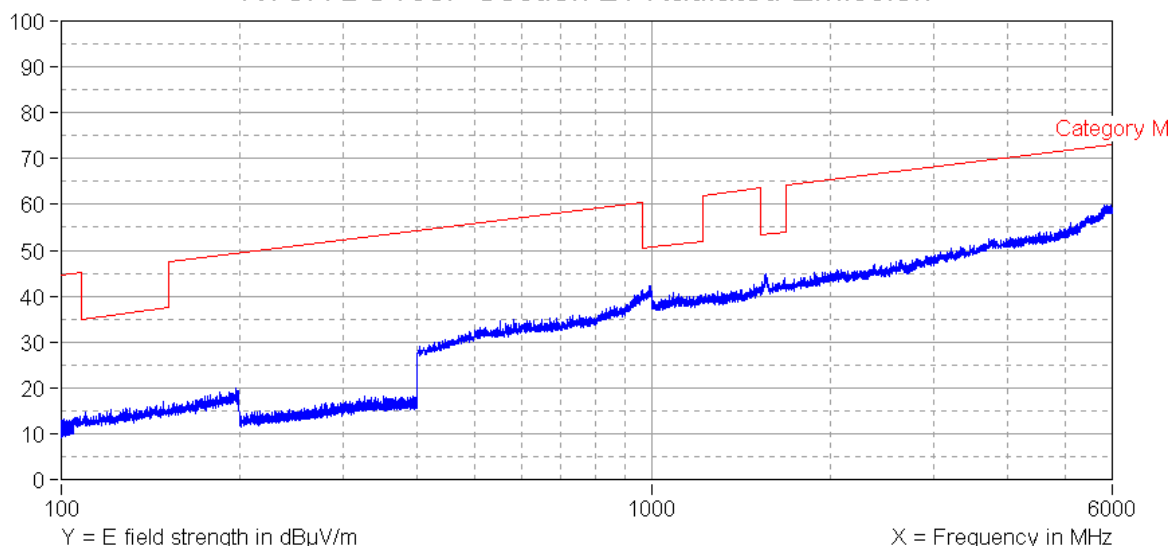
EUT on
Mode of operation: Normal mode
Cable: 28 VDC return

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Chart 3

RTCA DO160F Section 21 Radiated Emission



— 2012-02-16 09:52:16 File: RE01.TO1, EUT 1, Spidertracks S3 s/n:56ZAU3P49Z

Ambient noise
EUT off, resistive load on power (40 ohm)
Mode of operation: N/A
Polarization: Vertical

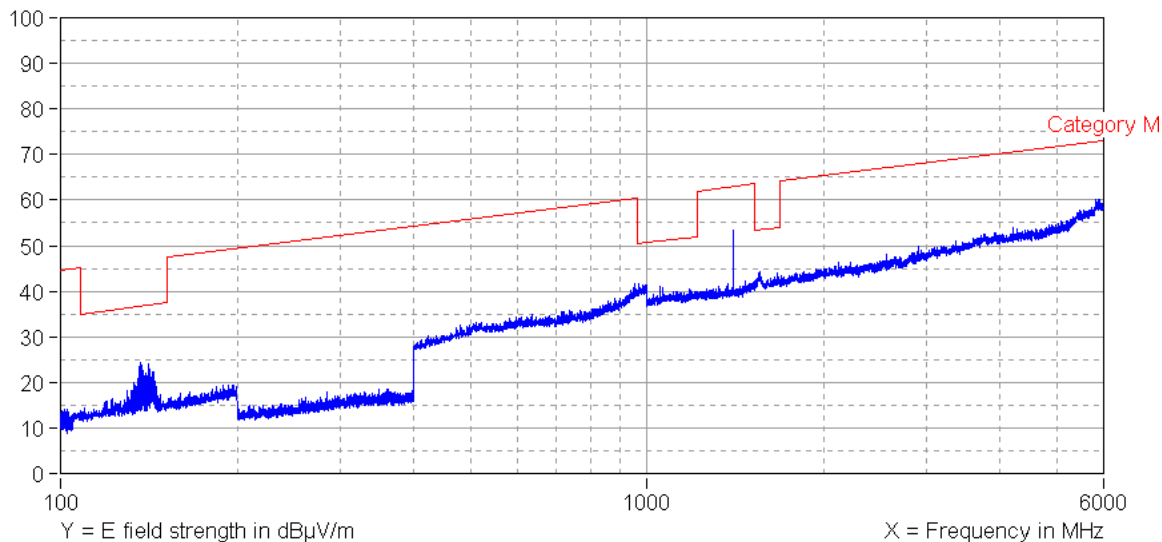
Saab AB Aeronautics, SE-581 88 Linköping, Sweden

OTTFGSZ-TN

Chart 4



RTCA DO160F Section 21 Radiated Emission



2012-02-16 10:03:26 File: RE05.TO1, EUT 1, Spidertracks S3 s/n:56ZAU3P49Z

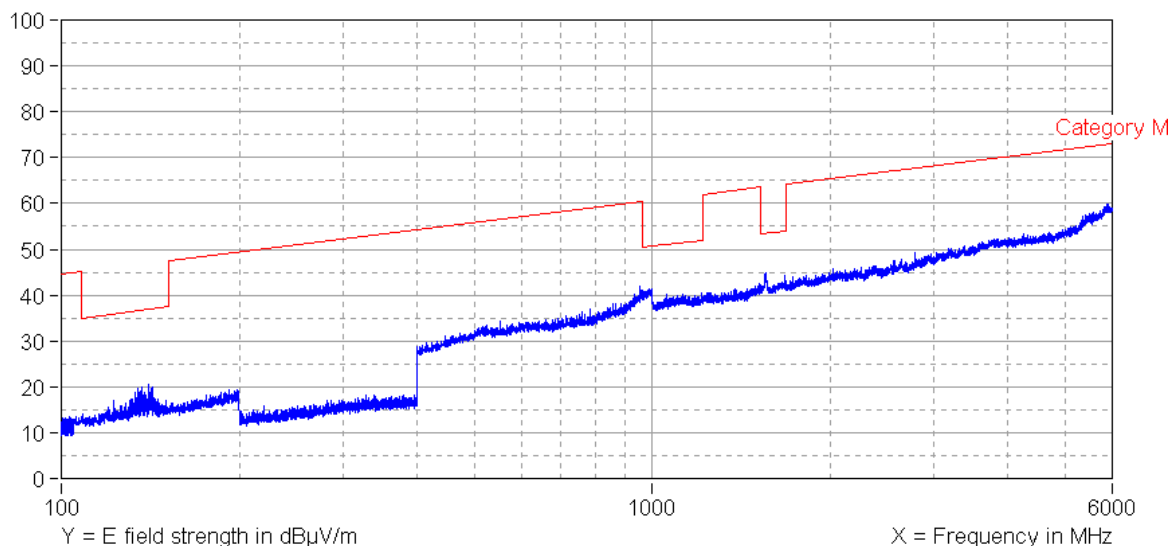
EUT on
Mode of operation: Normal mode
Polarization: Vertical

Saab AB Aeronautics, SE-581 88 Linköping, Sweden

OTTFGSZ-TN

Chart 5

RTCA DO160F Section 21 Radiated Emission



2012-02-16 10:11:26 File: RE06.TO1, EUT 1, Spidertracks S3 s/n:56ZAU3P49Z

EUT on
Mode of operation: Normal mode
Polarization: Horizontal

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Chart 6

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4 APPENDIX

4.1 Main characteristics of test facility

4.1.1 Semi Anechoic Chamber (SAC)

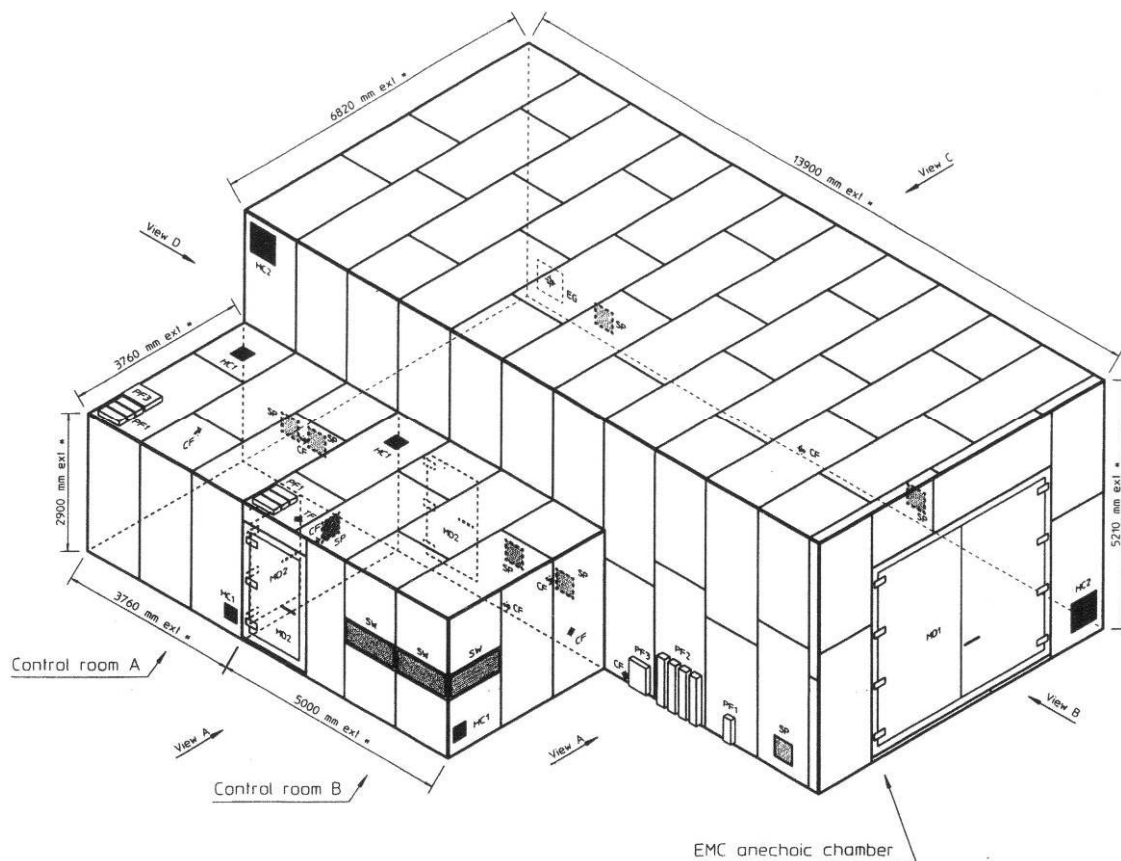


Figure 3: Test Chamber

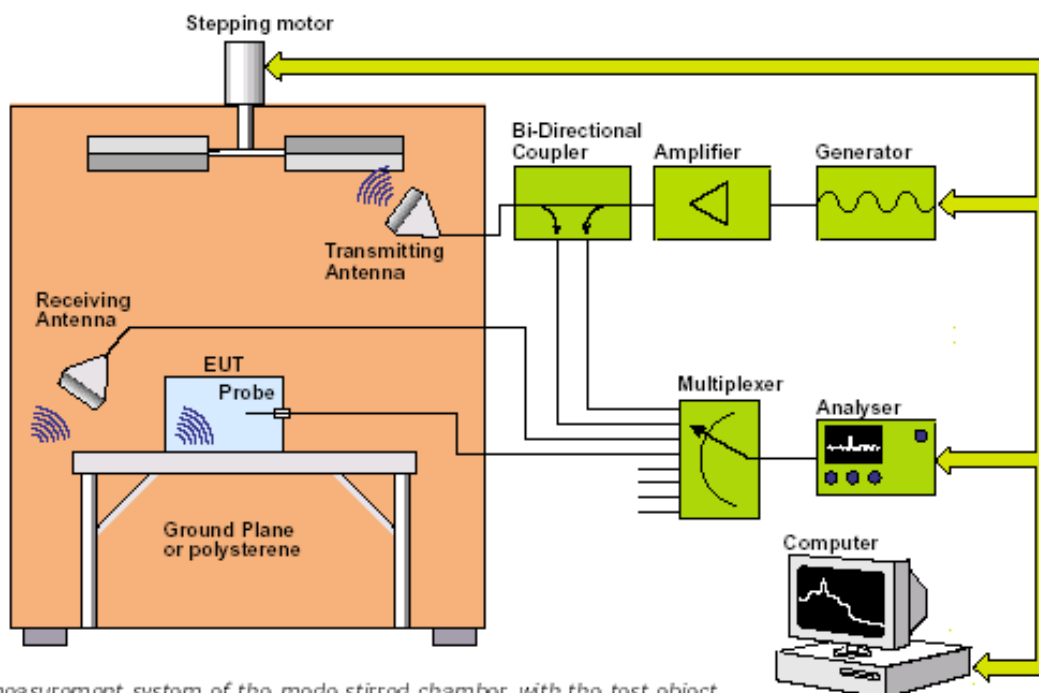
SEMI-ANECHOIC TEST CHAMBER SPECIFICATIONS

Manufactured by Siepel with Hyfral absorbers APM66 and APM30 to meet MIL-STD-462, DO-160 (ED14D) and EN61000-4-3 standards

<i>Chamber inner size</i>	12.5 x 5.5 x 4.2 m
<i>Door size</i>	4.0 x 3.6 m
<i>Ground plane floor</i>	13.0 x 4.5 m with a 3000 kg capacity
<i>Ground plane table</i>	4.5 x 1.2 m with a 600 kg capacity
<i>Turn table</i>	Ø 1.5 m with a 2000 kg capacity
<i>Power supply</i>	3-phase 400/230 V 32 A 50 Hz 1-phase 230 V 10 A 50 Hz 3-phase 200/115 V 16 A 400 Hz
<i>Customer control room</i>	3.7 x 3.7 m with a 3.5 x 1.0 m ground plane table

4.1.2 Reverberation Chamber (RC)

Sometime also named Mode Stirred Chamber (MSC)



The control and measurement system of the mode stirred chamber, with the test object being subjected to susceptibility testing and probed for leakage.

Figure 4: Mode Stirred Chamber.

MODE STIRRED CHAMBER SPECIFICATIONS

Mechanical construction	Electrical data
The chamber is of a continuously welded aluminium construction.	<i>Frequency range</i>
<i>Chamber dimensions</i>	0.2-18 GHz (first resonance mode at 58.3 MHz)
Length 5 m	<i>Q value</i>
Height 3 m	100,000
Width 2.5 m	<i>Field strength</i>
<i>Door size</i>	1-3 kV/m (at 200 W input power)
2 x 1 m.	
<i>Mechanical stirrer dimensions</i>	
Diameter 236 cm	
Height 26 cm	