Radio Test Report

for

Widex A/S

on

D-FS

Document No: TRA-007944-W-US1

Total number of pages: 32

TRaC Wireless Test Report	**:** TRA-007944-W-US1
Applicant	**:** Widex A/S
Apparatus	**:** D-FS
Specification(s)	**:** CFR 47, Part 15, June 2011
Purpose of Test	**:** Certification
FCCID	**:** TTY-DFS
IC ID	**:** 5676B-DFS
Authorised by	**:**  Radio Product Manager
Issue Date	**:** 29th November 2011
Authorised Copy Number	**:** *PDF*

Contents

Section 1: Introduction	4
1.1 General	4
1.2 Tests Requested By	5
1.3 Manufacturer	5
1.4 Apparatus Assessed	5
1.5 Test Result Summary	6
1.6 Notes relating to the assessment	7
1.7 Deviations from Test Standards	7
Section 2: Measurement Uncertainty	8
2.1 Measurement Uncertainty Values	8
Section 3: Modifications	10
3.1 Modifications Performed During Assessment	10
Appendix A: Formal Emission Test Results	11
A1 Transmitter Intentional Emission Radiated	12
A2 Radiated Spurious Emissions	13
A3 Unintentional Radiated Emissions	15
Appendix B: Supporting Graphical Data	17
Appendix C: Additional Test and Sample Details	20
C1 Test samples	21
C2 EUT operating mode during testing	22
C3 EUT Configuration Information	23
C4 List of EUT Ports	24
C5 Details of Equipment Used	25
Appendix D: Additional Information	26
Appendix E: Calculation of the duty cycle correction factor	27
Appendix F: Photographs and Figures	28
Appendix G: MPE Calculation	30
Appendix H: Cross Reference FCC Part 15c to IC RSS 210	31

Section 1: Introduction

1.1 General

This report contains an assessment of an apparatus against Electromagnetic Compatibility Standards based upon tests carried out on samples submitted to the Laboratory.

Test performed at:

☐ TRaC Global
Unit E
South Orbital Trading Park
Hedon Road
Hull HU9 1NJ.
United Kingdom

Telephone: +44 (0) 1482 801801
Fax: +44 (0) 1482 801806

☑ TRaC Global
Unit 1
Pendle Place
Pimbo Industrial Estate
Skelmersdale WN8 9PN
United Kingdom

Telephone: +44 (0) 1695 556666
Fax: +44 (0) 1695 577077

Email: test@tracglobal.com
Web site: http://www.tracglobal.com

Tests performed by: Steve Hodgkinson

Report author: Sandeep Bharat

1.2 Tests Requested By

This testing in this report was requested by:

Widex A/S
Nymoellevej 6
DK-3540 Lynge
Denmark

1.3 Manufacturer

Widex A/S
Nymoellevej 6
DK-3540 Lynge
Denmark

1.4 Apparatus Assessed

The following apparatus was assessed between 21-11-2011 and 23-11-2011:

D-FS

The above equipment is a hearing aid containing radio circuitry operating at 10.6 MHz

1.5 Test Result Summary

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

The statements relating to compliance with the standards below apply ONLY as qualified in the notes and deviations stated in sections 1.6 to 1.7 of this test report.

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

Test Type	Regulation	Measurement standard	Result
Spurious Emissions Radiated <1000MHz	Title 47 of the CFR: Part 15 Subpart (c) 15.209	ANSI C63.10	Pass
Spurious Emissions Radiated >1000MHz	Title 47 of the CFR: Part 15 Subpart (c)	ANSI C63.10	N/A
AC Power conducted emissions	Title 47 of the CFR: Part 15 Subpart (c) 15.207	ANSI C63.10	N/A
Intentional Emission Frequency	Title 47 of the CFR: Part 15 Subpart (c) 15.209	ANSI C63.10	Pass
Intentional Emission Field Strength:	Title 47 of the CFR: Part 15 Subpart (c) 15. 209	ANSI C63.10	Pass
Intentional Emission Band Occupancy	Title 47 of the CFR: Part 15 Subpart (c) 15.215	ANSI C63.10	Pass
Intentional Emission ERP (mW)	Title 47 of the CFR: Part 15 Subpart (c)	ANSI C63.10	N/A
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart (b) 15.109	ANSI C63.10	Pass
Antenna Arrangements Integral:	Title 47 of the CFR: Part 15 Subpart (c) 15.203	-	Pass
Antenna Arrangements External Connector	Title 47 of the CFR: Part 15 Subpart (c) 15.204	-	-
Restricted Bands	Title 47 of the CFR: Part 15 Subpart (c) 15.205	-	-
Maximum Frequency Of Search	Title 47 of the CFR: Part 15 Subpart (c) 15.33	-	-
Extrapolation Factor	Title 47 of the CFR: Part 15 Subpart (c) 15.31(f)	-	-

Abbreviations used in the above table:

CFR : Code of Federal Regulations
REFE : Radiated Electric Field Emissions
ANSI : American National Standards Institution
PLCE : Power Line Conducted Emissions

1.6 Notes relating to the assessment

With regard to this assessment, the following points should be noted:

The results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 1.7 of this test report (Deviations from Test Standards).

For emissions testing, throughout this test report, “Pass” indicates that the results for the sample as tested were below the specified limit (refer also to Section 2, Measurement Uncertainty).

Where relevant, the apparatus was only assessed using the monitoring methods and susceptibility criteria defined in this report.

All testing with the exception of testing at the Open Area Test Site was performed under the following environmental conditions:

Temperature	: 17 to 23 °C
Humidity	: 45 to 75 %
Barometric Pressure	: 86 to 106 kPa

All dates used in this report are in the format dd/mm/yy.

This assessment has been performed in accordance with the requirements of ISO/IEC 17025.

1.7 Deviations from Test Standards

There were no deviations from the standards tested to.

Section 2: Measurement Uncertainty

2.1 Measurement Uncertainty Values

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence where no required test level exists.

[1] Adjacent Channel Power

Uncertainty in test result = **1.86dB**

[2] Carrier Power

Uncertainty in test result (Power Meter) = **1.08dB**
Uncertainty in test result (Spectrum Analyser) = **2.48dB**

[3] Effective Radiated Power

Uncertainty in test result = **4.71dB**

[4] Spurious Emissions

Uncertainty in test result = **4.75dB**

[5] Maximum frequency error

Uncertainty in test result (Power Meter) = **0.113ppm**
Uncertainty in test result (Spectrum Analyser) = **0.265ppm**

[6] Radiated Emissions, field strength OATS 14kHz-18GHz Electric Field

Uncertainty in test result (14kHz – 30MHz) = **4.8dB**,
Uncertainty in test result (30MHz – 1GHz) = **4.6dB**,
Uncertainty in test result (1GHz – 18GHz) = **4.7dB**

[7] Frequency deviation

Uncertainty in test result = **3.2%**

[8] Magnetic Field Emissions

Uncertainty in test result = **2.3dB**

[9] Conducted Spurious

Uncertainty in test result – Up to 8.1GHz = **3.31dB**
Uncertainty in test result – 8.1GHz – 15.3GHz = **4.43dB**
Uncertainty in test result – 15.3GHz – 21GHz = **5.34dB**
Uncertainty in test result – Up to 26GHz = **3.14dB**

[10] Channel Bandwidth

Uncertainty in test result = **15.5%**

[11] Amplitude and Time Measurement – Oscilloscope

Uncertainty in overall test level = **2.1dB**,
Uncertainty in time measurement = **0.59%,**
Uncertainty in Amplitude measurement = **0.82%**

[12] Power Line Conduction

Uncertainty in test result = **3.4dB**

[13] Spectrum Mask Measurements

Uncertainty in test result = **2.59% (frequency)**
Uncertainty in test result = **1.32dB (amplitude)**

[14] Adjacent Sub Band Selectivity

Uncertainty in test result = **1.24dB**

[15] Receiver Blocking – Listen Mode, Radiated

Uncertainty in test result = **3.42dB**

[16] Receiver Blocking – Talk Mode, Radiated

Uncertainty in test result = **3.36dB**

[17] Receiver Blocking – Talk Mode, Conducted

Uncertainty in test result = **1.24dB**

[18] Receiver Threshold

Uncertainty in test result = **3.23dB**

[19] Transmission Time Measurement

Uncertainty in test result = **7.98%**

Section 3: Modifications

3.1 Modifications Performed During Assessment

No modifications were performed during the assessment

Appendix A: Formal Emission Test Results

Abbreviations used in the tables in this appendix:

Spec	: Specification
Mod	: Modification
EUT	: Equipment Under Test
SE	: Support Equipment
L	: Live Power Line
N	: Neutral Power Line
E	: Earth Power Line
Pk	: Peak Detector
QP	: Quasi-Peak Detector
Av	: Average Detector
CDN	: Coupling & decoupling network
ALSR	: Absorber Lined Screened Room
OATS	: Open Area Test Site
ATS	: Alternative Test Site
Ref	: Reference
Freq	: Frequency
MD	: Measurement Distance
SD	: Spec Distance
Pol	: Polarisation
H	: Horizontal Polarisation
V	: Vertical Polarisation

A1 Transmitter Intentional Emission Radiated

Test Details	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.209(b)(1)
Measurement standard	ANSI C63.10:2009
EUT sample number	S03-2
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1

Frequency (MHz)	Measurement Distance (m)	Measurement Rx Reading (dBµV/m)	Extrapolation Factor (dB)	Field Strength (µV/m)
10.39308	1	34.2	59.1	0.057
Limit value @ frequency		**30 µV/m**		
Band occupancy @ -20 dBc		**f_{lower}(MHz)**	**f_{higher}(MHz)**	
		10.266667	10.949358	
		BW = 682.691 kHz		

Notes:
1 Results quoted are extrapolated as indicated
2 Receiver detector @ fc = Quasi Peak, 10 kHz bandwidth
3 When battery powered the EUT was powered with new batteries
4 Extrapolation 1 - 30 Meters 59.1 dB as per 15.31(f)
5 Band occupancy plot is provided in Annex B
6 Due to the low level of the signal, measurements at distances greater than 1 m could not be made

Test Method:
1 As per Radio – Noise Emissions, ANSI C63.10
2 Measuring distance = 1m
3 EUT 0.8 m above ground plane
4 Emissions maximized by rotation of EUT, on an automatic turntable
5 Raising and lowering the receiver antenna between 1m & 4m
6 Horizontal and vertical polarizations, of the receive antenna
7 EUT orientation in three orthogonal planes
8 Maximum results recorded

A2 Radiated Spurious Emissions

Preliminary scans were performed using a peak detector with CISPR bandwidths. The radiated electric field emission test applies to all spurious emissions and harmonics emissions. The maximum permitted field strength is listed in Section 15.209. The EUT was set to transmit as required.

The following test site was used for final measurements as specified by the standard tested to:

3m open area test site : ☐ 3m alternative test site : ☒

The effect of the EUT set-up on the measurements is summarised in note (c) below.

Test Details	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.209
Measurement standard	ANSI C63.10:2009
Frequency range	9kHz – 1000MHz
EUT sample number	S03-2
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photographs 1 and 2

Ref No.	Frequency (MHz)	Measured at Rx (dBµV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-Amp Gain (dB)	Field Strength (dBµV/m)	Extrapolation Factor (dB)	Field Strength (µV/m)	Limit (µV/m)
No Significant Emissions Within 20 dB of the limit									

Notes:

1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10: section 4.5, Table 1. For emissions below 30MHz the cable losses are assumed to be negligible.
2 In accordance with 15.35(b), above 1 GHz, emissions measured using a peak detector shall not exceed a level 20 dB above the average limit.
3 Testing was performed with the EUT orientated in three orthogonal planes and the maximum emissions level recorded. In addition, the EUT antenna was varied within its range of motion in order to maximise emissions.
4 For Frequencies below 1 GHz, RBW= 120 kHz, testing was performed with CISPR16 compliant test receiver with QP detector. Above 1 GHz tests were performed using a spectrum analyser using the following settings:

Peak	RBW=VBW= 1MHz
Average	RBW=VBW= 1MHz

The upper and lower frequency of the measurement range was decided according to 47 CFR Part 15:2011 Clause 15.33(a) and 15.33(a)(1).

Radiated emission limits 47 CFR Part 15: Clause 15.209 for all emissions:

Frequency of emission (MHz)	Field strength μV/m	Measurement Distance m	Field strength dBμV/m
0.009-0.490	2400/F(kHz)	300	67.6/F (kHz)
0.490-1.705	24000/F(kHz)	30	87.6/F (kHz
1.705-30	30	30	29.5
30-88	100	3	40.0
88-216	150	3	43.5
216-960	200	3	46.0
Above 960	500	3	54.0

(a) Where results have been measured at one distance, and a signal level displayed at another, the results have been extrapolated using the following formula:

$$\text{Extrapolation}\,(\text{dB}) = 20\log_{10}\left(\frac{\text{measurement distance}}{\text{specification distance}}\right)$$

(b) The levels may have been rounded for display purposes.

(c) The following table summarises the effect of the EUT operating mode, internal configuration and arrangement of cables / samples on the measured emission levels:

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels		✓		
Effect of EUT internal configuration on emission levels		✓		
Effect of Position of EUT cables & samples on emission levels	✓			

(i) Parameter defined by standard and / or single possible, refer to Appendix D
(ii) Parameter defined by client and / or single possible, refer to Appendix D
(iii) Parameter had a negligible effect on emission levels, refer to Appendix D
(iv) Worst case determined by initial measurement, refer to Appendix D

A3 Unintentional Radiated Emissions

Preliminary scans were performed using a peak detector with the RBW = 100 kHz. The radiated electric filed emission test applies to all spurious emissions on directly related to the transmitter. The maximum permitted field strength is listed in Section 15.109. The EUT was set to operate in transmit standby / receive mode.

The following test site was used for final measurements as specified by the standard tested to:

3m open area test site : ☐ 3m alternative test site : ☒

The effect of the EUT set-up on the measurements is summarised in note (c) below.

Test Details	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.109
Measurement standard	ANSI C63.10:2009
Frequency range	30MHz – 1000MHz
EUT sample number	S03-1
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photographs 1 and 2

The worst case radiated emission measurements for spurious emissions are listed below:

Ref No.	Frequency (MHz)	Measured at Rx (dBµV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-Amp Gain (dB)	Field Strength (dBµV/m)	Extrapolation Factor (dB)	Field Strength (µV/m)	Limit (µV/m)
No Significant Emissions Within 20 dB of the limit									

Notes:

1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10: section 4.5, Table 1. For emissions below 30MHz the cable losses are assumed to be negligible.
2 In accordance with 15.35(b), above 1 GHz, emissions measured using a peak detector shall not exceed a level 20 dB above the average limit.
3 Testing was performed with the EUT orientated in three orthogonal planes and the maximum emissions level recorded. In addition, the EUT antenna was varied within its range of motion in order to maximise emissions.
4 For Frequencies below 1 GHz, RBW = 120 kHz, testing was performed with CISPR16 compliant test receiver with QP detector. Above 1 GHz tests were performed using a spectrum analyser using the following settings:

Peak	RBW=VBW= 1MHz
Average	RBW=VBW= 1MHz

The upper and lower frequency of the measurement range was decided according to 47 CFR Part 15:2011 Clause 15.33(a) and 15.33(a)(1).

Radiated emission limits 47 CFR Part 15: Clause 15.109 for all emissions:

Frequency of emission (MHz)	Field strength μV/m	Measurement Distance m	Field strength dBμV/m
30-88	100	3	40.0
88-216	150	3	43.5
216-960	200	3	46.0
Above 960	500	3	54.0

(a) Where results have been measured at one distance, and a signal level displayed at another, the results have been extrapolated using the following formula:

$$\text{Extrapolation}\,(\text{dB}) = 20\log_{10}\left(\frac{\text{measurement distance}}{\text{specification distance}}\right)$$

(b) The levels may have been rounded for display purposes.

(c) The following table summarises the effect of the EUT operating mode, internal configuration and arrangement of cables / samples on the measured emission levels :

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels		✓		
Effect of EUT internal configuration on emission levels		✓		
Effect of Position of EUT cables & samples on emission levels	✓			

(i) Parameter defined by standard and / or single possible, refer to Appendix D
(ii) Parameter defined by client and / or single possible, refer to Appendix D
(iii) Parameter had a negligible effect on emission levels, refer to Appendix D
(iv) Worst case determined by initial measurement, refer to Appendix D

Appendix B: Supporting Graphical Data

This appendix contains graphical data obtained during testing.

Notes:

(a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer Appendix A and B.

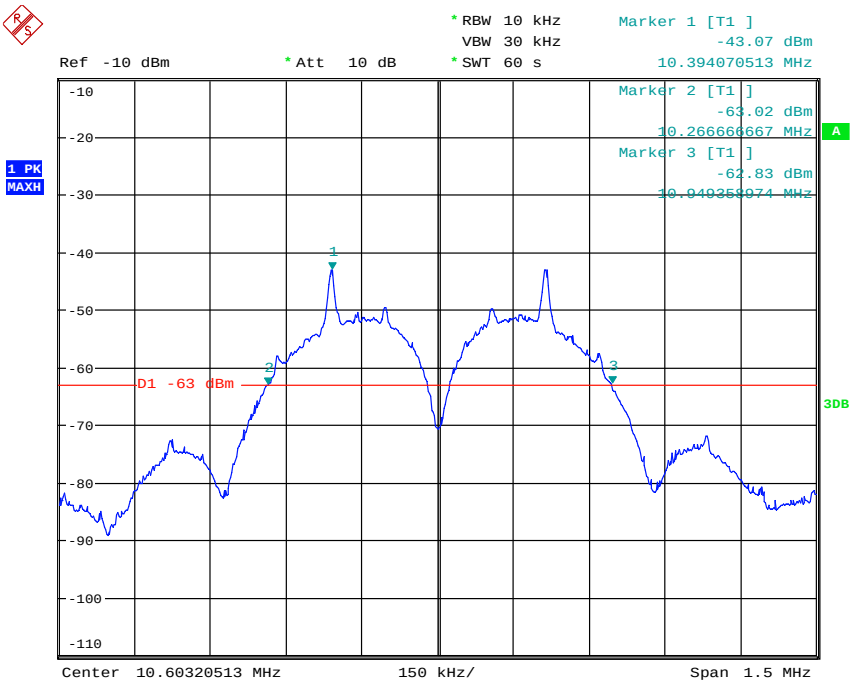
(b) The time and date on the plots do not necessarily equate to the time of the test.

(c) Where relevant, on power line conducted emission plots, the limit displayed is the average limit, which is stricter than the quasi peak limit.

(d) Appendix C details the numbering system used to identify the sample and its modification state.

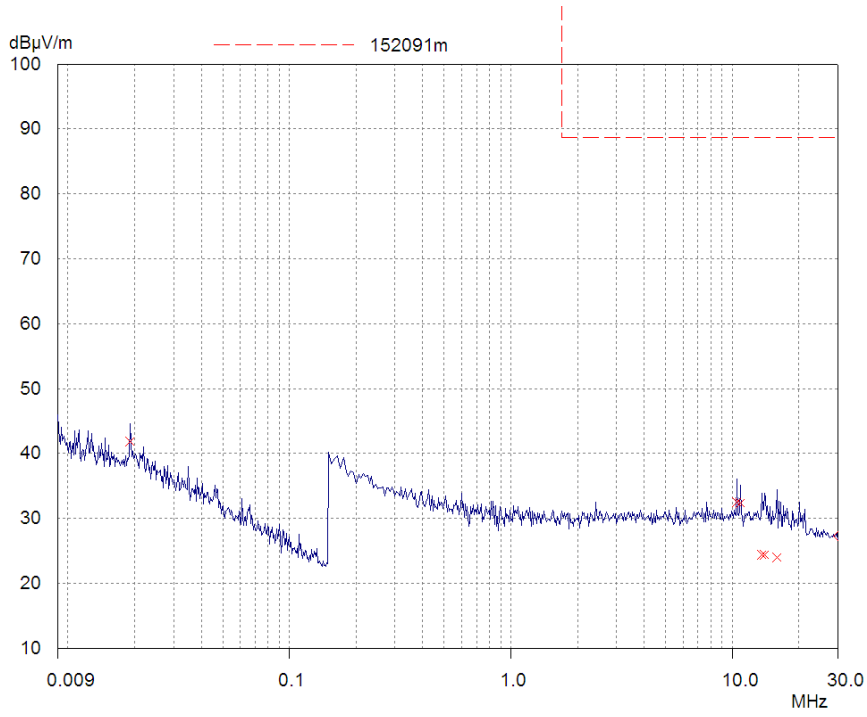
(e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.

20dB Bandwidth

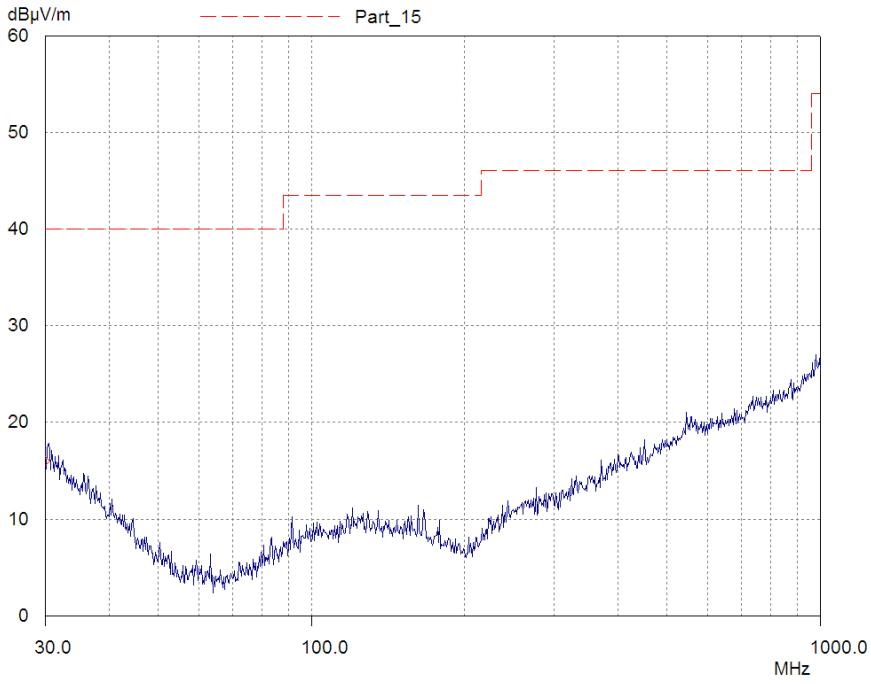


Date: 21.NOV.2011 15:14:46

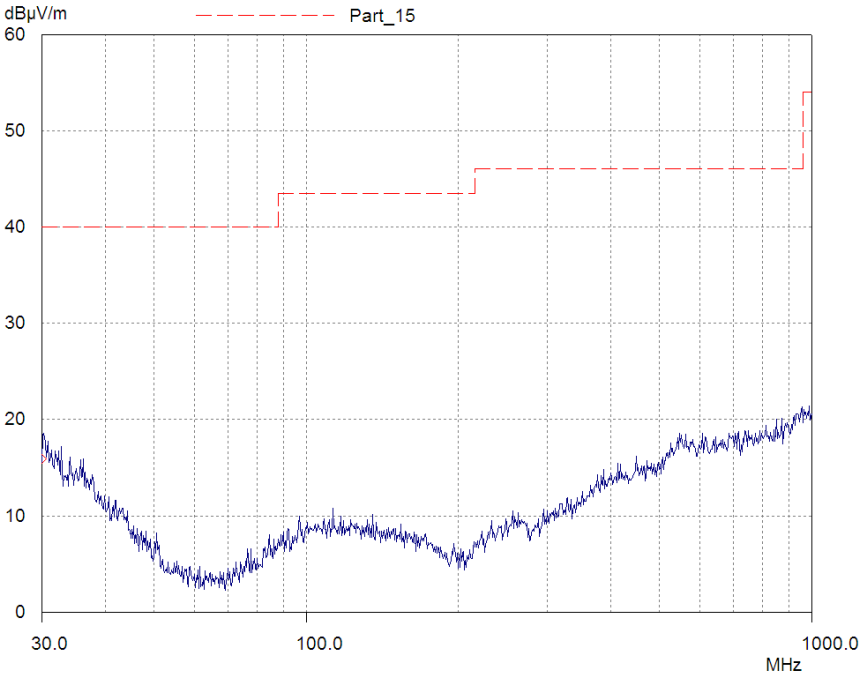
Radiated Magnetic Field Emissions (Transmit Mode)



Radiated Electric Field Emissions (Transmit Mode)



Radiated Electric Field Emissions (Receive Mode)



Appendix C: Additional Test and Sample Details

This appendix contains details of:

1. The samples submitted for testing.
2. Details of EUT operating mode(s)
3. Details of EUT configuration(s) (see below).
4. EUT arrangement (see below).

Throughout testing, the following numbering system is used to identify the sample and it's modification state:

Sample No: Sxx Mod w

where:

xx	= sample number	eg. S01
w	= modification number	eg. Mod 2

The following terminology is used throughout the test report:

Support Equipment (SE) is any additional equipment required to exercise the EUT in the applicable operating mode. Where relevant SE is divided into two categories:

SE in test environment: The SE is positioned in the test environment and is not isolated from the EUT (e.g. on the table top during REFE testing).

SE isolated from the EUT: The SE is isolated via filtering from the EUT. (e.g. equipment placed externally to the ALSR during REFE testing).

EUT configuration refers to the internal set-up of the EUT. It may include for example:

Positioning of cards in a chassis.
Setting of any internal switches.
Circuit board jumper settings.
Alternative internal power supplies.

Where no change in EUT configuration is **possible**, the configuration is described as “single possible configuration”.

EUT arrangement refers to the termination of EUT ports / connection of support equipment, and where relevant, the relative positioning of samples (EUT and SE) in the test environment.

For further details of the test procedures and general test set ups used during testing please refer to the related document "EMC Test Methods - An Overview", which can be supplied by TRaC Telecoms & Radio upon request.

C1 Test samples

The following samples of the apparatus were submitted by the client for testing:

Sample No	Description
S03-1	Hearing Aid (Receive mode sample)
S03-2	Hearing Aid (Constant transmit sample)

C2 EUT operating mode during testing

During testing, the EUT was exercised as described in the following tables:

Test	Description of Operating Mode: Transmit
Radiated Field Strength (Transmitter carrier output levels)	The EUT was transmitting continuously on maximum power using a new battery
Radiated Spurious emissions (H-Field) at frequencies below 30MHz (15.209)	
Radiated Spurious emissions (E-Field) at frequencies ≥ 30MHz (15.209)	
20dB Bandwidth of Emissions	

Test	Description of Operating Mode: Receive
(15.109) Unintentional Radiated Spurious emissions (E-Field) frequencies ≥ 30MHz	The EUT was placed in receive mode (non-transmitting) during the test, powered by a new battery

C3 EUT Configuration Information

The EUT was submitted for testing in one single possible configuration

C4 List of EUT Ports

The tables below describe the termination of EUT ports:

Port	Description of Cable Attached	Cable length	Equipment Connected
DC power port	None	N/A	None
Antenna port	None	N/A	Integral

.

C5 Details of Equipment Used

TRaC Ref Number	Equipment Type	Manufacturer	Last Calibrated	Calibration Period	Due For Calibration
UH03	Receiver	R&S	13/01/2011	12	13/01/2012
UH04	Receiver	R&S	14/12/2010	12	14/12/2011
UH191	Bilog	Chase	08/11/2010	24	08/11/2012
TRL07	Loop Antenna	R&S	09/11/2011	24	09/11/2013
UH281	Spectrum Analyser	R&S	10/02/2011	12	10/02/2012
UH293	K-Type Cable	Megaphase	24/11/2010	12	24/11/2011
UH372	Pre Amp	Wat-John	14/04/2010	24	14/04/2012

Appendix D: Additional Information

No additional information is included within this test report

Appendix E: Calculation of the duty cycle correction factor

No average detector measurements were made during testing; therefore this calculation is not required.

Appendix F: Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated electric field emissions arrangement: H-field
2. Radiated electric field emissions arrangement: E-field

Photograph 1

Photograph 2

Appendix G: MPE Calculation

OET Bulletin No. 65, Supplement C 01-01

47 CFR §§1.1307 and 2.1091

2.1091 Radio frequency radiation exposure evaluation: mobile devices.

For purposes of these requirements mobile devices are defined by the FCC as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimetres is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits. As the 20cm separation specified under FCC rules may not be achievable under normal operation of the EUT, an RF exposure calculation is needed to show the minimum distance required to be less than 1mW/cm^2 power density limit, as required under FCC rules.

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{EIRP}{4\pi R^2} \quad \text{re - arranged} \qquad R = \sqrt{\frac{EIRP}{S\ 4\pi}}$$

where:

S = power density
R = distance to the centre of radiation of the antenna
EIRP = EUT Maximum power

Note:

The EIRP value was determined using the peak H Field measurement

Result:

Prediction Frequency (MHz)	Maximum EIRP (mW)	Power density limit (S) (mW/cm^2)	Distance (R) from the body required for the power density to be less than 17 mW/cm^2
10.6	1x10^{-10}	17	**0.217µm**

Appendix H: Cross Reference FCC Part 15c to IC RSS 210

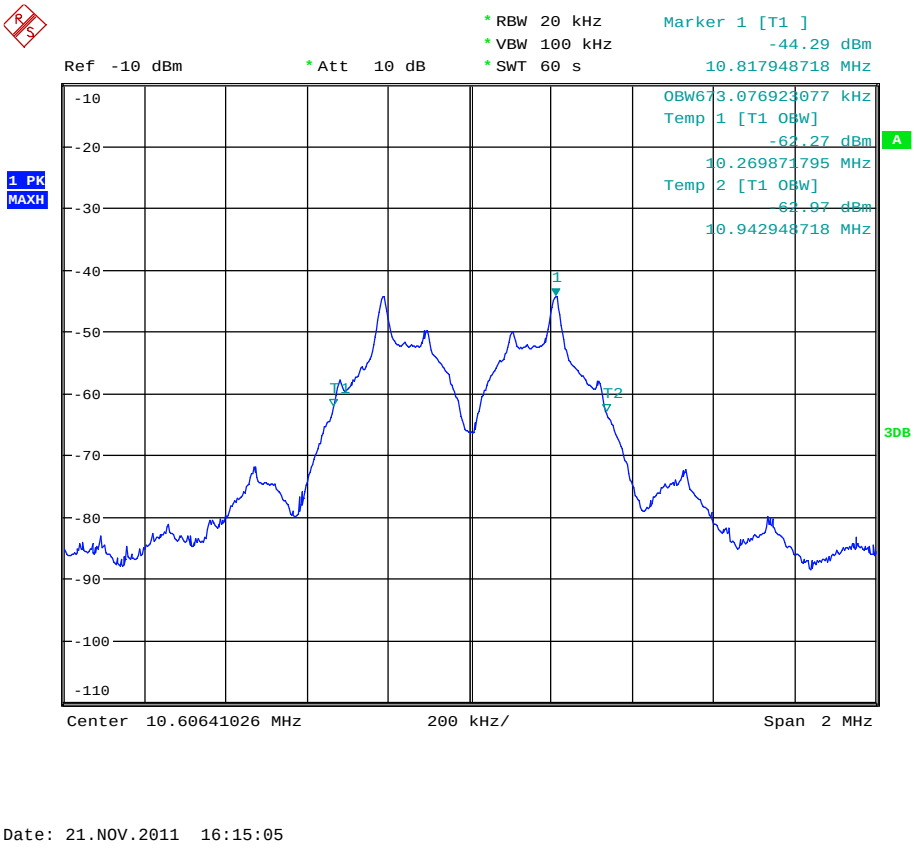
The testing was carried out to FCC 47CFR Part 15c and the results for this testing can be found in Appendix A of this report.

All measurements were carried out in accordance with ANSI C63.4, 'Methods of Measurements of RF Emissions from low voltage Electrical and Electronic Equipment in the Range 9 kHz to 1 GHz.

The table below shows the applicable RSS-210 parts and the corresponding FCC 47CFR Part 15 rules:

RSS-210	FCC 47CFR Part 15
2.6	Part 15.109
2.6	Part 15.209

In addition below is a plot of the 99% emissions bandwidth, as stipulated in Section 4.4.1 of RSS-Gen.



HULL
Unit E, South Orbital Trading Park, Hedon Road, Hull, HU9 1NJ, UK.
T +44 (0)1482 801801 **F** +44 (0)1482 801806 **E** test@tracglobal.com
www.tracglobal.com