REPORT ON THE RADIO TESTING

FOR

WIDEX A/S

ON

UNIQUE-CIC (MODEL U-CIC)

DOCUMENT NO. TRA-027495-00-47-06A

Report Number: TRA-027495-00-47-06A
Issue: A

REPORT ON THE RADIO TESTING OF A
Widex A/S
UNIQUE-CIC (MODEL U-CIC)
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.209

TEST DATE: 16th July - 28th July 2015

Tested by: A Tosif

A Tosif
Radio Test Engineer

Approved by: John Charters

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Date: 2015.08.13 11:32:27 +01'00'

John Charters
Radio Product Manager

Date: 12th August 2015

1 Revision Record

Issue Number	*Issue Date*	*Revision History*
A	12th August 2015	Original

2 Summary

TEST REPORT NUMBER:	TRA-027495-00-47-06A
WORKS ORDER NUMBER:	TRA-027495-00
PURPOSE OF TEST:	Certification
TEST SPECIFICATION(S):	47CFR15.209
EQUIPMENT UNDER TEST (EUT):	UNIQUE-CIC (MODEL U-CIC)
FCC IDENTIFIER:	TTY-UCIC
EUT SERIAL NUMBER:	005446, 005448, 005454
MANUFACTURER/AGENT:	Widex A/S
ADDRESS:	Nymoellevej 6 3540 Lynge Denmark
CLIENT CONTACT:	Hans-Otto Bindeballe ☎ +45 44355916 ✉ hob@widex.com
ORDER NUMBER:	138038
TEST DATE:	16th July - 28th July 2015
TESTED BY:	A Tosif TRaC Global Ltd.

2.1 Test Summary

Test Method and Description	*Requirement Clause 47CFR15*	*Applicable to this equipment*	*Result / Note*
Field strength of fundamental	15.209	☒	Pass
Occupied bandwidth	15.215	☒	Pass
Radiated spurious emissions	15.209	☒	Pass
Unintentional radiated spurious emissions	15.109	☒	Pass
AC power line conducted emissions	15.207	☐	N/A[#]

[#] EUT is a battery powered device.

Notes:

The results contained in this report relate only to the items tested, in the condition at time of test, 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. Any modifications made are identified in Section 8 of this report.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 5.2 of this test report (Deviations from Test Standards).

3 Contents

4 Introduction

This report TRA-027495-00-47-06A presents the results of the Radio testing on a Widex A/S, UNIQUE-CIC (MODEL U-CIC) to specification 47CFR15 Radio Frequency Devices.

The testing was carried out for Widex A/S by TRaC Global Ltd, at the address(es) detailed below.

☐ TRaC Hull
Unit E
South Orbital Trading Park
Hedon Road
Hull
HU9 1NJ
UK

☒ TRaC North West
Unit 1
Pendle Place
Skemersdale
West Lancashire
WN8 9PN
UK

This report details the configuration of the equipment, the test methods used and any relevant modifications where appropriate.

FCC Site Listing:
TRaC Global is accredited for the above sites under the US-EU MRA, Designation number UK0009.

The test site requirements of ANSI C63.4-2014 are met up to 1GHz.

5 Test Specifications

5.1 Normative References

- FCC 47 CFR Ch. I – Part 15 – Radio Frequency Devices.
- ANSI C63.10-2013 – American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- ANSI C63.4-2014 – American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

5.2 Deviations from Test Standards

- There were no deviations from the test standard.

6 Glossary of Terms

§	denotes a section reference from the standard, not this document
AC	Alternating Current
ANSI	American National Standards Institute
BW	bandwidth
C	Celsius
CFR	Code of Federal Regulations
CW	Continuous Wave
dB	decibel
dBm	dB relative to 1 milliwatt
DC	Direct Current
DSSS	Direct Sequence Spread Spectrum
EIRP	Equivalent Isotropically Radiated Power
ERP	Effective Radiated Power
EUT	Equipment Under Test
FCC	Federal Communications Commission
FHSS	Frequency Hopping Spread Spectrum
Hz	hertz
ITU	International Telecommunication Union
LBT	Listen Before Talk
m	metre
max	maximum
MIMO	Multiple Input and Multiple Output
min	minimum
MRA	Mutual Recognition Agreement
N/A	Not Applicable
PCB	Printed Circuit Board
PDF	Portable Document Format
Pt-mpt	Point-to-multipoint
Pt-pt	Point-to-point
RF	Radio Frequency
RH	Relative Humidity
RMS	Root Mean Square
Rx	receiver
s	second
Tx	transmitter
UKAS	United Kingdom Accreditation Service
V	volt
W	watt
Ω	ohm

7 Equipment under Test

7.1 EUT Identification

- Name: UNIQUE-CIC (MODEL U-CIC)
- Serial Number: 005446, 005448, 005454
- Model Number: U-CIC
- Software Revision: Not Applicable
- Build Level / Revision Number: Not Applicable

7.2 System Equipment

Not Applicable – No support/monitoring equipment required.

7.3 EUT Mode of Operation

7.3.1 Transmission

The mode of operation for Tx tests was as follows.

The EUT was transmitting continuously on maximum power using FSK (centre frequency 10.6MHz / Deviation ±200 kHz) modulation and powered by a new battery.

7.3.2 Reception

The mode of operation for Rx tests was as follows.

The EUT was placed in receive (non-transmitting) mode during the test.

7.4 EUT Radio Parameters

Frequency of operation:	10.6 MHz
Modulation type(s):	FSK
Declared output power(s):	-50 dBµA/m at 10m distance
Antenna type(s) and gain(s):	Integral
Nominal Supply Voltage:	1.4 Vdc

7.5 EUT Description

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

8 Modifications

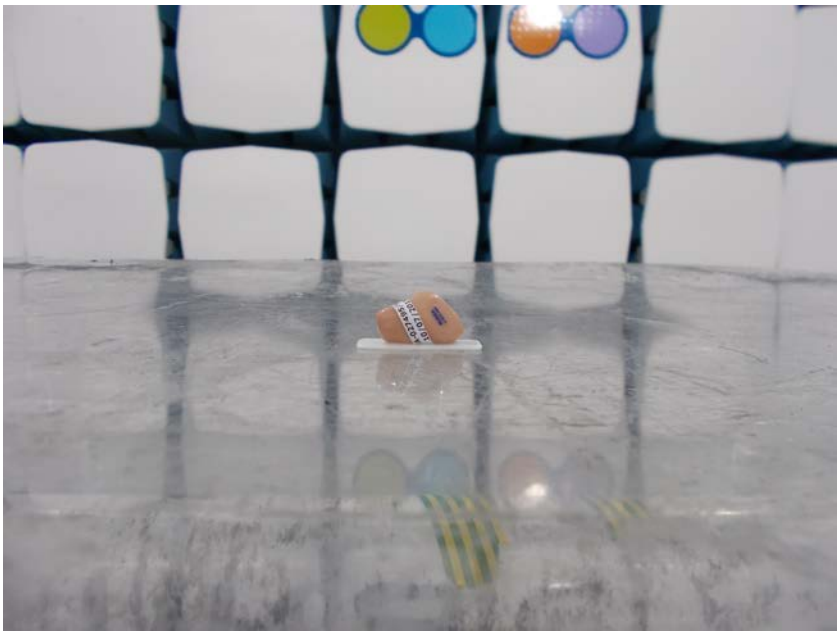
No modifications were performed during this assessment.

9 EUT Test Setup

9.1 Block Diagram

The following diagram shows basic EUT interconnections with cable type and cable lengths identified:

9.2 General Set-up Photograph



10 General Technical Parameters

10.1 Normal Conditions

The EUT was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was 1.4 Vdc from battery.

10.2 Varying Test Conditions

There are no specific frequency stability requirements for the type of device. The results contained in this report demonstrate that the occupied bandwidth is contained within the authorised band.

Variation of supply voltage is required to ensure stability of the declared output power. During carrier powers testing the following variations were made:

	Category	***Nominal***	***Variation***
☐	Mains	110V ac +/-2%	85% and 115%
☒	Battery	New battery	N/A

11 Transmitter output power (fundamental radiated emission)

11.1 Definition

The RF power dissipated in the standard output termination when operating under the rated duty cycle selected by the applicant for approval.

11.2 Test Parameters

Test Location:	TRaC North West
Test Chamber:	REF940
Test Antenna:	Active 60cm loop
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.3 / 6.4
EUT Channels / Frequencies Measured:	10.6 MHz
EUT Channel Bandwidths:	800 kHz
Deviations From Standard:	None
Measurement BW:	10 kHz
Measurement Detector:	Quasi-peak

Environmental Conditions (Normal Environment)

Temperature:	25 °C	+15 ºC to +35 ºC
Humidity:	39 %RH	20%RH to 75%RH

Test Limits

The field strength measured at 30 meters shall not exceed the limits in the following table:

Field Strength Limits for License-Exempt Transmitters for Any Application

Frequency, f (kHz)	Field Strength (µV/m)	Measurement Distance (m)
1,750 – 30,000	30	30

11.3 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure v, the resolution bandwidth of the spectrum analyser / receiver was increased above the EUT occupied bandwidth and the peak emission data noted.
The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration in each bandwidth.

Power values measured on the test receiver / analyzer are converted to field strength, FS, in µV/m at the regulatory distance, using:

$$FS = 10^{(PR - CF) / 20}$$

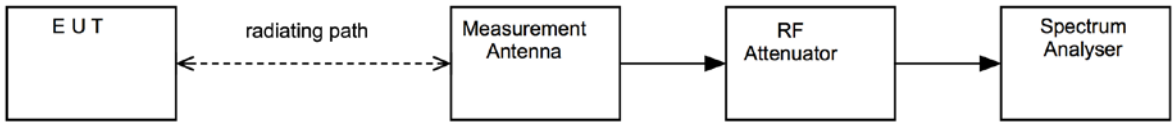
Where,

PR is the power recorded on the receiver / spectrum analyzer in dBµV and includes any cable loss, antenna factor and pre-amplifier gain;
CF is the distance extrapolation factor in dB (where measurement distance is different to limit distance);

Per FCC 47CFR15.31 (f) (2), an extrapolation factor of 40 dB per decade was used for measurements at distances closer than specified.

This field strength value is then compared with the regulatory limit.

Figure v Test Setup



11.4 Test Equipment

Equipment Description	Manufacturer	Equipment Type	TRaC No	Due For Calibration
Receiver	R&S	ESHS10	UH003	25/06/2017
Loop Antenna	R&S	hfh2	L007	10/04/2017
Radio Chamber - PP	Rainford EMC	ATS	REF940	08/09/2016

11.5 Test Results

Modulation: FSK; Power setting: Max.							
Channel Frequency (MHz)	Receiver Level (dBµV/m)	Measurement Distance (m)	Limit Distance (m)	Extrapolation Factor (dB)	Field Strength (µV/m)	Limit (µV/m)	Result
10.6 MHz	39.1	1	30	59.08	0.100	30	PASS

12 Occupied Bandwidth

12.1 Definition

20dB bandwidth
The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal.

12.2 Test Parameters

Test Location:	TRaC North West
Test Chamber:	REF940
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.9
EUT Channels / Frequencies Measured:	10.6 MHz
EUT Channel Bandwidths:	800 kHz
EUT Test Modulations:	FSK
Deviations From Standard:	None
Measurement BW: (requirement: 1% to 5% OBW)	10 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	30 kHz
Measurement Span: (requirement 2 to 5 times OBW)	2 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 ºC to +35 ºC
Humidity: 40 %RH	20%RH to 75%RH
Supply: 1.4 Vdc	New battery

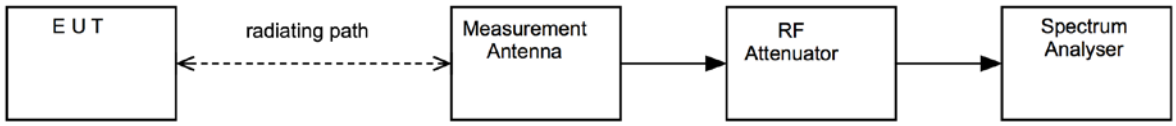
Test Limits

Federal Communications Commission:
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

12.3 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iv, the bandwidth of the EUT was measured on a spectrum analyser.
The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration in each bandwidth.

Figure iv Test Setup

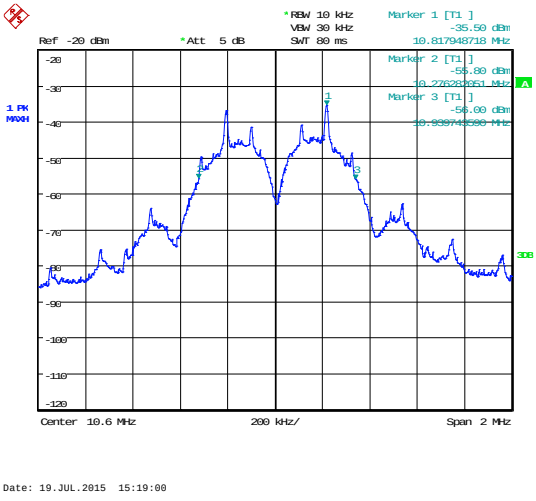


12.4 Test Equipment

Equipment Description	Manufacturer	Equipment Type	TRaC No	Last Cal Calibration	Calibration Period	Due For Calibration
Loop Antenna	R&S	hfh2	L007	10/04/2015	24	10/04/2017
Spectrum Analyser	R&S	FSU46	UH281	24/04/2015	12	24/04/2016

12.5 Test Results

FCC 15.215 Modulation: FSK; Power setting: Max.				
Channel Frequency (MHz)	F_L (MHz)	F_H (MHz)	20dB Bandwidth (kHz)	Result
10.6	10.276282	10.939744	663.462	PASS



13 Radiated emissions

13.1 Definitions

Spurious emissions
Spurious emissions are the emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

13.2 Test Parameters

Test Location:	TRaC North West
Test Chamber:	REF940
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.4 and Clause 6.5
EUT Channels / Frequencies Measured:	10.6 MHz
EUT Channel Bandwidths:	800 KHz
Measurement Distance and Site	9 kHz – 30 MHz: 1m, Alternative test site 30 MHz – 1 GHz: 3m, Alternative test site
EUT Height:	0.8 m
Deviations From Standard:	None
Measurement BW:	9 kHz to 150 kHz: 200 Hz 150 kHz to 30 MHz: 9 kHz 30 MHz to 1 GHz: 120 kHz
Measurement Detector:	9 – 90 kHz and 110 – 490 kHz: Average RMS Other frequencies: Quasi-peak

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 ºC to +35 ºC
Humidity: 38 %RH	20%RH to 75%RH
Supply: 1.4 Vdc	New battery

Test Limits

Emissions from license-exempt transmitters shall comply with the field strength limits shown in the table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

General Field Strength Limits for License-Exempt Transmitters

Frequency, f (kHz)	Field Strength (µV/m)	Measurement Distance (m)
9 – 490	2400/F(kHz)	300
490 – 1,750	24000/F(kHz)	30
1,750 – 30,000	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

13.3 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure ii, the emissions from the EUT were measured on a spectrum analyzer / EMI receiver.

Radiated electromagnetic emissions from the EUT are checked first by preview scans. Preview scans for all spectrum and modulation characteristics are checked, using a peak detector and where applicable worst-case determined for function, operation, orientation, etc. for both vertical and horizontal polarisations.

If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in ANSI C63.10 are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed, (see EUT setup photographs for more detail).

Emissions between 9 kHz and 30 MHz

Emissions between 9 kHz and 30 MHz are measured using a calibrated 60cm active loop antenna. Pre-amplifiers and filters are used where required. Care is taken to ensure that test receiver resolution bandwidth, video bandwidth and detector type(s) meet the regulatory requirements.

Power values measured on the test receiver / analyzer are converted to field strength, FS, in µV/m at the regulatory distance, using:

$$FS = 10^{(PR - CF) / 20}$$

Where,

PR is the power recorded on the receiver / spectrum analyzer in dBµV and includes any cable loss, antenna factor and pre-amplifier gain;
CF is the distance extrapolation factor in dB (where measurement distance is different to limit distance);

Per FCC 47CFR15.31 (f) (2), an extrapolation factor of 40 dB per decade was used for measurements at distances closer than specified.
This field strength value is then compared with the regulatory limit.

Emissions between 30 MHz and 1 GHz

Emissions between 30 MHz and 1 GHz are measured using calibrated broadband antennas. Care is taken to ensure that test receiver resolution bandwidth, video bandwidth and detector type(s) meet the regulatory requirements.

For both horizontal and vertical polarizations, the EUT is then rotated through 360 degrees in azimuth until the highest emission is detected. At the previously determined azimuth the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected, this maximum value is recorded.

Power values measured on the test receiver / analyzer are converted to field strength, FS, in dBµV/m at the regulatory distance, using:

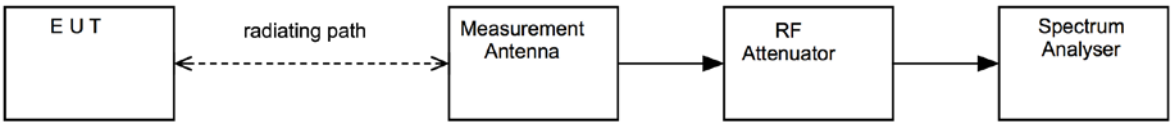
$$FS = PR + CL + AF - PA + DC - CF$$

Where,

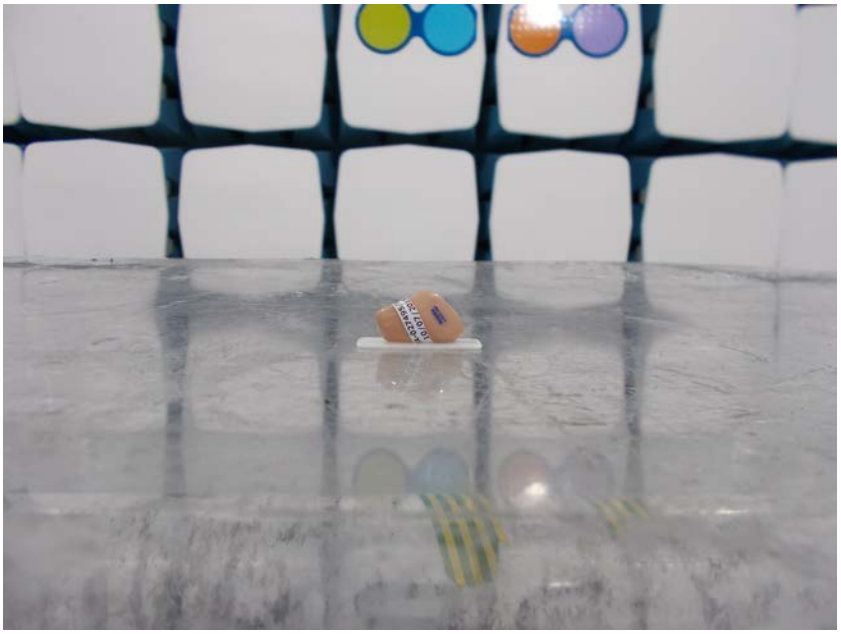
PR is the power recorded on the receiver / spectrum analyzer in dBµV;
CL is the cable loss in dB;
AF is the test antenna factor in dB/m;
PA is the pre-amplifier gain in dB (where used);
DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);
CF is the distance factor in dB (where measurement distance is different to limit distance);

This field strength value is then compared with the regulatory limit.

Figure ii Test Setup



Test Setup Photograph(s)



13.4 Test Equipment

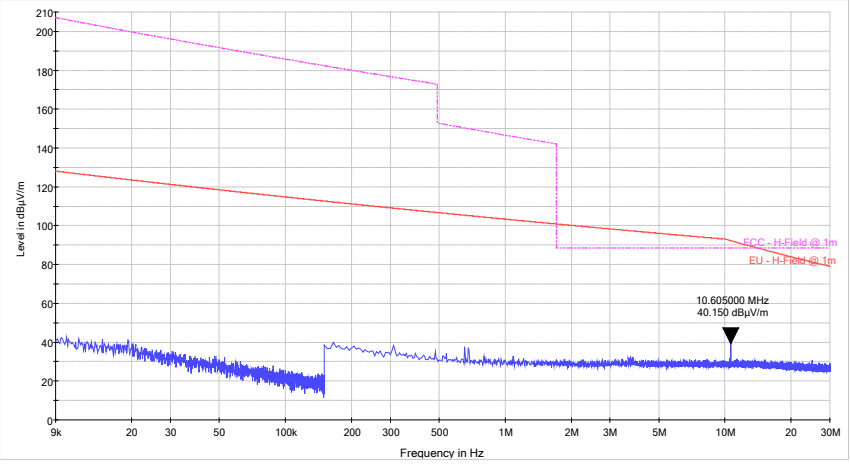
Equipment Description	Manufacturer	Equipment Type	TRaC No	Due For Calibration
Receiver	R&S	ESHS10	UH003	25/06/2017
Bilog	Chase	CBL611/A	UH191	26/02/2017
Loop Antenna	R&S	hfh2	L007	10/04/2017
Receiver	R&S	ESVS10	L317	26/02/2016
Radio Chamber - PP	Rainford EMC	ATS	REF940	08/09/2016

13.5 Test Results

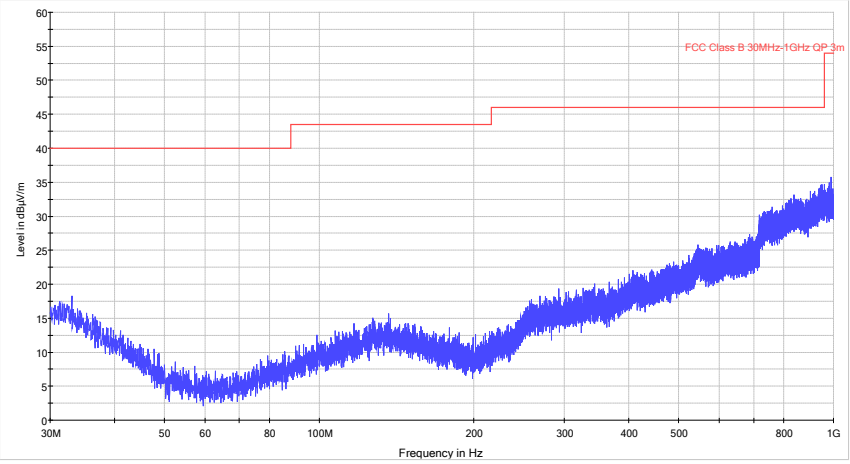
High Power Setting										
Detector	Freq. (MHz)	Meas'd Emission (dBµV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Duty Cycle Corr'n (dB)	Distance Extrap'n Factor (dB)	Field Strength (dBµV/m)	Field Strength (µV/m)	Limit (µV/m)
No emissions were detected within 10 dB of the limit										

Worst measured noise floor was 36.1 dBµV/m @ 9 kHz at 1 m distance.

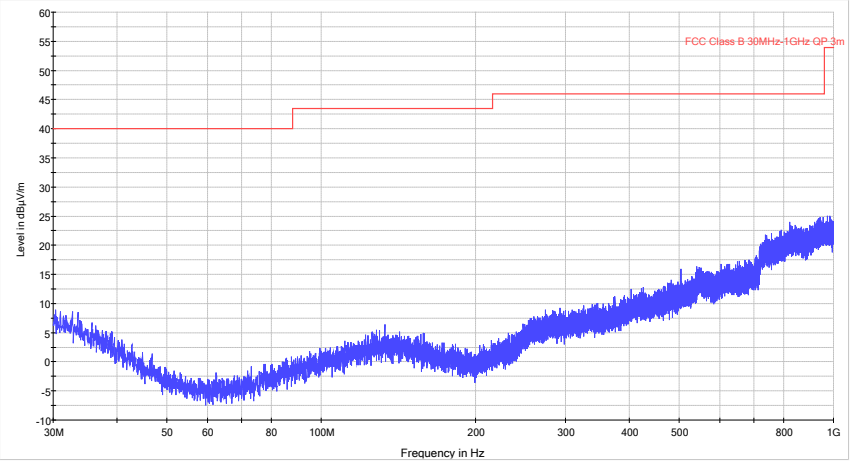
Radiated Spurious Emission



9 kHz – 30 MHz



30 MHz – 1 GHz @ 3m



30 MHz – 1 GHz @ 1m

14 Radiated emissions – unintentional radiation / receiver emissions

14.1 Definitions

Receiver spurious emissions
The radio frequency signals generated within the receiver, which may cause interference to other equipment. This includes the period during which the equipment is scanning or switching channels.

Unintentional radiator
A device that generates RF energy which is not intended to be radiated for reception by a radio receiver.

14.2 Test Parameters

Test Location:	TRaC North West
Test Chamber:	REF940
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Channels / Frequencies Measured:	10.6 MHz
EUT Channel Bandwidths:	800 KHz
Deviations From Standard:	None
Measurement BW:	120 kHz
Measurement Detector:	Quasi-peak

Environmental Conditions (Normal Environment)

Temperature:	22 °C	+15 ºC to +35 ºC
Humidity:	38%RH	20%RH to 75%RH
Supply:	1.4 Vdc	New battery

Test Limits

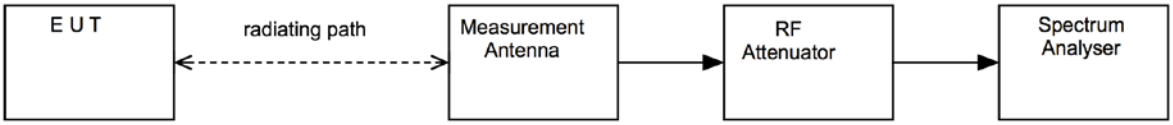
Receiver Radiated Limits

Frequency (MHz)	Field Strength (µV/m at 3m)
30-88	100
88-216	150
216-960	200
Above 960	500

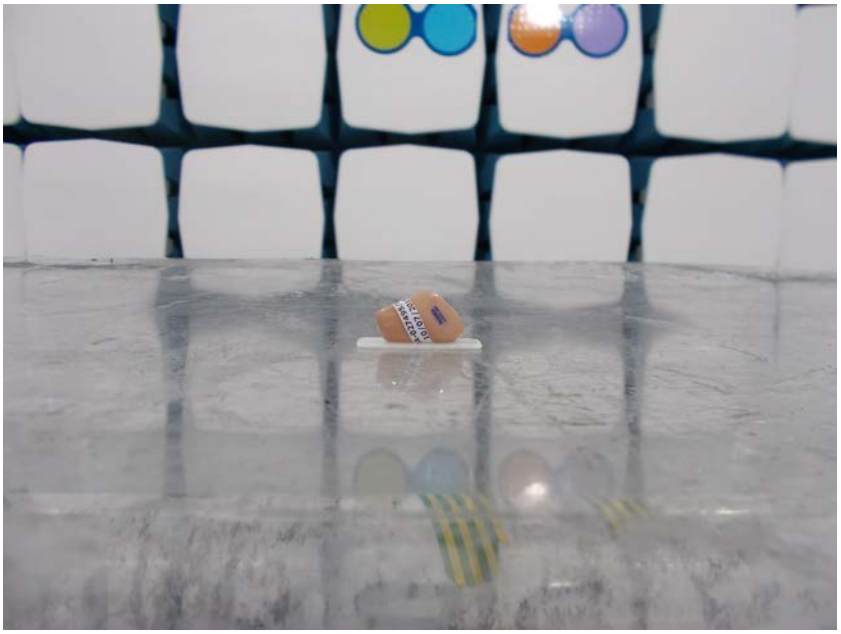
14.3 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure viii, the emissions from the EUT were measured on a spectrum analyzer / EMI receiver. The EUT was rotated in three orthogonal planes and the measurement antenna height scanned (below 1GHz, from 1 to 4 m; above 1GHz as necessary) in order to maximise emissions.
The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration at each frequency. Pre-scan plots are shown with a peak detector and 100 kHz RBW.

Figure viii Test Setup



Test Setup Photograph(s)

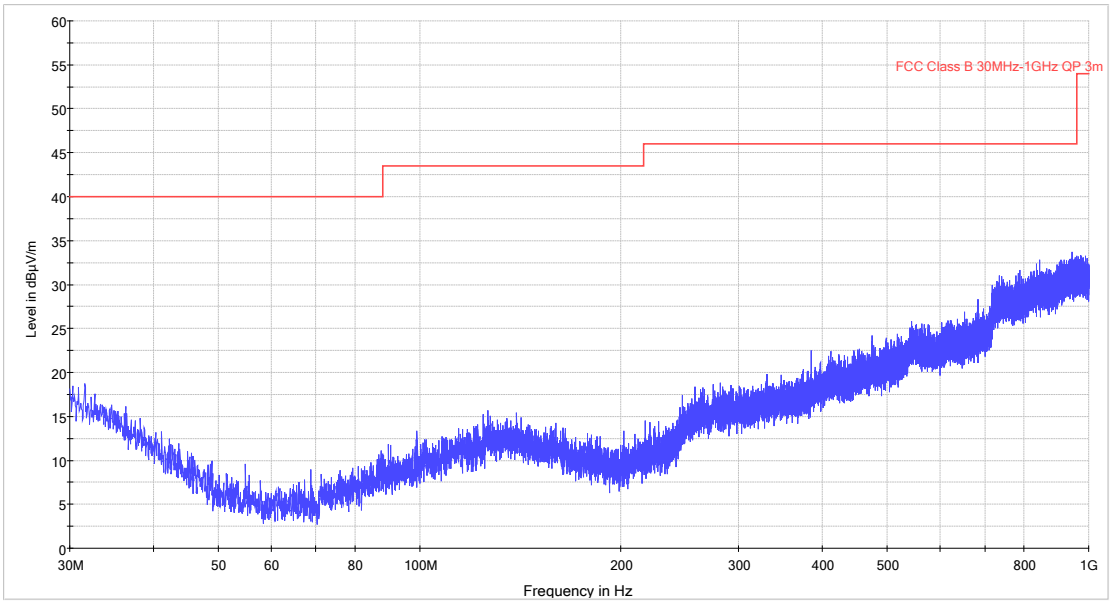


14.4 Test Equipment

Equipment Description	Manufacturer	Equipment Type	TRaC No	Due For Calibration
Bilog	Chase	CBL611/A	UH191	26/02/2017
Receiver	R&S	ESVS10	L317	26/02/2016
Radio Chamber - PP	Rainford EMC	ATS	REF940	08/09/2016

14.5 Test Results

Unintentional Radiated Spurious Emission



30 MHz – 1 GHz

High Power									
Detector	Freq. (MHz)	Measured Emission (dBµV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Field Strength (dBµV/m)	Extrap'n Factor (dB)	Field Strength (µV/m)	Limit (µV/m)
No emissions were detected within 10 dB of the limit									

15 Measurement Uncertainty

Calculated Measurement Uncertainties

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence:

[1] Radiated emissions

Uncertainty in test result (9 kHz – 30 MHz) = 2.3 dB
Uncertainty in test result (30 MHz – 1GHz) = 4.6 dB

[2] AC power line conducted emissions

Uncertainty in test result = 3.4 dB

[3] Occupied bandwidth

Uncertainty in test result = 15.5%

16 General SAR test reduction & exclusion guidance

KDB 447498

Section 4.3 General SAR test reduction and exclusion guidance

For Standalone SAR exclusion consideration, when SAR Exclusion Threshold requirement in KDB 447498 is satisfied, standalone SAR evaluation for general population exposure conditions by measurement or numerical simulation is not required.

The SAR Test Exclusion Threshold for frequency range below 100 MHz will be determined as follows.

SAR Exclusion Threshold (SARET) = Step 2 * Step 3

Step 1

$$NT = [(MP/TSD^{A}) * \sqrt{f_{GHz}}]$$

NT = Numeric Threshold (3.0 for 1-g SAR and 7.5 for 10-g SAR)
MP = Max Power of channel (mW) (including tune-up tolerance)
TSD^{A} = Min Test separation Distance or 50mm (whichever is lower) = 5mm (in this case)

We can transpose this formula to allow us to find the maximum power of a channel allowed and compare this to the measured maximum power.

$$= [(NT \times TSD^{A}) / \sqrt{f_{GHz}}]$$

Step 2

$$\text{Step 2} = \text{Step 1} + (TSD^{B} - 50\text{mm}) * 10$$

TSD^{B} = Min Test separation Distance (mm) = 50

So,

$$\text{Step 2} = \text{Step 1} = [(NT \times TSD^{A}) / \sqrt{f_{GHz}}]$$

Step 3

a) the power threshold at the corresponding test separation distance at 100 MHz in step 2 is multiplied by $[1 + \log (100/ f_{MHz})]$ for test separation distances > 50 mm and < 200 mm

b) the power threshold determined by the equation (a) for 50 mm and 100 MHz is multiplied by ½ for test separation distances ≤ 50 mm

$$SARET = [(NT \times TSD^{A}) / \sqrt{0.1}] * [1 + \log (100/ f_{MHz})] * {}^{1}/_{2}$$
$$SARET = [(3.0 \times 50) / \sqrt{0.1}] * [1 + \log (100/ 10.6)] * {}^{1}/_{2}$$
SARET = 468 mW

The calculated output power is 3.0×10^{-10} mW (eirp) and is less than the SAR Exclusion Threshold of 468 mW, at a test separation distance ≤ 50mm, for general population and uncontrolled exposure.
Therefore standalone SAR evaluation for general population exposure conditions by measurement or numerical simulation is not required.

17 MPE Calculation

Prediction of MPE limit at a given distance

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 centimeters 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 the power density limit, as required under FCC rules.

Equation from IEEE C95.1

$$S = \frac{EIRP}{4\pi R^2} \quad \text{re-arranged } R = \sqrt{\frac{EIRP}{S4\pi}}$$

Where:

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

Result

Prediction Frequency (MHz)	Maximum EIRP (mW)	Power density limit (S) (mW/cm^2)	Distance (R) cm required to be less than the power density limit
10.6	3.0×10^{-10}	1.6	3.9×10^{-6}

Note: EIRP is calculated from maximum radiated field strength.