

Report on the Radio Testing
For
Widex A/S
On
TV-Controller II
Report no. TRA-031974-47-02B
9th September 2016

Report Number: TRA-031974-47-02B
Issue: B

REPORT ON THE RADIO TESTING OF A
Widex A/S
TV-Controller II

WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.209

TEST DATE: 25th- 29th July 2016

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Approved by:

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Department Manager- Radio

Date: 9th September 2016

Disclaimers:

- [1] THIS DOCUMENT MAY BE REPRODUCED ONLY IN ITS ENTIRETY AND WITHOUT CHANGE
[2] THE RESULTS CONTAINED IN THIS DOCUMENT RELATE ONLY TO THE ITEM(S) TESTED

RF922 2.0

1 Revision Record

<i>Issue Number</i>	<i>Issue Date</i>	<i>Revision History</i>
A	24 th August 2016	Original
B	9 th September 2016	Up date to EUT name

2 Summary

TEST REPORT NUMBER:	TRA-031974-47-02B
WORKS ORDER NUMBER	TRA-031974-00
PURPOSE OF TEST:	Certification
TEST SPECIFICATION(S):	47CFRPart 15.209
EQUIPMENT UNDER TEST (EUT):	TV-Controller II
FCC IDENTIFIER:	TTY-TV/C2
EUT SERIAL NUMBER:	118826
MANUFACTURER/AGENT:	Widex A/S
ADDRESS:	Nymoellevej 6 3540 Lynge Denmark
CLIENT CONTACT:	Hans-Otto Bindeballe ☎ +45 44355916 ✉ hob@widex.com
TEST DATE:	25 th – 29 th July 2016
TESTED BY:	S Hodgkinson Element

2.1 Test Summary

<i>Test Method and Description</i>	<i>Requirement Clause 47CFR15</i>	<i>Applicable to this equipment</i>	<i>Result / Note</i>
Field strength of fundamental	15.209	<input checked="" type="checkbox"/>	Pass
Occupied bandwidth	15.215	<input checked="" type="checkbox"/>	Pass
Radiated spurious emissions	15.209	<input checked="" type="checkbox"/>	Pass
Unintentional radiated spurious emissions	15.109	<input checked="" type="checkbox"/>	Pass
AC power line conducted emissions	15.207	<input type="checkbox"/>	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).

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4 Introduction

This report TRA-031974-47-02B presents the results of the Radio testing on a Widex A/S, TV-Controller II to specification 47CFR15 Radio Frequency Devices.

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

<input type="checkbox"/>	Element Hull Unit E South Orbital Trading Park Hedon Road Hull HU9 1NJ UK	<input checked="" type="checkbox"/>	Element North West Unit 1 Pendle Place Skelmersdale West Lancashire WN8 9PN UK
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This report details the configuration of the equipment, the test methods used and any relevant modifications where appropriate.

All test and measurement equipment under the control of the laboratory and requiring calibration is subject to an established programme and procedures to control and maintain measurement standards. The quality management system meets the principles of ISO 9001, and has quality control procedures for monitoring the validity of tests undertaken. Records and sufficient detail are retained to establish an audit trail of calibration records relating to its test results for a defined period. Under control of the established calibration programme, key quantities or values of the test & measurement instrumentation are within specification and comply with the relevant traceable internationally recognised and appropriate standard specifications, which are UKAS calibrated as such where these properties have a significant effect on results. Participation in inter-laboratory comparisons and proficiency testing ensures satisfactory correlation of results conform to Elements own procedures, as well as statistical techniques for analysis of test data providing the appropriate confidence in measurements.

Throughout this report EUT denotes equipment under test.

FCC Site Listing:

Element 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 1 GHz.

The test site SVSWR requirements of CISPR 16-1-4:2010 are met over the frequency range 1 GHz to 18 GHz.

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
IC	Industry Canada
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
SVSWR	Site Voltage Standing Wave Ratio
Tx	transmitter
UKAS	United Kingdom Accreditation Service
V	volt
W	watt
Ω	ohm

7 Equipment under Test

7.1 EUT Identification

- Name: TV-Controller II
- Model Number / Type: TV-Controller II
- Serial Number: 118826
- Hardware: build 21062016Ver010019
- Software Revision: V01.00.1921.06.16GCC

7.2 System Equipment

Equipment listed below forms part of the overall test setup and is required for equipment functionality and/or monitoring during testing. The compliance levels achieved in this report relate only to the EUT and not items given in the following list.

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 ± 300 kHz) modulation and powered by a new battery.

7.4 EUT Radio Parameters

Frequency of operation:	10.6 MHz
Modulation type(s):	FSK
Declared output power(s):	25 μ V/m
Antenna type(s) and gain(s):	ferrite rod
Nominal Supply Voltage:	4.0 Vdc

7.5 EUT Description

The EUT is a TV remote control that contains a 10.6MHz and a 2.4GHz Transceiver.

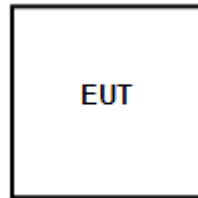
8 Modifications

No modifications were performed during this assessment.

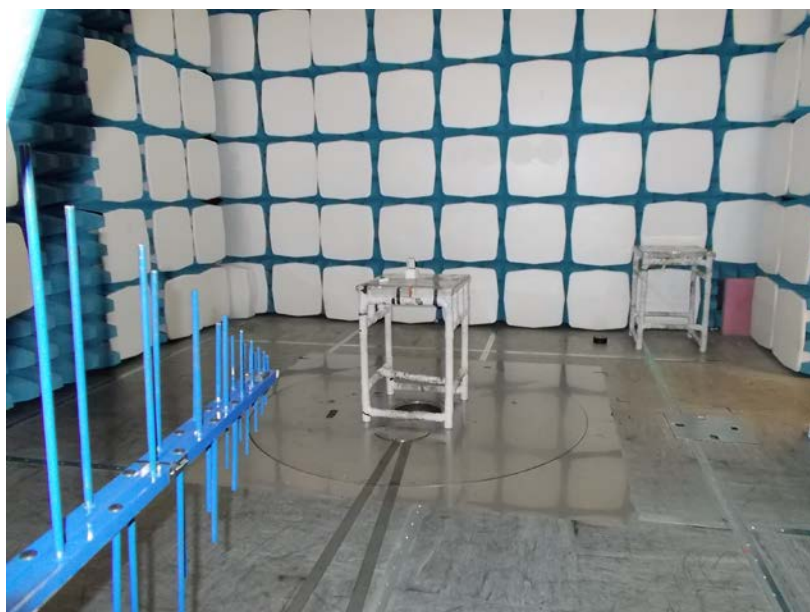
9 EUT Test Setup

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 4.0 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
<input type="checkbox"/>	Mains	110V ac +/-2%	85% and 115%
<input checked="" type="checkbox"/>	Battery	New battery	85% and 115%

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:	Element Skelmersdale
Test Chamber:	REF940
Test Antenna:	Active 60cm loop
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.3
EUT Channels / Frequencies Measured:	10.6 MHz
Deviations From Standard:	None
Measurement BW:	10 kHz
Measurement Detector:	Quasi-peak

Environmental Conditions (Normal Environment)

Temperature:	22 °C	+15 °C to +35 °C
Humidity:	44 %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 ($\mu\text{V/m}$)	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 $\mu\text{V/m}$ at the regulatory distance, using:

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

Where,

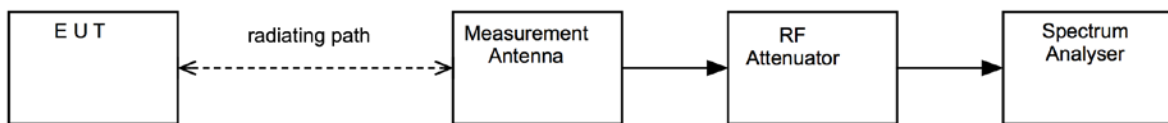
PR is the power recorded on the receiver / spectrum analyzer in $\text{dB}\mu\text{V}$ and includes any cable loss, antenna factor and pre-amplifier gain;

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	Element No	Due For Calibration
hfh2	R&S	Loop Antenna	L007	10/04/2017
ESHS10	R&S	Receiver	U187	29/10/2016

11.5 Test Results

Channel Frequency (MHz)	Receiver Level ($\text{dB}\mu\text{V}$)	Antenna Factor (dB/m)	Field strength ($\text{dB}\mu\text{V/m}$)	Measurement Distance (m)	Limit Distance (m)	Extrapolation Factor (dB)	Field Strength ($\text{dB}\mu\text{V/m}$)	Field Strength ($\mu\text{V/m}$)	Result
10.6	71.2	19.5	90.70	1	30	61.40	29.30	29.309	PASS
10.6	49.8	19.5	69.30	3	30	40.00	29.30	29.309	PASS

12 Occupied Bandwidth

12.1 Definition

20dB bandwidth

The emission bandwidth (-20 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 20 dB below the maximum in-band spectral density of the modulated signal.

12.2 Test Parameters

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

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 °C to +35 °C
Humidity: 37 %RH	20%RH to 75%RH
Supply: 4.0 Vdc	New battery

Test Limits

Federal Communications Commission:

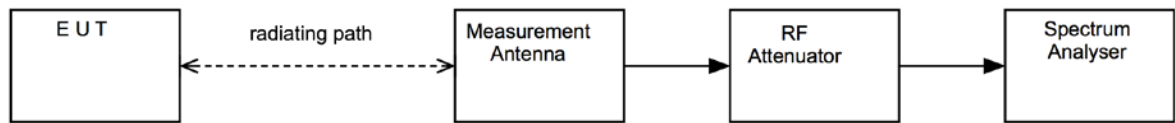
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific 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

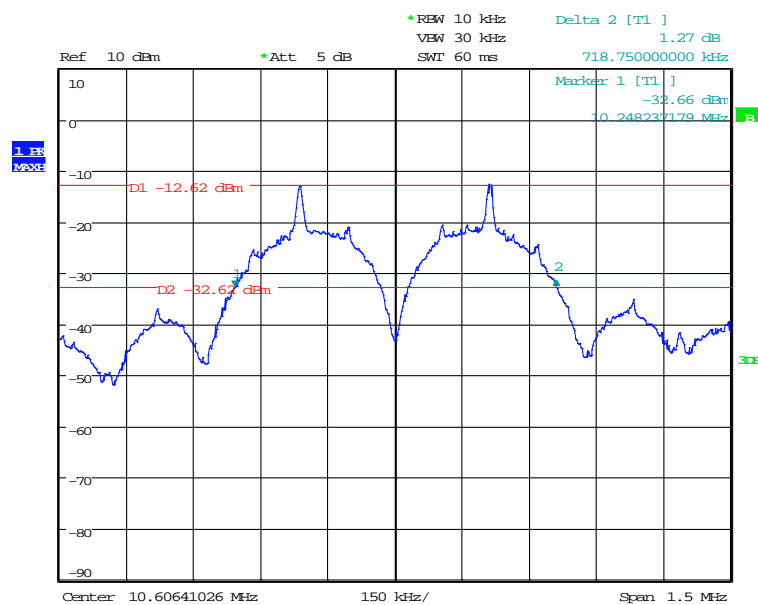


12.4 Test Equipment

Equipment Description	Manufacturer	Equipment Type	Element No	Due For Calibration
Spectrum Analyser	R&S	FSU26	U405	02/06/2017

12.5 Test Results

FCC 15.215				
Channel Frequency (MHz)	F _L (MHz)	F _H (MHz)	20dB Bandwidth (kHz)	Result
10.6	10.248237	10.966987	718.75	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:	Element Skelmersdale
Test Chamber:	REF940
Test Standard and Clause:	Part 15.209 ANSI C63.10-2013, Clause 6.4 and Clause 6.5
EUT Channels / Frequencies Measured:	10.6 MHz
Measurement Distance and Site	9 kHz – 30 MHz: 1m & 3m, Alternative test site 3m 30 MHz – 1 GHz: 3m, Alternative test site 3m
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: 23 °C	+15 °C to +35 °C
Humidity: 37 %RH	20%RH to 75%RH
Supply: 4.0 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 $\mu\text{V/m}$ at the regulatory distance, using:

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

Where,

PR is the power recorded on the receiver / spectrum analyzer in $\text{dB}\mu\text{V}$ 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 $\text{dB}\mu\text{V/m}$ at the regulatory distance, using:

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

Where,

PR is the power recorded on the receiver / spectrum analyzer in $\text{dB}\mu\text{V}$;

CL is the cable loss in dB;

AF is the test antenna factor in dB/m ;

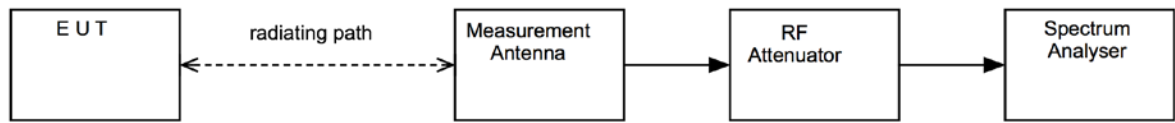
PA is the pre-amplifier gain in dB (where used);

DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);

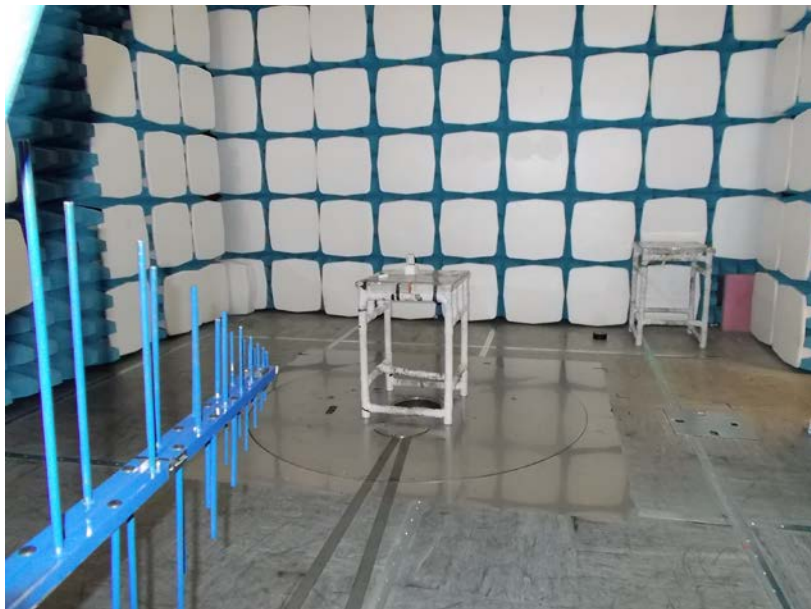
CF is the distance factor in dB (where measurement distance is different to limit distance);

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

Figure ii Test Setup



Test Setup Photograph(s)



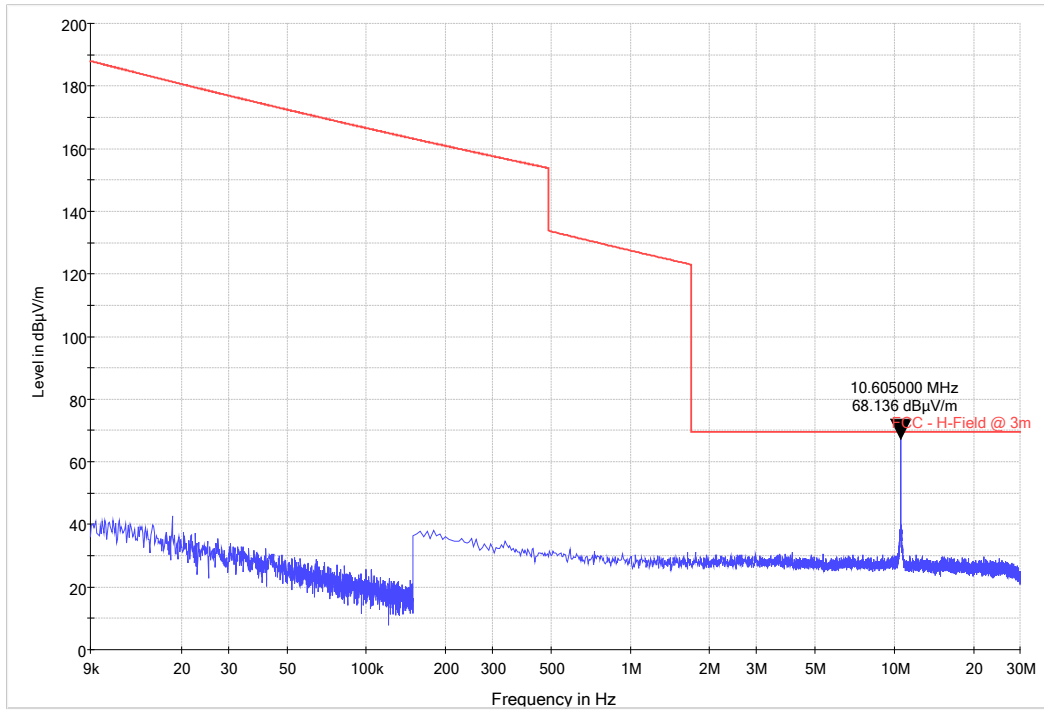
13.4 Test Equipment

Equipment Description	Manufacturer	Equipment Type	Element No	Due For Calibration
CBL611/A	Chase	Bilog	U191	26/02/2017
ESVS10	R&S	Receiver	L317	11/03/2017
hfh2	R&S	Loop Antenna	L007	10/04/2017
ESHS10	R&S	Receiver	U187	29/10/2016

13.5 Test Results

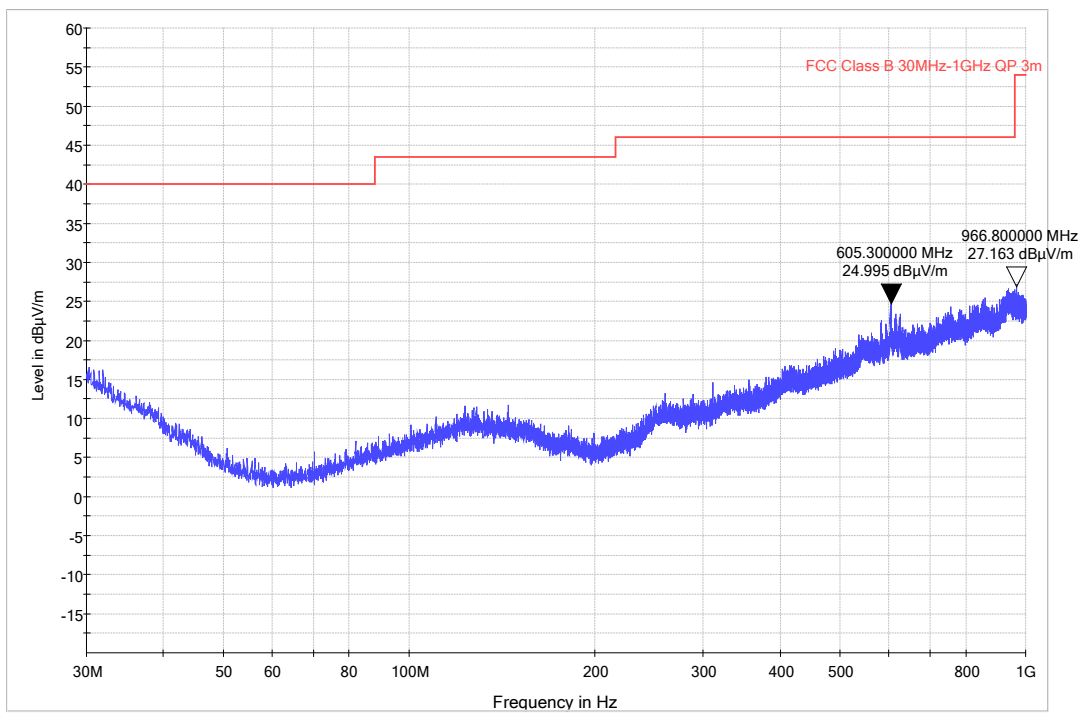
Detector	Freq. (MHz)	Meas'd Emission (dBµV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Field Strength (dBµV/m)	Field Strength (µV/m)	Limit (µV/m)
No emissions were detected within 10 dB of the limit								

Worst measured noise floor was 25.2 dBµV/m Pk @ 966.8 MHz at 3 m distance.
19.7 dBµV/m Qp @ 966.8 MHz at 3 m distance.



9 kHz – 30 MHz

30 MHz – 1 GHz



14 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] Occupied bandwidth

Uncertainty in test result = 15.5%

15 RF exposure

General SAR test reduction and exclusion guidance

KDB 447498

Section 4.3 General SAR test reduction and exclusion guidance

For Standalone SAR exclusion consideration, when the considering 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.

In the frequency range below 100 MHz and test separation distance $\leq 50\text{mm}$, the SAR Test Exclusion Threshold will be determined as follows

SAR Exclusion Threshold (SARET)

SAR Exclusion Threshold = $([\text{Step 1} + \text{Step 2}] * \text{Step 3a}) * \text{Step 3b}$

Step 1

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

NT = Numeric Threshold (3.0 for 1-g SAR and 7.5 for 10-g SAR)
 MP = Max Power of channel (mW) (inc tune up)
 TSD^A = Min Test separation Distance or 50mm (whichever is lower) = 50
 f_{GHz} = Transmit frequency (or 100MHz if lower)

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.

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

For Distances Greater than 50 mm Step 2 applies

Step 2

$$(TSD^B - 50\text{mm}) * f_{\text{(MHz)}}/150$$

Where:

f_{MHz} = Transmit frequency
 TSD^B = Min Test separation Distance (mm) = 50

Step 3

3a) The power threshold at the corresponding test separation distance at 100 MHz in step 2) is multiplied by $[1 + \log(100/f(\text{MHz}))]$ for *test separation distances* $> 50\text{ mm}$ and $< 200\text{ mm}$

3b) The power threshold determined by the equation in steps 1 and 2 for 50 mm and 100 MHz is multiplied by $1/2$ for *test separation distances* $\leq 50\text{ mm}$

$$\begin{aligned} \text{SARET} &= (([(NT * TSD^A) / \sqrt{f_{\text{GHz}}}] + (TSD^B - 50) * [100/150]) * (1 + \log [100 / F_{\text{MHz}}])) * 1/2 \\ \text{SARET} &= (([(3.0 * 50) / \sqrt{0.1}] + (50 - 50) * [100/150]) * (1 + \log [100 / F_{\text{MHz}}])) * 1/2 \\ \text{SARET} &= (474.34 * (1 + \log [100 / 10.6])) * 1/2 \\ \text{SARET} &= 468.3\text{ mW} \end{aligned}$$

The calculated output power is 0.00002553mW (eirp) is less than the SAR Exclusion Threshold of 468mW, at 5mm test separation distance, for general population and uncontrolled exposure.

Therefore standalone SAR evaluation for general population exposure conditions by measurement or numerical simulation is not required.

Prediction of MPE limit at a given distance

For purposes of these requirements mobile devices are defined by the Industry Canada 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 Industry Canada 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 1.67W/m² power density limit, as required under Industry Canada rules.

Equation from IEEE C95.1

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

Where:

S = power density

R = distance to the centre of radiation of the antenna

EIRP = EUT Maximum power

Note:

The EIRP value was calculated using the peak E Field measurement.

Result

Prediction Frequency (MHz)	Maximum EIRP (mW)	Power density limit (S) (mW/cm ²)	Distance (R) cm required to be less than 1.6 mW/cm ²
10.56	0.00002553	1.6	0.00113