

Report on the Radio Testing
For
HWM-Water Ltd
on
USB Transceiver
Report no. TRA-031981-47-02A
11th August 2017

RF922 3.0

Report Number: TRA-031981-47-02A
Issue: B

REPORT ON THE RADIO TESTING OF A
HWM-Water Ltd

USB Transceiver

WITH RESPECT TO SPECIFICATION

FCC 47CFR 15.249 ISED RSS-210 Issue 9 August 2016
RSS Gen Issue 4 November 2014

TEST DATE: 22nd June- 31st July 2017

Written by: S Hodgkinson

S Hodgkinson
Radio Test Engineer

Approved by:

John Charters
Department Manager - Radio

Date: 11th August 2017

Disclaimers:

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[2] THE RESULTS CONTAINED IN THIS DOCUMENT RELATE ONLY TO THE ITEM(S) TESTED

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1 Revision Record

<i>Issue Number</i>	<i>Issue Date</i>	<i>Revision History</i>
B	17th August 2017	Original

2 Summary

TEST REPORT NUMBER:	TRA-031981-47-02A
WORKS ORDER NUMBER	TRA-031981-02
PURPOSE OF TEST:	USA: Testing of radio frequency equipment per the relevant authorization procedure of chapter 47 of CFR (code of federal regulations) Part 2, subpart J. Canada: Testing of radio apparatus for TAC (technical acceptance certificate) per subsections 4(2) of the Radio communication Act and 21(1) of the Radio communication Regulations.
TEST SPECIFICATION(S):	47CFR15.249, ISED RSS-210 Issue 9 August 2016, RSS Gen Issue 4 November 2014
EQUIPMENT UNDER TEST (EUT):	USB Transceiver
FCC IDENTIFIER:	RUZ-553
IC IDENTIFIER	10962A-553
EUT SERIAL NUMBER:	25328289
MANUFACTURER/AGENT:	HWM-Water Ltd
ADDRESS:	Ty Coch House Llantarnam Industrial Park Cwmbran NP44 3AW United Kingdom
CLIENT CONTACT:	Andy Earp ☎ 01633 627853 ✉ aearp@hwm-water.com
ORDER NUMBER:	73070
TEST DATE:	22nd June- 31st July 2017
TESTED BY:	S Hodgkinson Element

2.1 Test Summary

Test Method and Description	Requirement Clause		Applicable to this equipment	Result / Note
	RSS	47CFR15		
Radiated spurious emissions	210, B10(b)	15.249(d)	☒	Pass
AC power line conducted emissions	Gen, 8.8	15.207	☒	Pass
Occupied bandwidth	Gen, 6.6	15.215(c)	☒	Pass
Field strength of fundamental	210, B.10(a)	15.249(a)	☒	Pass
Calculation of duty correction ¹	-	15.35(c)	☐	N/A

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-031981-47-02A presents the results of the Radio testing on a HWM-Water Ltd, USB Transceiver to specification 47CFR15 Radio Frequency Devices and ISSED RSS-210 Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.

The testing was carried out for HWM-Water Ltd by Element, at the address(es) detailed below.

☐	Element Hull Unit E South Orbital Trading Park Hedon Road Hull HU9 1NJ UK	☒	Element North West Unit 1 Pendle Place Skemersdale 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.

IC Registration Number(s):

Element North West 3930B

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.
- Industry Canada ISSED RSS-210, Issue 9 August 2016 Systems Licence-Exempt Radio Apparatus
- Industry Canada RSS-Gen, Issue 4, November 2014 – General Requirements for Compliance of Radio Apparatus.

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: USB Transceiver
- Serial Number: 25328289
- Model Number: 553-020-914

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.

Toshiba WT8-A Tablet, HP Compaq 6720s

7.3 EUT Mode of Operation

7.3.1 Transmission

The mode of operation for Tx tests was as follows...

The operating modes were selected via the test software PermaNet 2.49.4
Channel selection/output power level etc.

7.4 EUT Radio Parameters

7.4.1 General

Frequency of operation:	914.5MHz
Modulation type(s):	GFSK
Occupied channel bandwidth(s):	129.80kHz
Channel spacing:	Wideband
ITU emission designator(s):	137kF1D
Declared output power(s):	93.8dBμV/m
Nominal Supply Voltage:	5Vdc
Duty cycle:	12.5%

7.4.2 Antennas

Gain:	2dBi
Mounting:	Integral, the Antenna will be permanently fixed in place, and not removable.

7.5 EUT Description

USB Transceiver operating in the 902-928MHz Band, The USB transceiver is part of a water leak detection system.

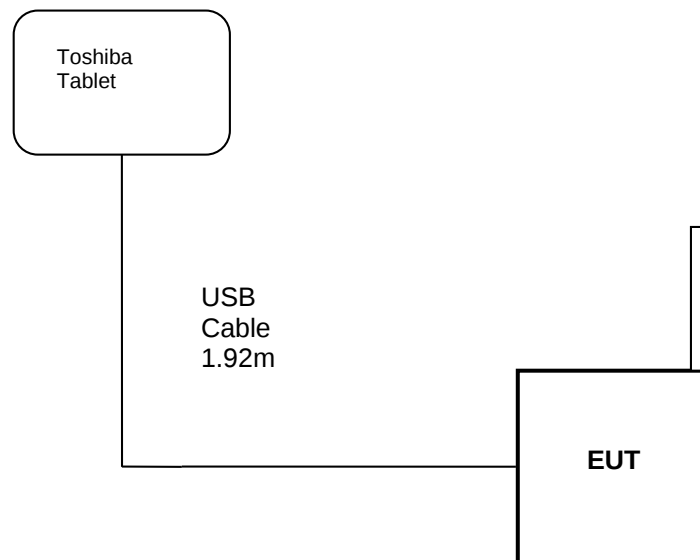
8 Modifications

No modifications were performed during this assessment.

9 EUT Test Setup

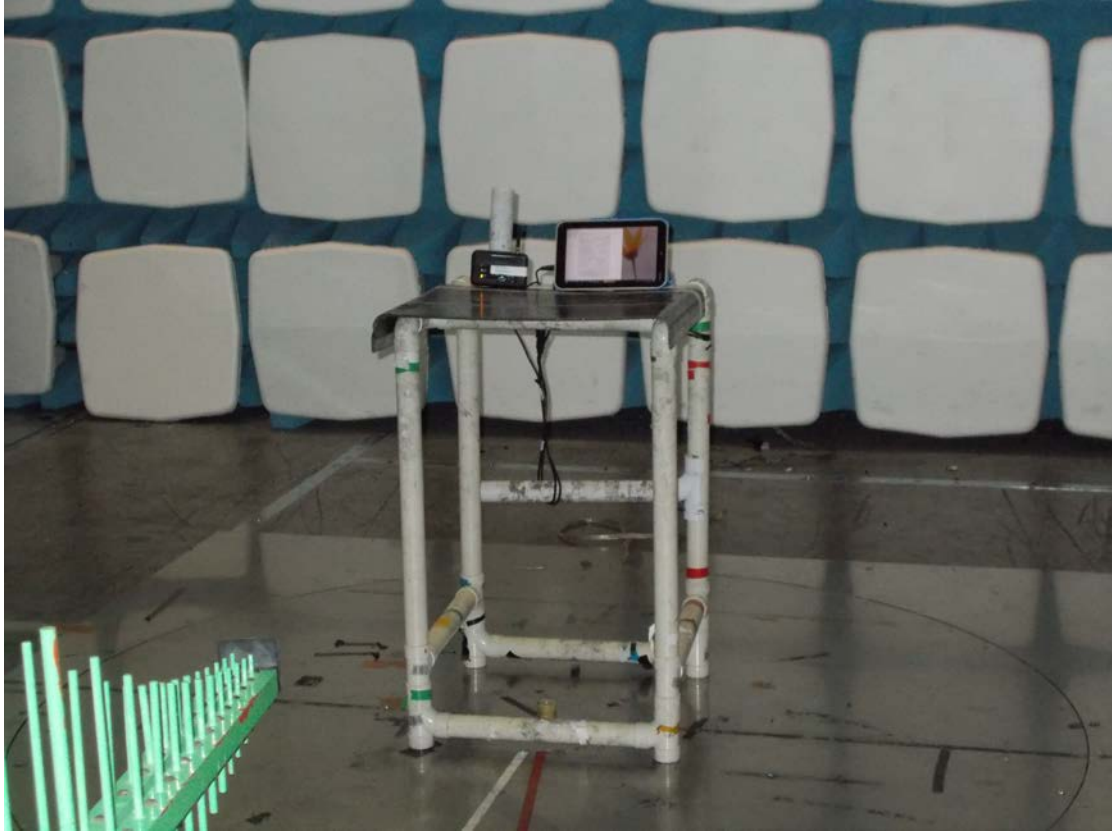
9.1 Block Diagram

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



9.2 General Set-up Photograph

The following photograph shows basic EUT set-up:



10 General Technical Parameters

10.1 Normal Conditions

The E U T was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was approx. 5 V dc from tablet or laptop.

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 and the manufacturer has declared sufficient frequency stability (refer to section 7.4).

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

	Category	Nominal	Variation
☐	Mains	110 V ac +/- 2 %	85 % and 115 %
☐	Battery	New battery	N/A
☒	USB powered via tablet or Laptop	5Vdc	N/A

11 Radiated emissions

11.1 Definitions

Out-of-band emissions

Emissions on a frequency or frequencies immediately outside the necessary bandwidth which result from the modulation process, but exclude spurious emissions.

Spurious emissions

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.

Restricted bands

A frequency band in which intentional radiators are permitted to radiate only spurious emissions but not fundamental signals.

11.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Chamber 3
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Channels / Frequencies Measured:	914.5MHz
Deviations From Standard:	None
Measurement BW:	30 MHz to 1 GHz: 120 kHz Above 1 GHz: 1 MHz
Measurement Detector:	Up to 1 GHz: quasi-peak Above 1 GHz: RMS average and Peak

Environmental Conditions (Normal Environment)

Temperature: 23 °C

Humidity: 32 % RH

Supply: 5 Vdc via tablet

11.3 Test Limit

Except for harmonics, out-of-band emissions shall be attenuated by at least 50 dB below the level of the fundamental or to the general field strength limits listed in FCC 47CFR15.209 / RSS-Gen {see table below}, whichever is less stringent.

Harmonics shall be limited to a maximum level of 0.5 mV/m measured at 3 metres.

General Field Strength Limits for License-Exempt Transmitters at Frequencies above 30 MHz

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

n.b. per FCC 47CFR15.35(b) / RSS-Gen 8.1, peak limit is 20 dB above average.

11.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure i, 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. Pre-scan plots are shown with a peak detector and 100 kHz RBW.

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 30 MHz and 1 GHz are measured using calibrated broadband antennas. Emissions above 1 GHz are characterized using standard gain horn antennas. 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.

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;

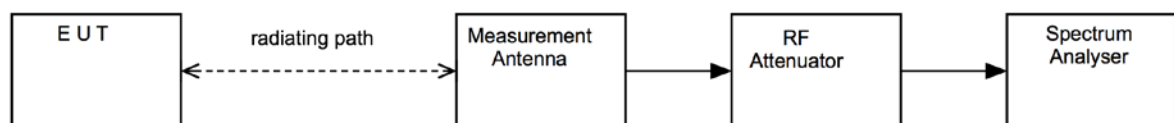
PA is the pre-amplifier gain in dB (where used);

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

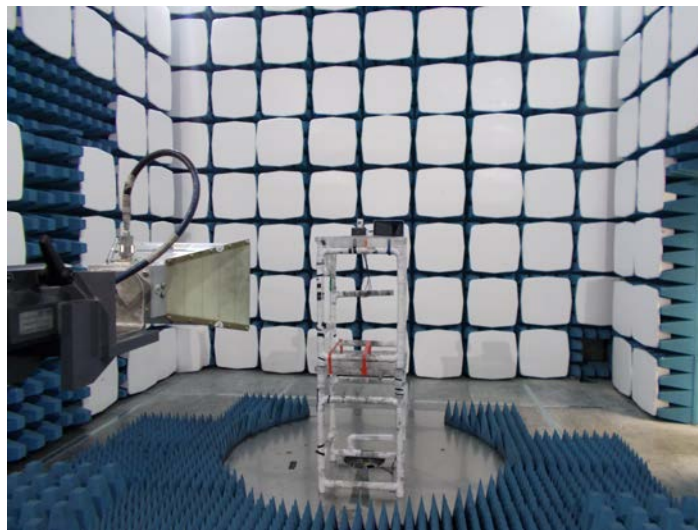
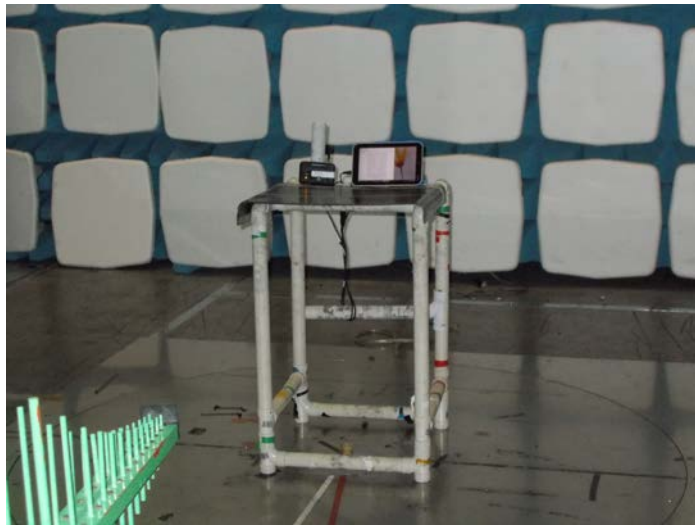
CF is the distance factor in dB (where measurement distance different to limit distance);

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

Figure i Test Setup



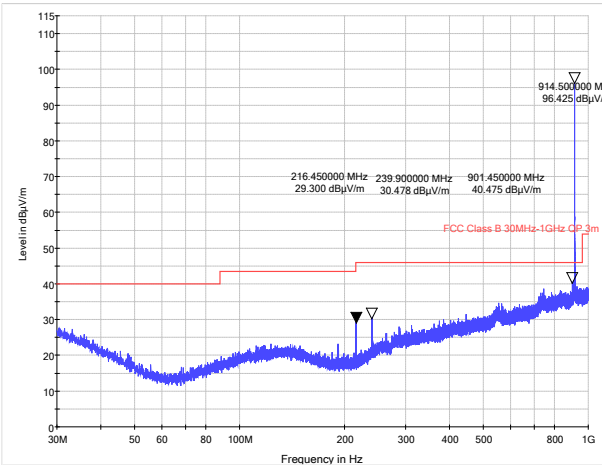
11.5 Test Set-up Photograph



11.6 Test Equipment

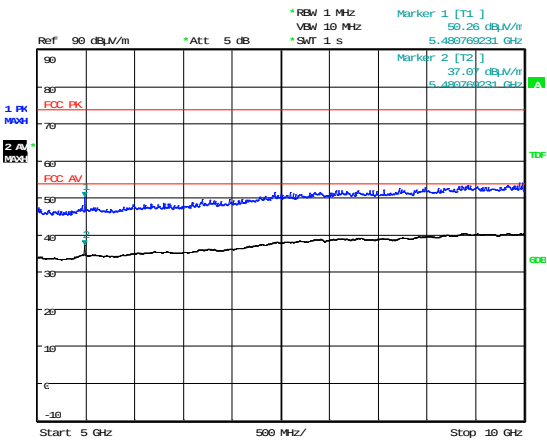
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
ESVS10	R&S	Receiver	L352	14/07/2017
CBL6112	Chase	Bilog	U420	18/04/2018
FSU46	R&S	Spectrum Analyser	U281	19/06/2018
3115	EMCO	1-18GHz Horn	L139	25/09/2017
8449B	Agilent	Pre Amp	L572	07/02/2018

11.7 Test Results
30MHz-1GHz

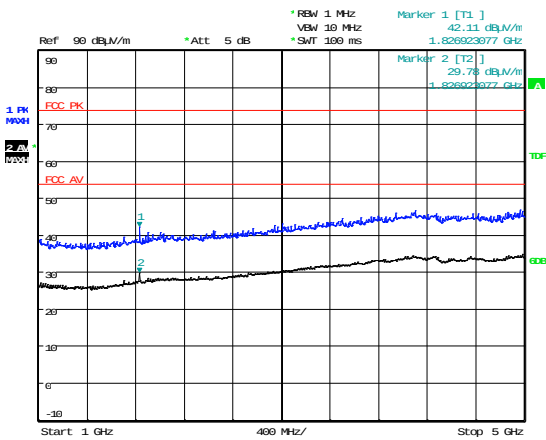


1-5GHz

5-10GHz



Date: 22 JUN 2017 15:52:42



Date: 22 JUN 2017 15:47:40

914.5MHz										
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)
Pk	1829.0	51.29	2.5	26.7	36.2	N/A	N/A	44.30	164.6	5000
Av	1829.0	46.29	2.5	26.7	36.2	N/A	N/A	39.30	92.6	500
Pk	5487.0	49.94	4.3	34.1	36.0	N/A	N/A	52.34	415.4	5000
Av	5487.0	44.36	4.3	34.1	36.0	N/A	N/A	46.76	218.5	500

12 AC power-line conducted emissions

12.1 Definition

Line-to-ground radio-noise voltage that is conducted from all of the EUT current-carrying power input terminals that are directly (or indirectly via separate transformers or power supplies) connected to a public power network.

12.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Transient Lab 2
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.2
EUT Channels / Frequencies Measured:	914.50MHz
EUT Channel Bandwidths:	Wideband
Deviations From Standard:	None
Measurement BW:	10kHz
Measurement Detectors:	Quasi-Peak and Average,

Environmental Conditions (Normal Environment)

Temperature:	22 °C
Humidity:	32 % RH
Supply:	110 V ac Laptop 5v dc USB to EUT

12.3 Test Limit

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz, shall not exceed the limits in Table 3.

Table 3 – AC Power Line Conducted Emission Limits

Frequency (MHz)	Conducted limit (dBμV)	
	Quasi-Peak	Average**
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

*The level decreases linearly with the logarithm of the frequency.

**A linear average detector is required.

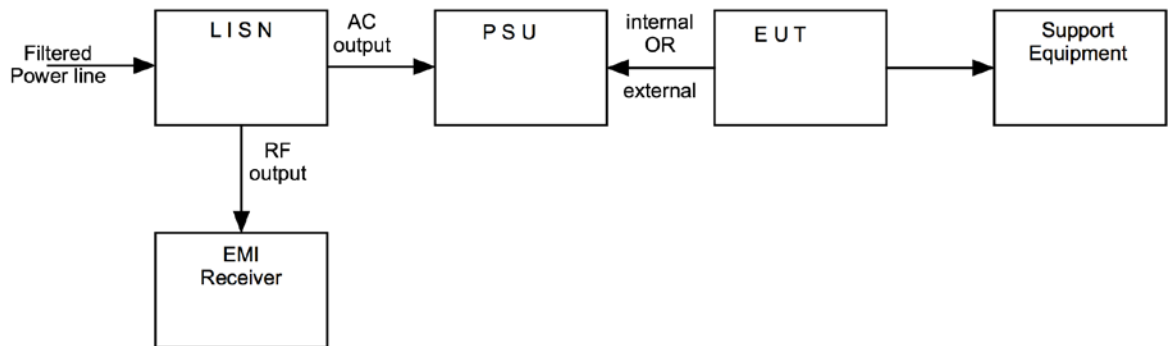
12.4 Test Method

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

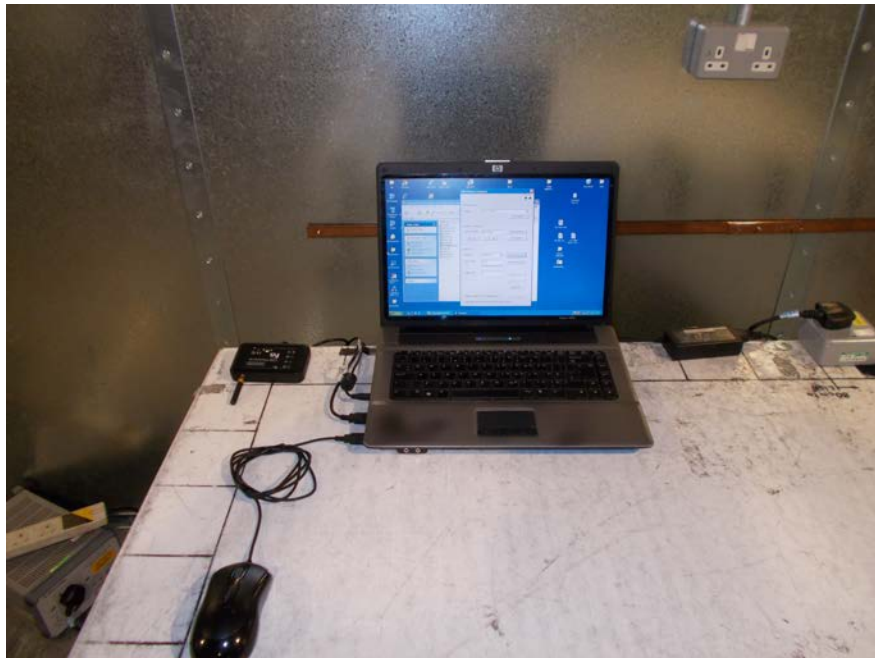
AC power line conducted emissions from the EUT are checked first by preview scans with peak and average detectors covering both live and neutral lines. A spectrum analyzer is used to determine if any periodic emissions are present.

Formal measurements using the correct detector(s) and bandwidth are made on frequencies identified from the preview scans. Final measurements were performed with EUT set at its maximum duty in transmit and receive modes.

Figure ii Test Setup



12.5 Test Set-up Photograph

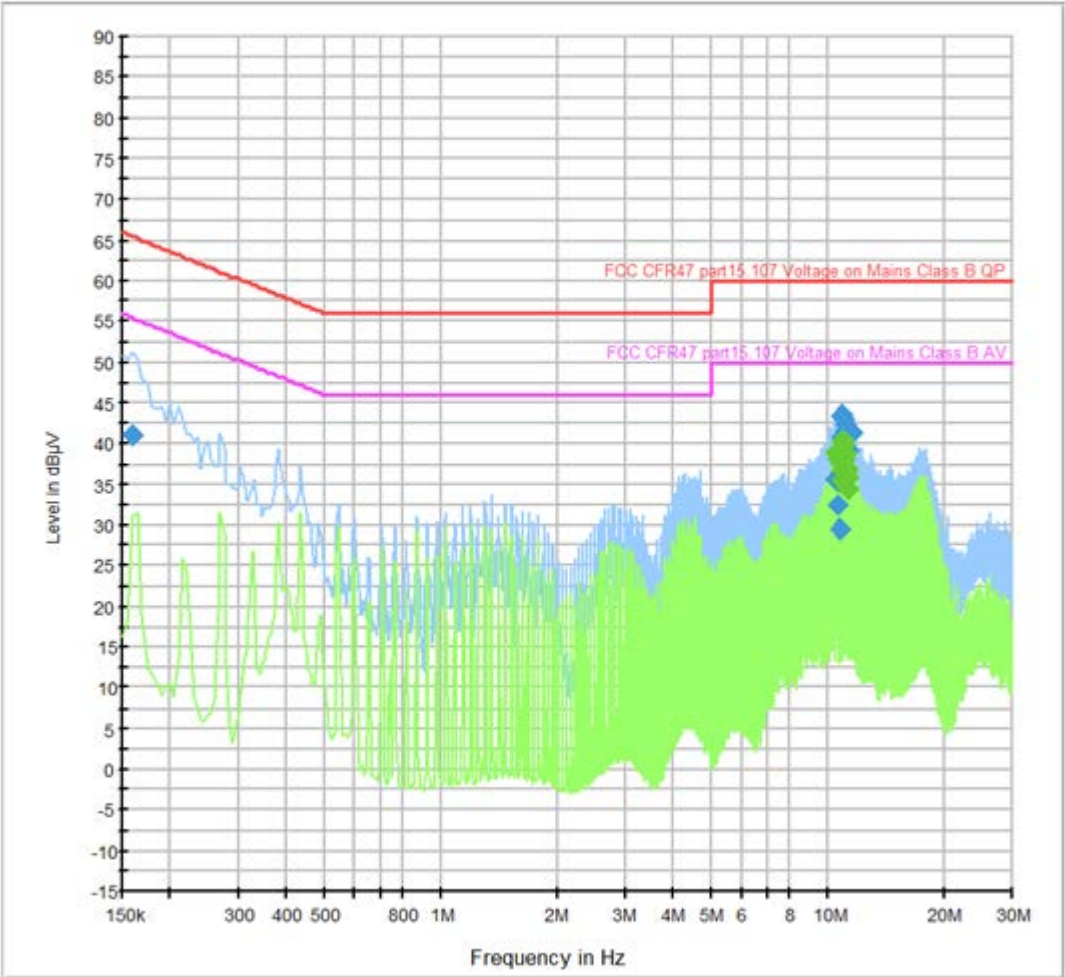


12.6 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
ESHS10	R&S	Receiver	U187	25/10/2017
ENV216	R&S	Lisn	U396	29/06/2017

12.7 Test Results

Conducted emissions on Mains 9kHz-30MHz ESHS10 + UH396



Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.160000	41.0	5000.0	10.000	On	L1	9.6	24.5	65.5	Pass
10.505000	35.6	5000.0	10.000	On	L1	9.8	24.4	60.0	Pass
10.615000	35.5	5000.0	10.000	On	L1	9.8	24.5	60.0	Pass
10.670000	32.5	5000.0	10.000	On	L1	9.8	27.5	60.0	Pass
10.725000	29.5	5000.0	10.000	On	L1	9.8	30.5	60.0	Pass
10.830000	40.8	5000.0	10.000	On	L1	9.8	19.2	60.0	Pass
10.880000	43.6	5000.0	10.000	On	N	9.8	16.4	60.0	Pass
10.935000	43.3	5000.0	10.000	On	N	9.8	16.7	60.0	Pass
10.990000	43.1	5000.0	10.000	On	N	9.8	16.9	60.0	Pass
11.045000	43.1	5000.0	10.000	On	N	9.8	16.9	60.0	Pass
11.100000	42.4	5000.0	10.000	On	N	9.8	17.6	60.0	Pass
11.155000	41.5	5000.0	10.000	On	N	9.8	18.5	60.0	Pass
11.210000	40.8	5000.0	10.000	On	N	9.8	19.2	60.0	Pass
11.265000	39.1	5000.0	10.000	On	N	9.8	20.9	60.0	Pass
11.535000	41.4	5000.0	10.000	On	N	9.9	18.6	60.0	Pass

Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
10.555000	38.8	5000.0	10.000	N	9.8	11.2	50.0	Pass
10.610000	38.3	5000.0	10.000	N	9.8	11.7	50.0	Pass
10.665000	38.1	5000.0	10.000	N	9.8	11.9	50.0	Pass
10.720000	37.8	5000.0	10.000	N	9.8	12.2	50.0	Pass
10.775000	37.5	5000.0	10.000	L1	9.8	12.5	50.0	Pass
10.830000	36.5	5000.0	10.000	L1	9.8	13.5	50.0	Pass
10.885000	35.5	5000.0	10.000	L1	9.8	14.5	50.0	Pass
10.935000	40.4	5000.0	10.000	N	9.8	9.6	50.0	Pass
10.990000	40.3	5000.0	10.000	N	9.8	9.7	50.0	Pass
11.045000	39.9	5000.0	10.000	N	9.8	10.1	50.0	Pass
11.100000	38.8	5000.0	10.000	N	9.8	11.2	50.0	Pass
11.155000	38.0	5000.0	10.000	N	9.8	12.0	50.0	Pass
11.210000	36.9	5000.0	10.000	N	9.8	13.1	50.0	Pass
11.265000	36.0	5000.0	10.000	L1	9.8	14.0	50.0	Pass
11.320000	34.4	5000.0	10.000	L1	9.8	15.6	50.0	Pass

13 Occupied Bandwidth

13.1 Definitions

Occupied bandwidth

The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5 % of the emitted power. This is also known as the 99 % *emission bandwidth*. For transmitters in which there are multiple carriers, contiguous or non-contiguous in frequency, the occupied bandwidth is to be the sum of the occupied bandwidths of the individual carriers.

20 dB 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.

13.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Lab
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.9
EUT Channels / Frequencies Measured:	914.50MHz
EUT Channel Bandwidths:	Wideband
Deviations From Standard:	None
Measurement BW:	3kHz
(requirement: 1 % to 5 % OBW)	
Spectrum Analyzer Video BW:	10kHz
(requirement at least 3x RBW)	
Measurement Span:	500kHz
(requirement 2 to 5 times OBW)	
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 23 °C
 Humidity: 32 % RH
 Supply: 5.0 V dc via tablet

13.3 Test Limit

Industry Canada:

If the frequency stability of the license-exempt radio apparatus is not specified in the applicable standard (RSS), measurement of the frequency stability is not required provided that the occupied bandwidth of the license-exempt radio apparatus lies entirely outside the restricted bands and the prohibited TV bands of 54 to 72 MHz, 76 to 88 MHz, 174 to 216 MHz, 470 to 608 MHz and 614 to 806 MHz.

Federal Communications Commission:

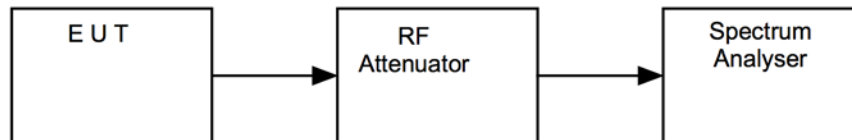
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific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

13.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iii, 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 iii Test Setup

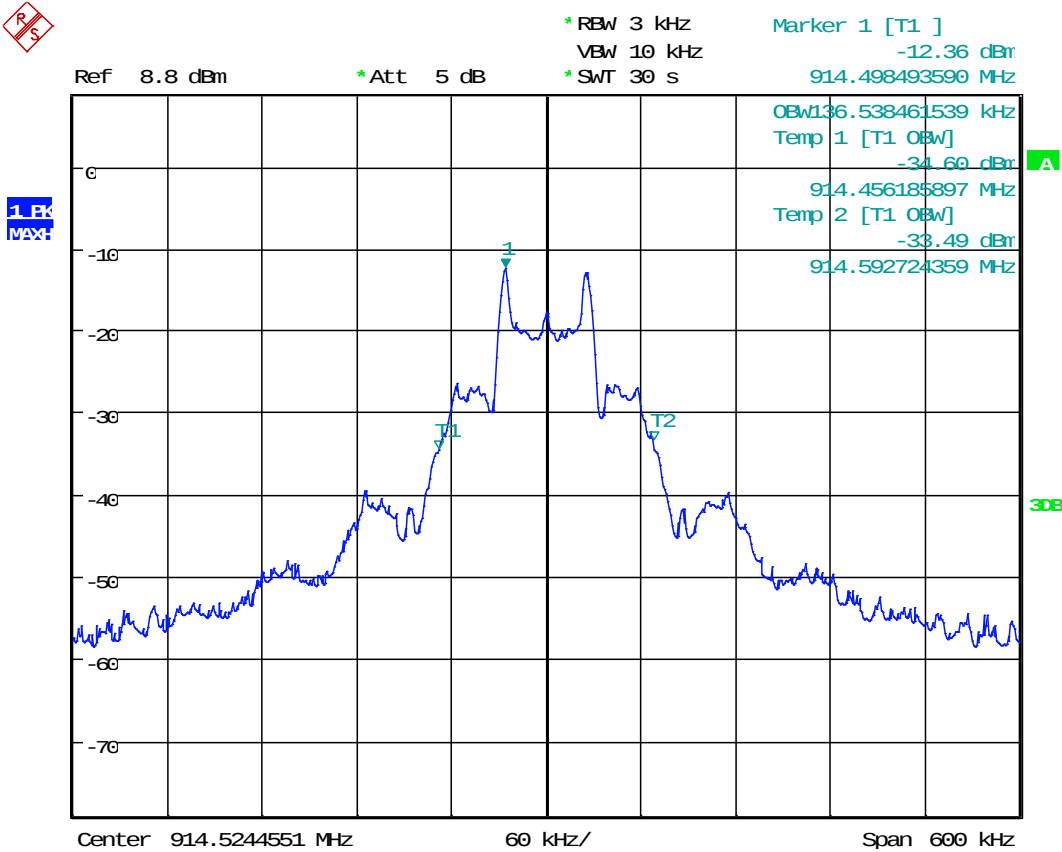


13.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU46	R&S	Spectrum Analyser	U281	19/06/2018

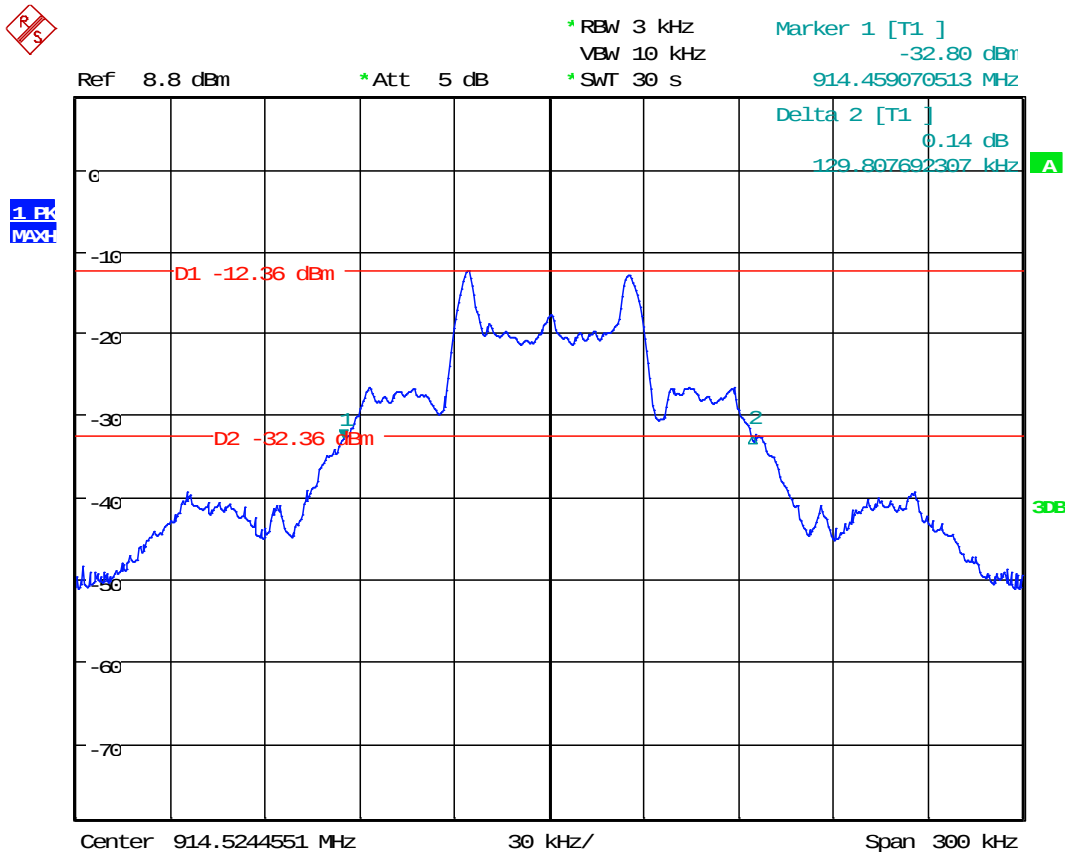
13.6 Test Results

RSS-Gen. 914.5MHz				
Channel Frequency (MHz)	F _L (MHz)	F _H (MHz)	99% Bandwidth (kHz)	Result
914.50	914.456185	914.592724	136.53	PASS



Date: 23.JUN.2017 12:11:10

FCC 15.249. 914.5MHz				
Channel Frequency (MHz)	F _L (MHz)	F _H (MHz)	20dB Bandwidth (kHz)	Result
914.50	914.459070	914.588878	129.807692	PASS



Date: 23.JUN.2017 11:57:10

14 Transmitter output power (fundamental radiated emission)

14.1 Definition

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

14.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Chamber 3
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 / 6.6
EUT Channels / Frequencies Measured:	914.50MHz
EUT Channel Bandwidths:	Wideband
Deviations From Standard:	None
Measurement BW:	120kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	
Measurement Detector:	Up to 1 GHz: Quasi-peak Above 1 GHz: Average RMS and Peak
Voltage Extreme Environment Test Range:	Mains Power = 85 % and 115 % of Nominal (FCC only requirement); Battery Power = new battery.

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 °C to +35 °C (as declared)
Humidity: 32 % RH	20 % RH to 75 % RH (as declared)

14.3 Test Limit

The field strength measured at 3 metres shall not exceed the limits in the following table:

Field Strength Limits for License-Exempt Transmitters for Any Application

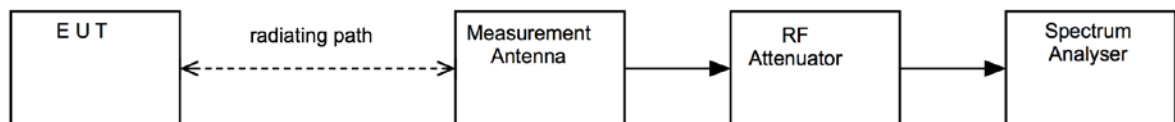
<i>Fundamental frequency (MHz)</i>	<i>Field strength (mV/m at 3 m)</i>	<i>Detector</i>
902 to 928	50	Quasi-Peak
2400 to 2483.5	50	Average RMS
5725 to 5875	50	Average RMS

14.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iv, the resolution bandwidth of the spectrum analyser 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.

Figure iv Test Setup



14.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
ESVS10	R&S	Receiver	<u>L352</u>	14/07/2017
CBL611/A	Chase	Bilog	<u>U191</u>	23/02/2019

14.6 Test Results

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 (mV/m)	Limit (mV/m)
QP	914.50	66.4	4.0	23.4	N/A	100	N/A	93.8	48.97	50

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] Carrier power

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

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

[2] Spurious emissions

Uncertainty in test result (30 MHz to 1 GHz) = **4.6 dB**

Uncertainty in test result (1 GHz to 18 GHz) = **4.7 dB**

[3] AC power line conducted emissions

Uncertainty in test result = **3.4 dB**

[4] Occupied bandwidth

Uncertainty in test result = **15.5 %**

[5] Maximum frequency error

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

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

[6] Duty cycle

Uncertainty in test result = **7.98 %**