Test Report (PDF copy)
FCC Testing of the
M6260
USA Microwave
Oven
For
Sharp Manufacturing Company of UK

Document number 11345/TR/3

Project number C1303

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Disclaimers: The uncertainties are for a confidence probability of not less than 95%

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1 Introduction

Name and address of laboratory:

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The test results contained in this test report relate only to the unit(s) tested.

Equipment under test	Microwave Oven		
EUT Model No.	M6160/M6260 TC USA	**Serial No.**	0977638862
Noise filter board No.	FPWBFA496WRKZ	**HV capacitor No.**	RC-QZA389WRZZ
Transformer No.	RTRN-A041URE0	**Magnetron No.**	RV-MZA398WRZZ
Date of receipt	15th January 2014	**Number tested**	One
Date(s) of test(s)	20th January 2014 6th, 7th, 10th, 18th, 24th and 25th February 2014		
Date(s) when EUT was out of laboratory's control	None		
Personnel witnessing tests	The tests were carried out on an unwitnessed basis.		

Any other relevant information: The operating frequency of the EUT was declared as 2.45GHz; therefore, as per FCC MP-5, section 2.3(a), measurements were made to the tenth harmonic, which is 24.5GHz.

2 Test Specification

2.1 Environment

The equipment under test is a microwave oven intended for use in a household environment.

2.2 Relevant standards

2.2.1 Emissions

ANSI C63.4-2009 CFR 47 Part 18 Code of Federal Regulations	Conducted disturbance (AC mains port) 150kHz-30MHz limit as defined in 18.307 conduction limits Radiated disturbance (enclosure port) 30MHz-24.5GHz limit as defined in 18.305 Field strength limits

Note 1: Testing was limited to the above tests as requested by the customer.

Note 2: The operating frequency of the EUT was declared as 2.45GHz; therefore, measurements were made to the tenth harmonic i.e. 24.5GHz.

2.2.2 Immunity

No Immunity testing required by the customer

2.2.3 Operating modes

The EUT was operated in a total of 1 mode, the selection of which was test dependant.

Mode of operation	Description	Mode No.
	100% microwave power	1

Where the microwave function was being tested, the cavity was loaded with the amount of tap water, as specified within section 4.1 of FCC/OST MP-5 (1986), in a 150mm diameter borosilicate glass container, placed in the centre of the turntable unless otherwise specifically stated. Water was changed periodically to maintain the level and prevent the water boiling.

3 Test Results

3.1 Power Output measurements (Calorimetric direct method)

Mode of operation	Description	Mode No.
	100% microwave power	1

Test standard	Test description	Class/limit
MP-5 1986, section 4.3. Test method based upon EN60705:1999, Section 8.	Power output measurements for microwave ovens	N/A

Input Voltage (V)	Input Power (kW)	Input Current (A)	Duration of run (sec)	Start Temp Water (°C)	Final Temp Water (°C)	ΔT (°C)	Output Power (W)
120	1.6	14.55	60	16.1	28.9	12.8	893.18
120	1.6	14.52	60	19.0	31.5	12.5	872.25

Note 1: The test was performed using 1000g ±5g of tap water heated in a 150mm diameter cylindrical glass vessel placed in the centre of the oven. Start Temp is that of the water before it was poured into the glass vessel. Final temperature of the water was taken within 60sec of the microwave cycle finishing, after it had been stirred.

Note 2: The output power used to determine the value regarding out of band field strength limits, under the specified section of 18.305, was rounded to that of the lowest value i.e. 870W as this produced the lower limit line for electric field strength measurements see section 3.6 of this test report.

3.2 Frequency measurements

Mode of operation	Description	Mode No.
	100% microwave power	1

Test standard	Test description	Class/limit
MP-5 1986, section 4.5.	Frequency measurements for microwave magnetron fundamental frequency	As defined in CFR 18.301 2,450MHz ±50MHz

3.2.1 Frequency variation over time MP-5 section 4.5 (a)

Time (Mins)	Measured Frequency (MHz)
Start of Test	2454.48
6	2451.96
12	2453.92
18	2453.92
24	2455.04
30	2453.08
36	2454.48
42	2442.16
48	2453.08
54	2453.08
60	2460.36

Note 1: The test was performed using 1500mililetres of tap water in a 150mm diameter cylindrical glass vessel placed in the centre of the oven. The test duration was defined by the length of time taken by the microwave to reduce the load by means of evaporation to approximately 20% of the start level. Frequency measurements are shown in figure 5.6.1. The frequency is plotted within the allowable band of variation for the ISM frequency of 2450MHz ± 50MHz i.e. 2400MHz to 2500MHz.

3.2.2 Frequency variation over supply voltage variation MP-5 section 4.5 (b)

Supply Voltage (V) at 60Hz	Frequency (MHz)
96	2454.4
150	2454.6

Note 1: The test was performed using 1500mililetres of tap water in a 150mm diameter cylindrical glass vessel placed in the centre of the oven. The microwave had been operating for 10mins prior to the test start and the load used was started at room temperature. The supply voltage was lowered to 80% of the nominal value and the EUT allowed enough time to respond to the voltage change prior to recording the frequency. The test was then repeated with the supply voltage at 125% of the nominal value.

3.2 Conducted emissions (150kHz to 30MHz)

Mode of operation	Description	Mode No.
	100% microwave power	1

Test standard	Test description	Class/limit
CFR 47 part 18	Conducted emissions ac power	As defined in 18.307

Results	Figure	Result	Comments
	C01	Pass	None.

QP Results	Freq (MHz)	Line (L or N)	QP level (dBµV)	Limit (dBµV)	Comments
(Max 6)	0.935	N	40.9	56	None
	0.975	N	45.6	56	None
	1.010	N	43.2	56	None
	10.325	L	50.8	60	None
	14.270	N	47.8	60	None
	14.970	L	50.8	60	None

AV Results	Freq (MHz)	Line (L or N)	AV level (dBµV)	Limit (dBµV)	Comments
(Max 6)	0.935	N	37.5	46	None
	0.975	N	41.5	46	None
	1.010	N	37.8	46	None
	1.050	N	38.6	46	None
	11.525	L	44.2	50	None
	11.750	N	45.6	50	None

Note 1: The graphical data for this test can be found in Appendix 4 of this report.

3.3 Radiated emissions (100MHz to 1000MHz)

Mode of operation	Description	Mode No.
	100% microwave power	1

Test standard	Test description	Class/limit
CFR 47 Part 18	Radiated emissions	As defined in 18.305

Results	Figure	Result	Comments
	R01	Pass	None

Frequency (MHz)	Polarity (H/V)	Height (m)	Angle (degrees)	Detector Type	Meas distance (m)	Spec distance (m)	E field @ spec distance (dBuV/m)	E field Limit (dBuV/m)	Margin (dB)
257.040	V	1	90	QP	3	300	-29.0	30.4	-59.4
257.160	V	1	90	QP	3	300	-21.2	30.4	-51.6
257.280	V	1	90	QP	3	300	-29.6	30.4	-60.0
258.780	V	1	90	QP	3	300	-29.6	30.4	-60.0
295.200	V	1	270	QP	3	300	-30.0	30.4	-60.4
296.640	V	1	270	QP	3	300	-30.1	30.4	-60.5
717.240	V	1	270	QP	3	300	-21.1	30.4	-51.5

Table 3.3.1 Final Quasi peak measurements

Note 1: The graphical data of this test can be found in Appendix 5 of this report.

3.4 Radiated emissions (1GHz to 18GHz)

Mode of operation	Description	Mode No.
	100% microwave power	1

Test standard	Test description	Class/limit
CFR 47 Part 18	Radiated emissions	As defined in 18.305

Results	Figure	Result	Comments
	R02	N/A	Measurements were performed in an anechoic chamber.
	R03	Pass	These tests were performed on the open area test site.

Frequency (GHz)	1 Analyser Level (dBµV)	2 AF (dB/m)	3 Cable loss (dB)	4 Pre Amplifier Gain (dB)	(1+2+3-4) Average detector Result @3m dBµV/m	Limit@3m dBµV/m
2.200	45.83	27.84	2.22	35.93	39.96	70.36
2.308	42.99	28.03	2.22	35.93	37.31	70.36
2.544	44.07	28.29	2.55	35.93	38.98	70.36
2.714	41.80	29.12	2.55	35.93	37.54	70.36
7.344	27.83	36.74	5.31	35.38	34.23	70.36
8.436	23.91	37.31	5.74	35.77	31.19	70.36
8.574	27.49	37.40	5.62	35.77	34.74	70.36

Table 3.4.1 Horizontal measurements

Frequency (GHz)	1 Analyser Level (dBµV)	2 AF (dB/m)	3 Cable loss (dB)	4 Pre Amplifier Gain (dB)	(1+2+3-4) Average detector Result @3m dBµV/m	Limit@3m dBµV/m
2.200	51.00	27.84	2.22	35.93	45.13	70.36
2.652	46.00	28.63	2.55	35.93	41.25	70.36
2.662	44.17	28.63	2.55	35.93	39.42	70.36
8.556	25.96	37.34	5.62	35.77	33.15	70.36
8.562	27.06	37.40	5.62	35.77	34.31	70.36

Table 3.4.1 Vertical measurements

Note 1: The tests in the above table carried out between 1GHz to 2GHz and 3GHz to 18GHz were performed with a 2.4GHz notch filter connected, this was to avoid spurious harmonics from the magnetron fundamental frequency of 2.45GHz appearing in the measuring instrumentation. The bands between 2GHz and 3GHz were performed without the filter. Testing was performed over the frequency ranges 1000MHz to 18000MHz. Results were compared with the limit line as defined in 18.305 and scaled for a measurement distance of 3m.

Note 2: The above results >1GHz were recorded using an average detector.

3.5 Radiated emissions (18GHz to 24.5GHz)

Mode of operation	Description	Mode No.
	100% microwave power	1

Test standard	Test description	Class/limit
CFR 47 Part 18	Radiated emissions	As defined in 18.305

Results	Figure	Result	Comments
	R04	Pass	None

Note 1: The EUT was rotated from 0° to 360° and back to 0° whilst the peak emissions were recorded, with the antenna first in horizontal polarisation. This was then repeated with the antenna in vertical polarisation.

Note 2: No emissions were detected above the noise floor of the anechoic chamber when investigated at a distance of 3m.

Note 3: The graphical data can be found in Appendix 5 of this test report.

3.6 Calculation of Electric Field Strength Limit

ISM equipment operating on a frequency specified in Section 18.301 of the FCC Rules is permitted unlimited radiated energy in the band specified for that frequency.

The limit of field strength levels of emissions that lie outside the ISM bands is specified in Section 18.305 of the FCC rules as follows:

Where the operating frequency is within an ISM frequency band and where the output power is greater than 500W at a measurement distance of 300m the limit for radiated field strength outside of the ISM bands is:

$$\text{Limit}\,(\mu\text{V/m})\,\text{at}\,300\text{m} = 25\sqrt{\frac{P}{500}}$$

Where P is the measured output power of the oven in w (refer to section 3.1 of this test report).

In units of dBµV/m, and at a measurement distance of 3m the limit is calculated as:

$$\text{Limit}\,(\text{dB}\mu\text{V/m})\,\text{at}\,3\text{m} = 20\log_{10}\left(25\sqrt{\frac{P}{500}}\right) + 20\log_{10}\left(\frac{300}{3}\right)$$

The measured oven power P, was 870W (refer to section 3.1 of this test report). Using this measured value of P in above formula this gives a field strength limit of 70.4dBµV/m at a measurement distance of 3m.

The electric field strength between 100MHz and 24.5GHz was measured at 3m and compared to this limit calculated at 3m.

Note: Section 4.6.1 of FCC Document MP5 dated 1986 states that a conservative value of the field strength limit at closer distances than 300m may be calculated using inverse linear variation of field with distance.

4 Summary

4.1 Emissions

Standard	Test Description	Result
CFR 47 Part 18 (10-1-08 edition)	Conducted disturbance (AC mains port) 150kHz-30MHz, Limit as defined in 18.307	Pass
	Radiated disturbance (enclosure port) 30MHz-24.5GHz, Limit as defined in 18.305	Pass

4.2 Compliance statement

The Miele M6260 USA microwave oven, as tested was shown to meet the requirements of the tests listed in 4.1 of this report.

5 Appendices

5.1 Appendix 1 Conducted emission test method

5.1.1 Test information

Standard	CFR 47 Part 18 (10-1-08 edition)
YES Test Method	Based upon CEP19
Measurement uncertainty	+/- 2.38dB
Equipment Used	Rohde & Schwarz ESHS10 receiver Rohde & Schwarz ESH3-Z5 LISN Chase 9206 transient limiter

The conducted emissions from the ac power port were assessed from both the live and neutral lines with respect to earth.

For this test the EUT was placed in a screened room and the test carried out using equipment compliant to CISPR 16.

Following an initial measurement made with a peak detector, any disturbances within 10dB of the limit line were measured with a quasi-peak and average detector respectively.

5.2 Appendix 2 Radiated emission test method (30MHz to 1000MHz)

5.2.1 Test information

Standards	CFR 47 Part 18
YES Test Method	CEP23
Measurement uncertainty	±5dB
Equipment Used	Rohde & Schwarz receiver Bilog antenna Rohde & Schwarz positioning mast and controller EMCO 2m diameter turntable and controller 80cm non conducting test table

Pre-compliance measurement in an anechoic chamber

The radiated emissions from the enclosure port of the EUT were initially assessed in an anechoic chamber at a test distance of 3m, using an X Wing Bilog antenna at a fixed height of 1.5m. The measurement was made using a peak detector and the emissions were assessed with the antenna in both horizontal and vertical polarisation on the four faces of the EUT i.e. 0°, 90°, 180° and 270°. The purpose of these preliminary investigations is to highlight any frequencies within 15dB of the applied limit line. Any identified frequencies inside the anechoic chamber are then maximised on the open area test site.

Compliance measurement on the Open Area Test Site (OATS)

Any disturbances within 10dB of the limit line, or as a minimum the 10 highest values found during the anechoic chamber scans, were measured with a quasi-peak detector on the OATS using equipment compliant with CISPR16. The EUT was rotated 360°, the antenna was orientated in both horizontal and vertical polarisation with the mast scanned from 1m to 4m to maximise the Quasi-Peak values at the identified frequencies.

5.3 Appendix 3 Radiated emission test method (1GHz to 24.5GHz)

5.3.1 Test information

Standards	CFR 47 Part 18 (10-1-08 edition)
YES Test Method	CEP27
Measurement uncertainty	±4.86dB
Equipment Used	Anritsu spectrum analyser HP Pre-amplifier Horn antenna EMCO turntable and controller 80cm non conducting (plastic) table

Pre-compliance measurement in an anechoic chamber

The radiated emissions from the enclosure port of the EUT were initially assessed in an anechoic chamber at a test distance of 3m, using a horn antenna at a fixed height, directed towards the radiation centre of the EUT. The measurement was made using a peak detector and the emissions were assessed with the antenna in both horizontal and vertical polarisation with the EUT rotated 360°.

Compliance measurement on the Open Area Test Site (OATS)

The highest values found during the anechoic chamber scans, were measured with an average detector on the OATS. The EUT was rotated 360°, the antenna was orientated in both horizontal and vertical polarisation with the mast scanned from 1m to 4m to maximise the values at the identified frequencies.

5.4 Appendix 4 Conducted emission test results

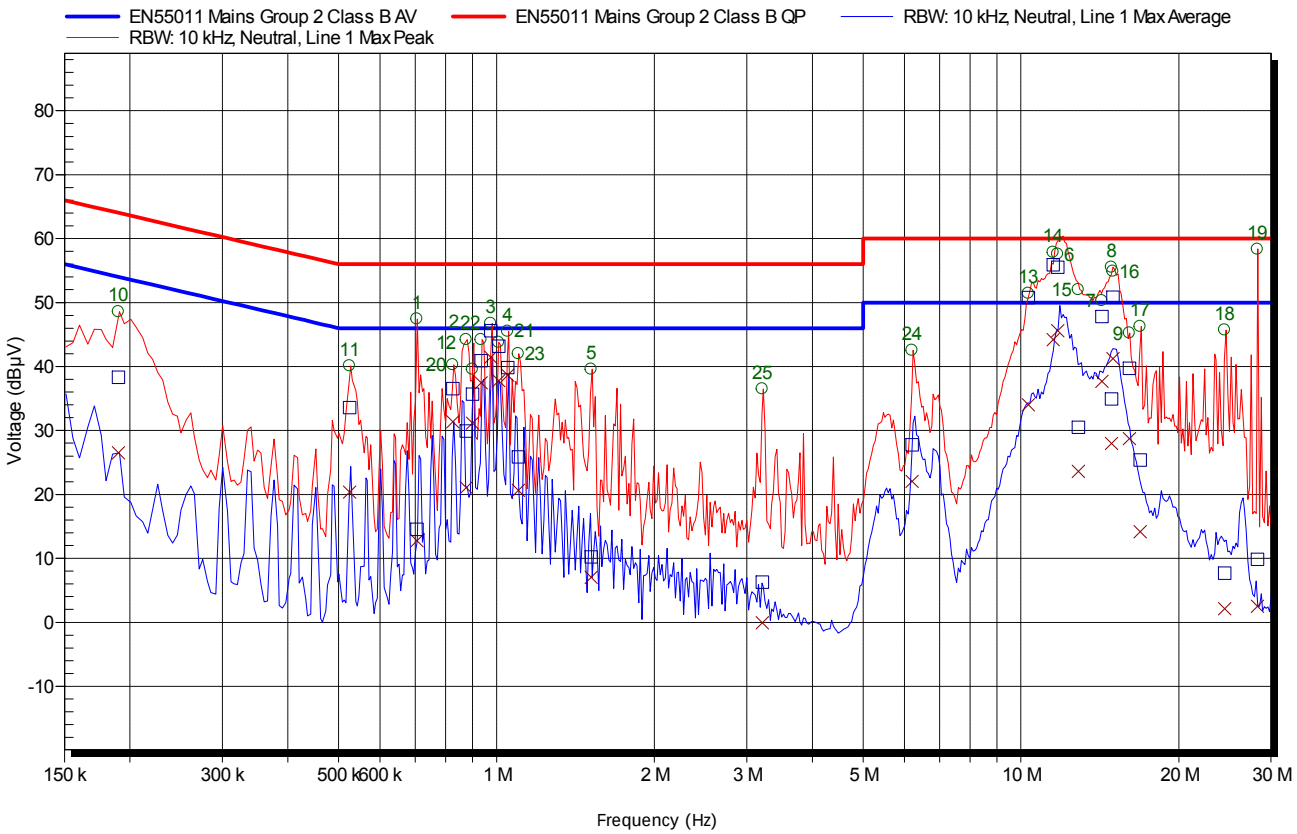


Figure 5.4.1 Conducted emissions results, (C01).

5.5 Appendix 5 Radiated emission test results

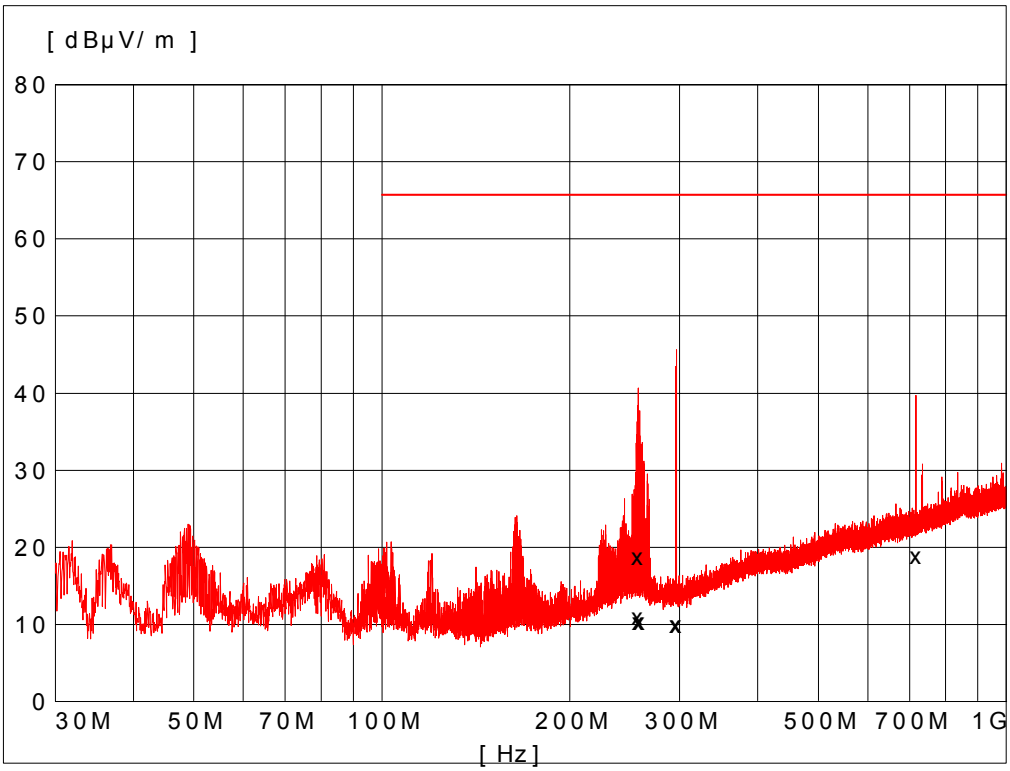


Figure 5.5.1 Radiated emissions results (R01, Peak Detector Chamber – information only).

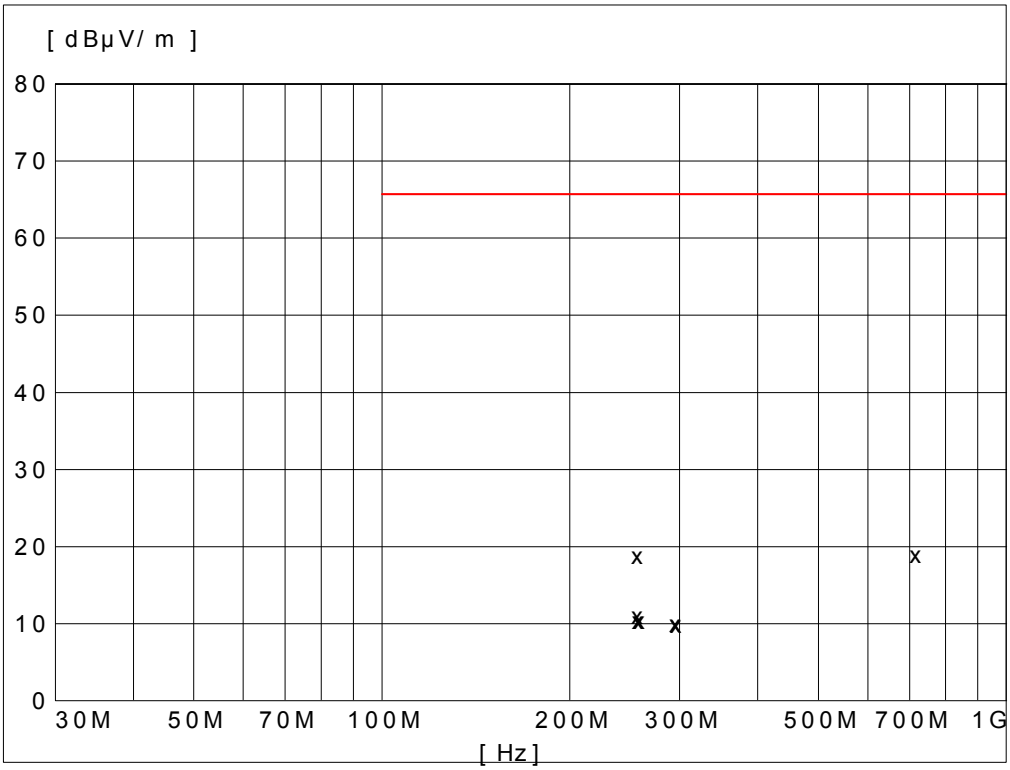


Figure 5.5.2 Radiated emissions results (R02, OATS) – Maximised Quasi Peak data.

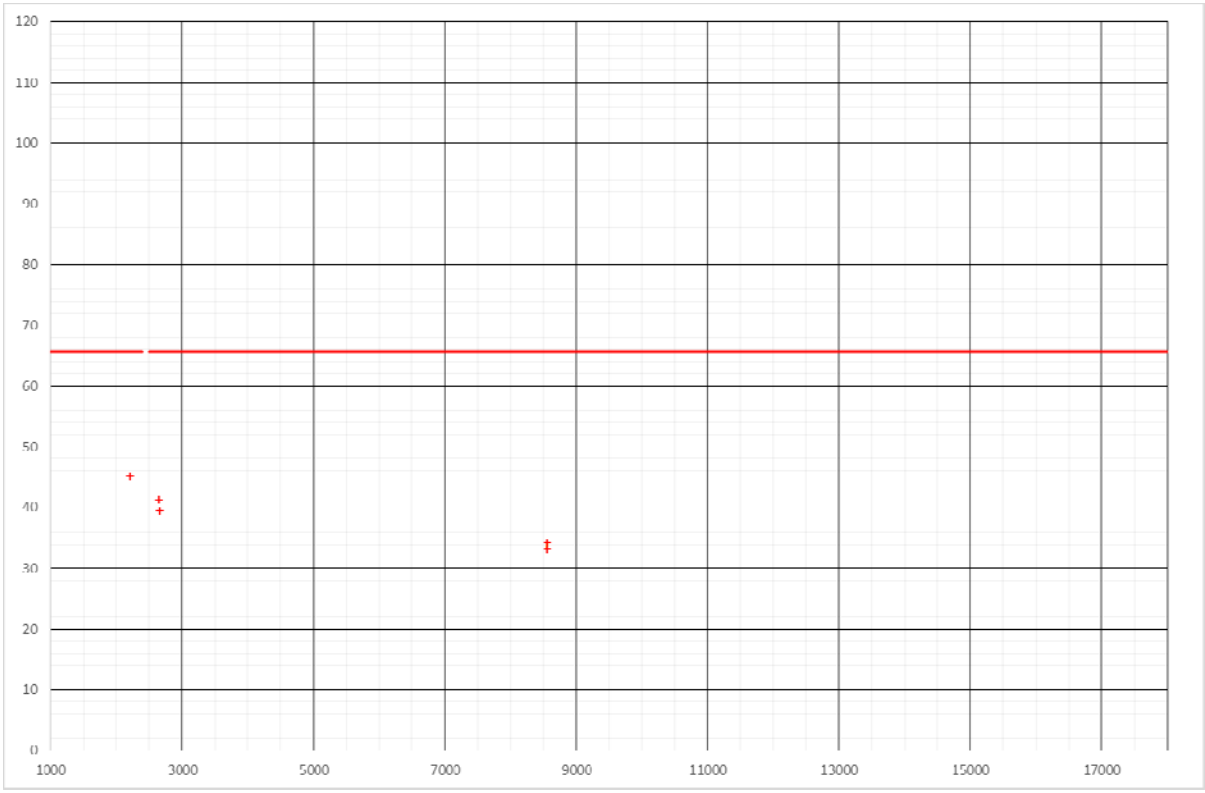


Figure 5.5.3 Radiated emissions Average results Vertical 1-18GHz (R03)

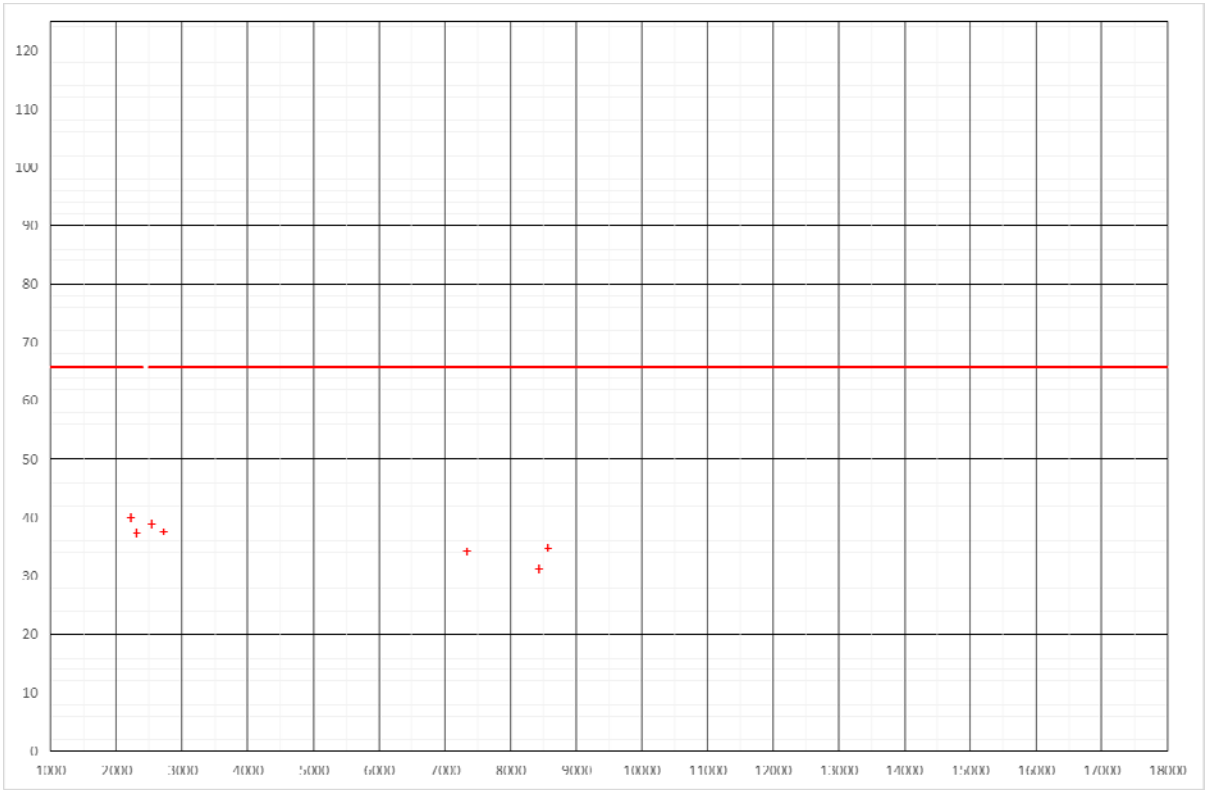


Figure 5.5.4 Radiated emissions Average results horizontal 1-18GHz (R04)

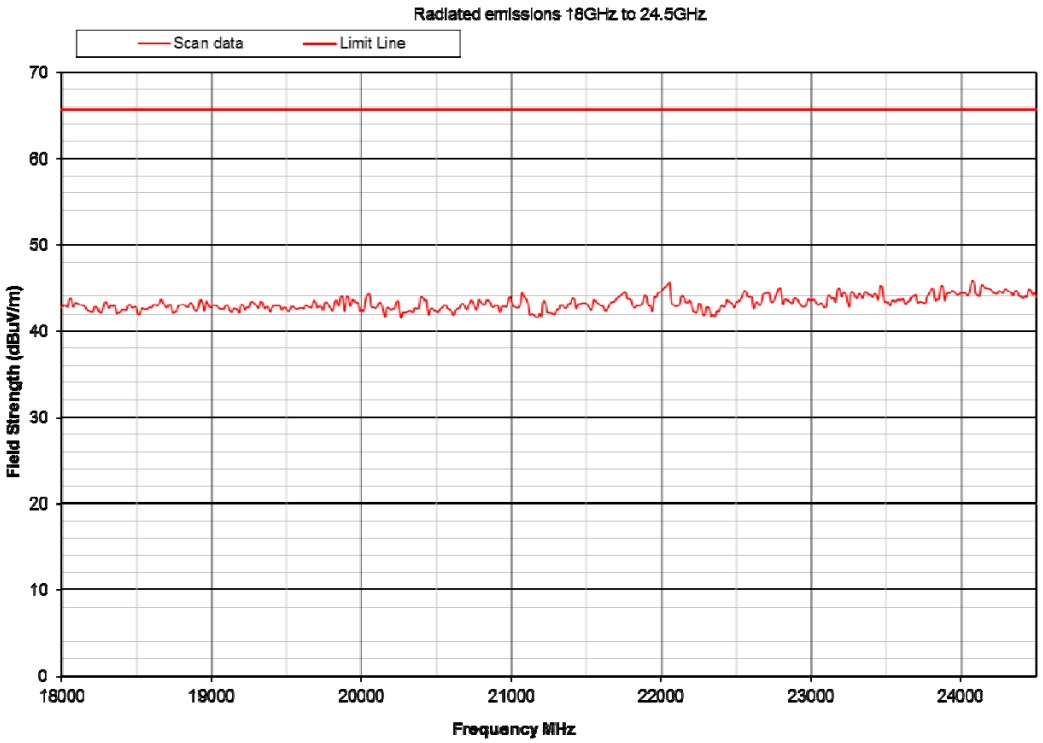


Figure 5.5.5 Radiated emissions, Peak scan, Vertical, 18GHz to 24.5GHz

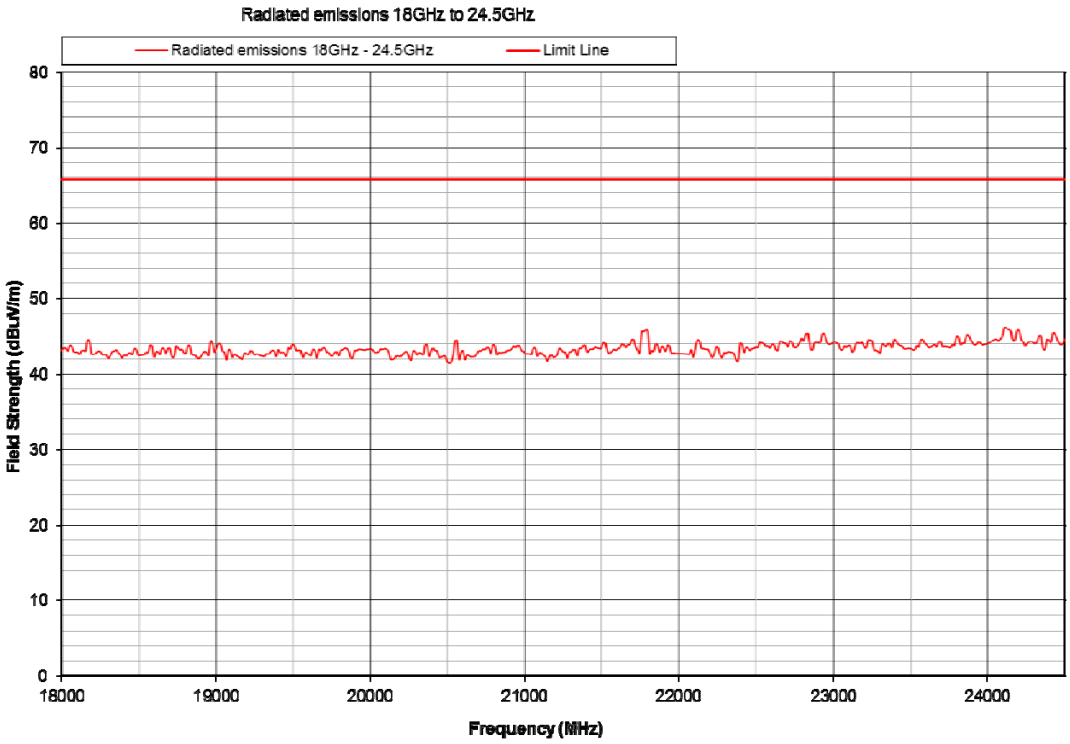


Figure 5.5.6 Radiated emissions, Peak scan, Horizontal, 18GHz to 24.5GHz

Note: The graphs shown in this Appendix contain the limit line extrapolated for a 3m measurement distance

5.6 Appendix 6 Frequency variation measurements

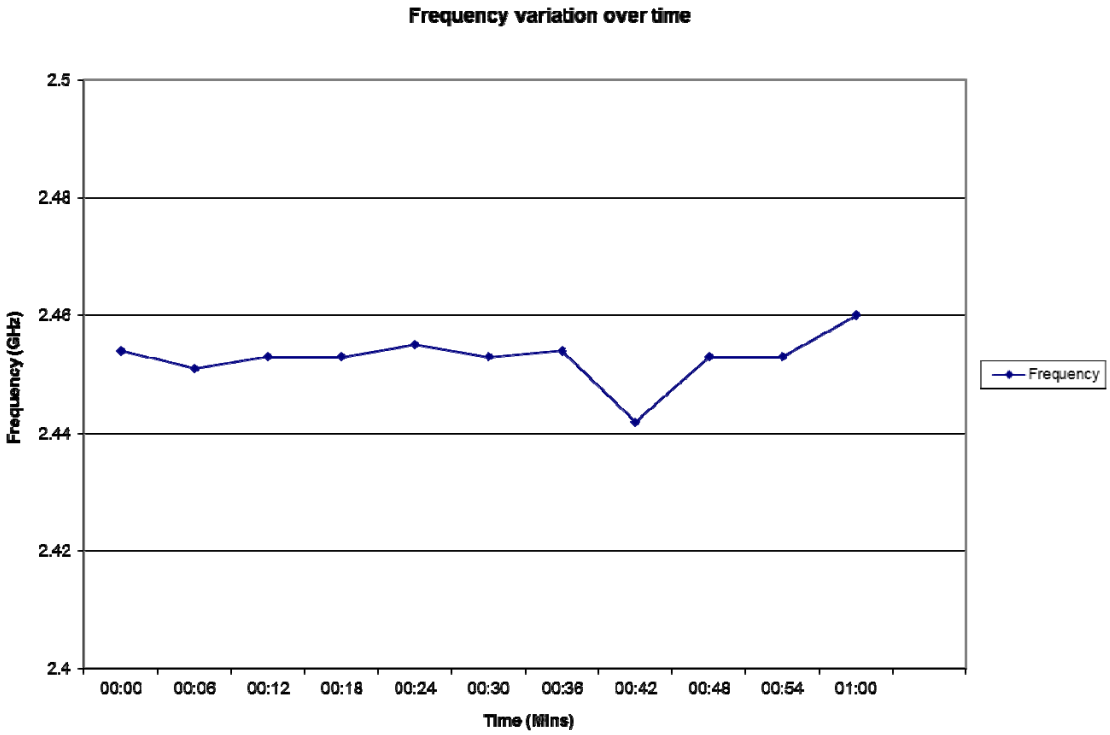


Figure 5.6.1 Frequency variation over time.

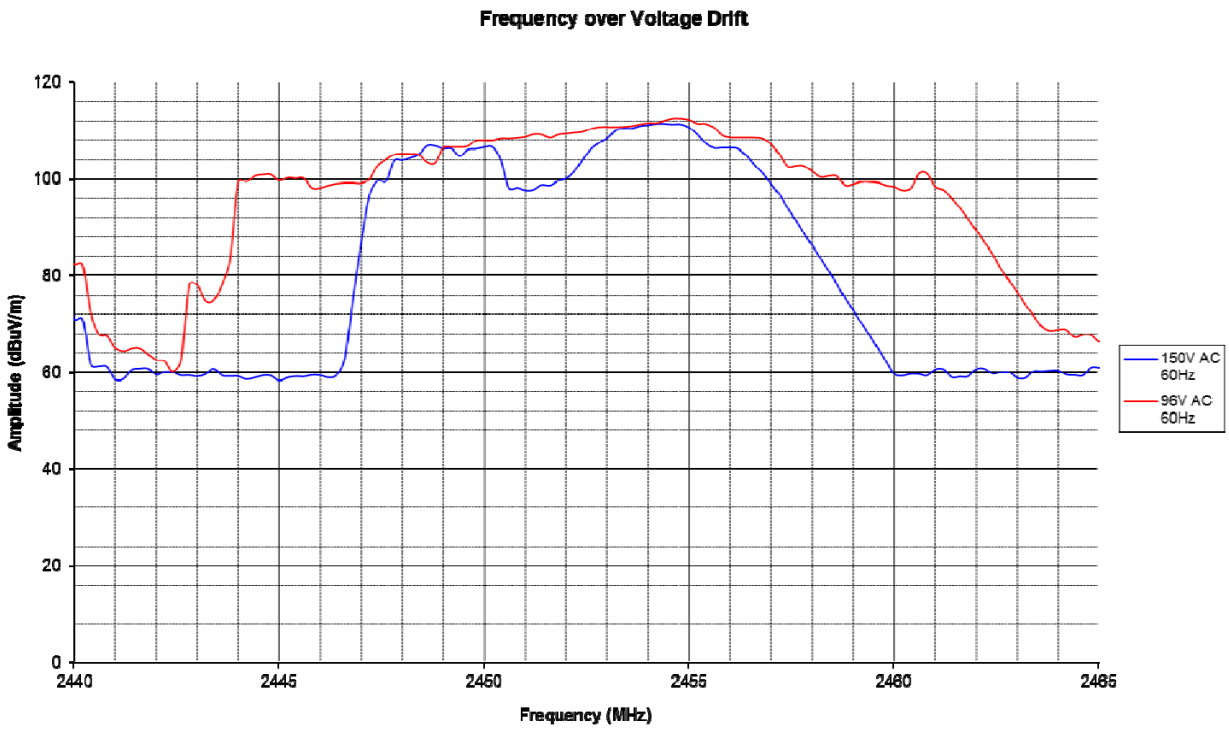
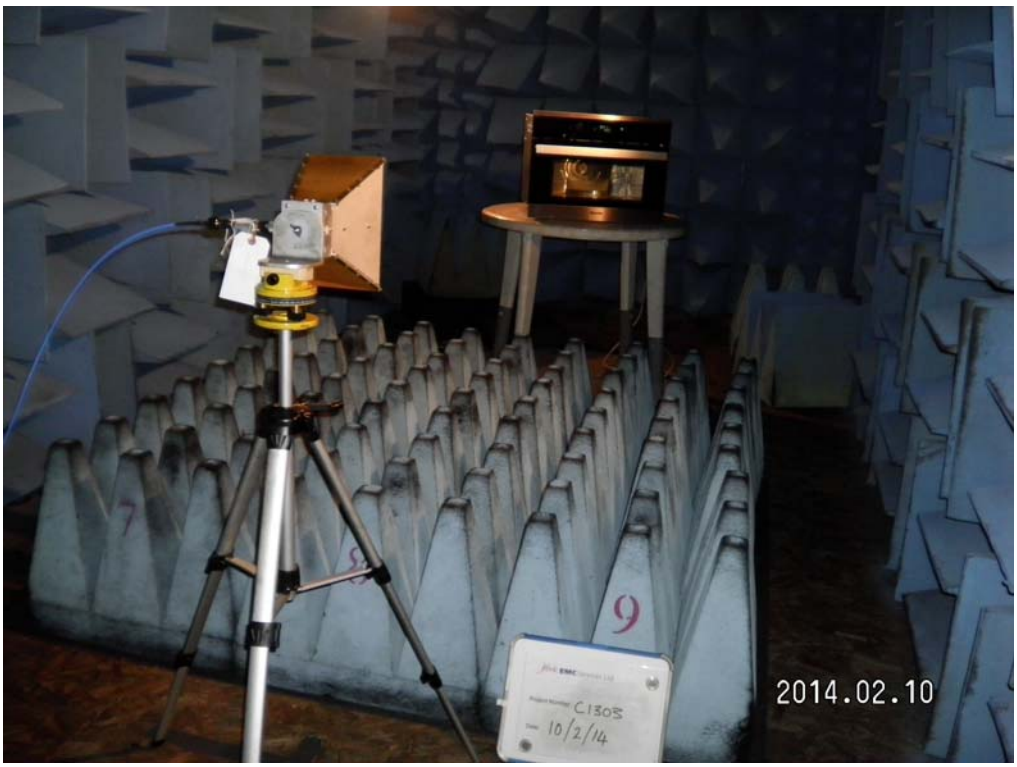


Figure 5.6.2 Frequency variation over voltage.

5.7 Appendix 7 EUT test configurations

Photograph 5.7.1 Conducted emissions testing.

Photograph 5.7.2 Radiated emissions testing 30MHz-1GHz (Anechoic chamber)



Photograph 5.7.3 Radiated emissions testing above 1GHz (Anechoic chamber)

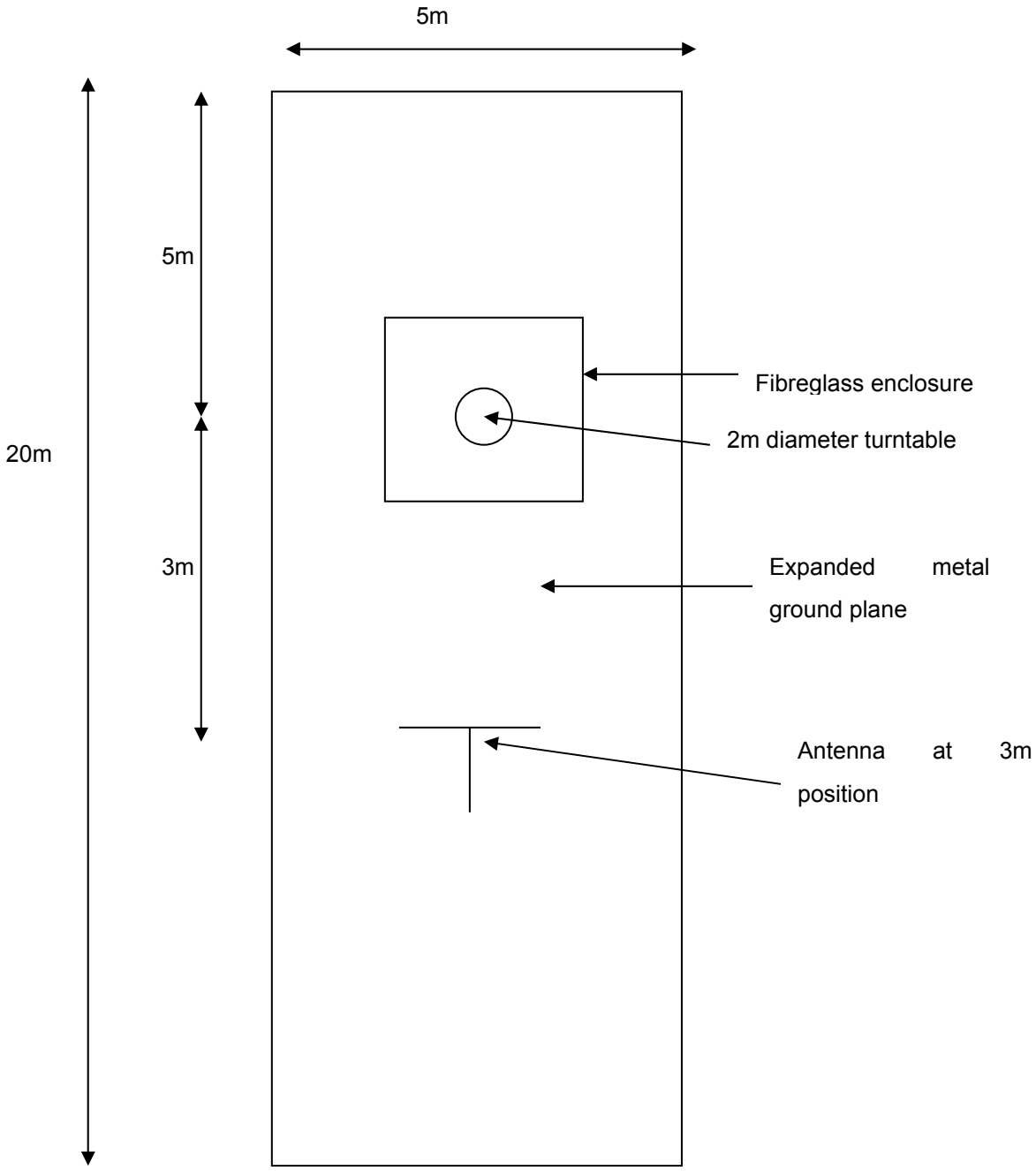
5.8 Appendix 8 Equipment used

Equipment	No.	Cal Type	Used	Equipment	No.	Cal Type	Used
AR FM2000 Field Probe Set	78211	UKAS		R&S SMT06 Signal Generator	78653	UKAS	
Blackstar Function Generator	78200	In-house		Schaffner NSG1025 EFT/B Gen	78136	UKAS	
Chase Van Veen Loop	78217	In-house		Schaffner NSG2025 EFT/B Gen	78006	UKAS	
Chase CBL 6111A Bilog Antenna	78167	UKAS		Schaffner NSG2050 + PNW2055	78178	UKAS	
Chase CBL 6112B Bilog Antenna	78708	UKAS	✓	R&S SMT06 Signal Generator	79124	UKAS	
Chase CBL 6140 X-Wing Antenna	78310	In-house	✓	Lem-Heme Current Probe	78482	NCS	
Chase CFL 9206 Transient Limiter	78101	In-house		Schaffner NSG435 ESD Simulator	78008	UKAS	
Chase CFL 9206 Transient Limiter	78087	In-house	✓	Schaffner INA 172 surge CDN	78462	In-house	
Chase HLA6120 Loop Antenna	78128	NPL		Schaffner NSG650 + CDN113	78478	UKAS	
Chase MDS21 Absorbing Clamp	78195	UKAS		Schaffner NSG2050 + PNW2056	78458	UKAS	
Fischer FCC-801-M1-16 CDN	78240	UKAS		Schaffner voltage probe CVP2200	78596	UKAS	
Fischer FCC-801-M2-25 CDN	78241	UKAS		Schaffner current probe SMZ11	78569	UKAS	
Fischer FCC-801-M2-16 CDN	78400	UKAS		Schaffner current probe	79020	UKAS	
Fischer FCC-801-M3-16 CDN	78044	UKAS		Schaffner 40 ohm load	78570	In-house	
Fischer FCC-801-M3-25 CDN	78242	UKAS		Schaffner Chase CBL6111C	78707	UKAS	
Fischer FCC-801-M4-25 CDN	78045	UKAS		Schaffner Chase CBL6112B	78708	Manufac	
Emco 3115 Horn Antenna	78347	UKAS	✓	Schaffner INA 175 surge CDN	78461	In-house	
3116 40GHz Horn Antenna	78951	UKAS	✓	Solar 9108-IN Current Probe	78545	UKAS	
Fluke 45 Digital Mutimeter	78655	UKAS		California Inst PACS-1 analyser	79135	UKAS	
Fluke 85 Digital Mutimeter	78375	UKAS		California Inst 5000 iX Power supply	79136	UKAS	✓
Gould 475 Digital Oscilloscope	78057	UKAS		Fischer FCC-801-M3-25 CDN	79008	UKAS	
HP LF spectrum analyser	79129	UKAS		Fischer FCC-801 M1-16 CDN	79001	UKAS	
HP 8449B Pre-amplifier	C0221	UKAS	✓	EM Test UCS 500	79059	UKAS	
Anritsu MS2667C Analyser	78490	UKAS	✓	CDN 118	78460	NCS	
2.4GHz notch filter	79178	UKAS	✓	Schaffner clamp	79045	In-house	
ISO-TECH 9053 LCR meter	78487	NCS		Keytek AC line qualifier	78350	UKAS	
Keytek EMC Pro	78348	UKAS		Spitzenberger & Spies	78131	NCS	
Keytek MZ-15/EC ESD Simulator	78133	UKAS		Arb Waveform Generator	79116	In-house	
LEM HEME clamp	78483	NCS		6dB attenuator	79073	In-house	
Intek Function Generator	78673	UKAS		HP Dynamic Signal Analyzer	79121	In-house	
Rolfe Heine NNB 32A LISN	78205	UKAS	✓	Magnetic immunity loop (multi)	78722	In-house	
R&S ESH3-Z5 LISN	78119	UKAS		Wandel & Golterman EFA-2	78551	Manufac	
R&S ESHS 10 Receiver	78035	UKAS		Schaffner EFT/B clamp	79184	In-house	
R&S ESHS10 Receiver	79182	UKAS	✓	Wandel & Golterman EMC 20	79005	Manufac	
R&S ESVS 30 Receiver	79183	UKAS	✓	AR50S/G4A Amplifier	79095	NCS	
R&S ESVS 10 Receiver	78036	UKAS		AR FM2000 Field Probe Set	78108	UKAS	
R&S ESVS 30 Receiver	78107	UKAS	✓	650V Transformer	78123	In-House	
Schaffner Profline	78374	UKAS		HCP	79099	In-house	
Variac	78192	In-house		VCP	79102	In-house	
MV 2616	79149	In-house		EFT 503	79132	UKAS	
Schaffner Discontinuous Analyser	79215	UKAS		Fischer clamp	78043	In-house	
Variac	78688	In-house		Thermometer and K-Type Thermocouple	79242	UKAS	✓

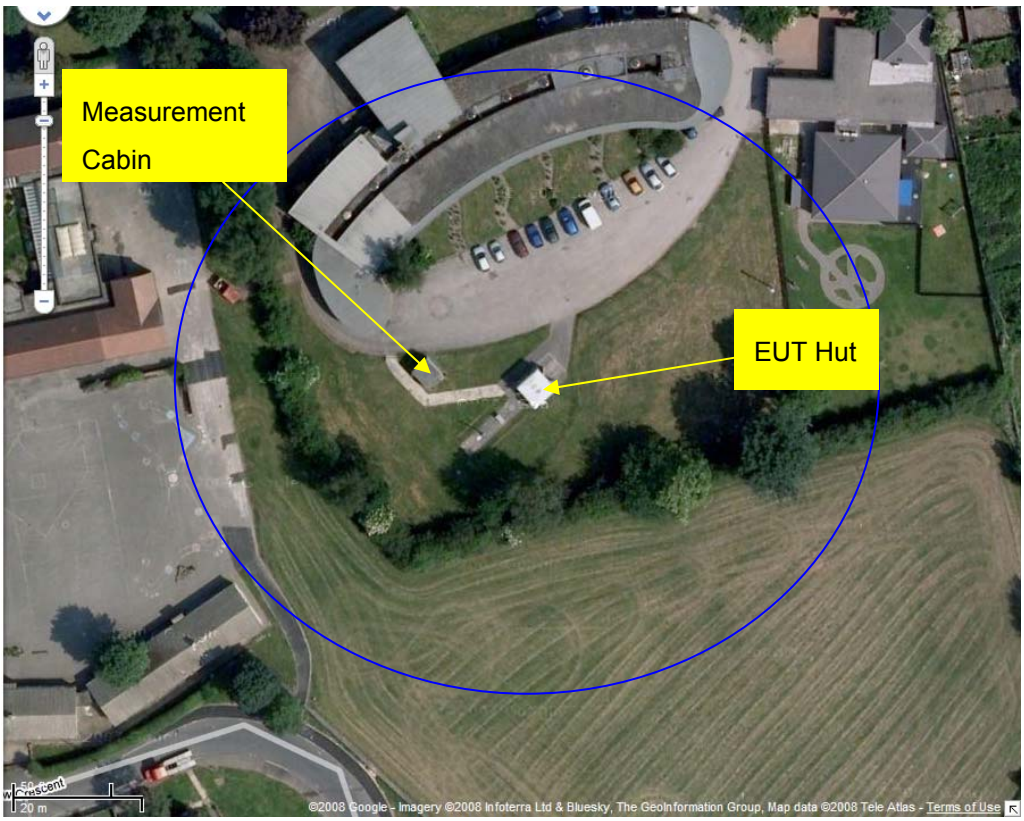
NCS-Not on calibration schedule

5.9 Appendix 9 Open Area Test Site Description

The Open Area Test Site (OATS) is constructed of welded expanded galvanised steel “Expamet” with major aperture size of approximately 28mm. The ground plane was approximately 20mx5m fitted with a 2m diameter flush mounted turntable, covered with a fibreglass enclosure approximately 4.3m x 4.3m x 3.5m high. This enclosure is fitted with double doors at both the front and rear, and has an apex height of approximately 3.5m. The site was fitted with a Rohde and Schwarz antenna mast, which was bolted to the ground plane at a 3m measurement position. No other objects were located within the CISPR ellipse. A “portacabin” type building (approximately 3.9mx3.3m was located to one side of the site, approximately 8.6m from the edge of the ground plane and containing the measuring equipment.



Open Area Test Site Dimensions



Open area test site, via Google, showing all structures within the estimated 5 times the distance between the measuring set and the EUT.

5.10 Appendix 10 Calibration data

Yes No.	Equipment description	Calibration Date	Calibration Frequency
79182	9kHz-30MHz R&S ESHS 10 Receiver	27/12/2013	12 Months
78205	Rolfe Heine 32A LISN	26/07/2013	24 Months
78087	CFL9206 Transient limiter	09/12/2013	12 Months
79183	30MHz-1000MHz R&S ESVS 30 Receiver	25/09/2013	12 Months
78107	30MHz-1000MHz R&S ESVS 30 Receiver	27/12/2013	12 Months
78310	Chase X-Wing Bilog antenna- Used for initial pre-compliance chamber measurements	09/01/2013	12 Months
78708	CBL6112B Green Bilog antenna – used for OATS tests	17/12/2013	12 Months
78347	EMCO 3115 horn antenna	02/01/2014	24 Months
78951	EMCO 3116 40GHz horn antenna	14/02/2013	60 Months
78490	Anritsu MS2667C Spectrum analyser	27/12/2013	12 Months
C0221	HP 8449B Pre-amplifier	26/11/2012	24 Months
79178	Microtronics BRM13134 2.4GHz Notch filter	23/12/2013	24 Months
79242	Digital Thermometer and K-Type Thermocouple	01/10/2013	12 Months

5.11 Appendix 11 Test Report History

Issue	Modification details
1	Original issue of the test report
2	Re-measurement of the output power. Results amended and Limit line re-scaled.
3	Radiated emissions limits amended to the correct value. Horn Antenna Cal date corrected.