Report on the Radio Testing

For

Paxton Access Ltd

on

Paxton 10 Wireless Connector

Report no. TRA-041571-45-03A

18 January 2019

Report Number: TRA-041571-45-03A
Issue: A

REPORT ON THE RADIO TESTING OF A
Paxton Access Ltd
Paxton 10 Wireless Connector
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.249

TEST DATE: 2018-10-17 to 2018-10-18

Written by: D Garvey
Radio Engineer

Approved by: J Charters
Department Manager – Radio

Digitally signed by John Charters
DN: cn=John Charters, o, ou=Element Materials Technology Ltd., email=john.charters@element.com, c=GB
Reason: I am approving this document
Date: 2019.01.23 11:37:34 Z

Date: 18 January 2019

1 Revision Record

Issue Number	*Issue Date*	*Revision History*
A	18 January 2019	Original

2 Summary

TEST REPORT NUMBER:	TRA-041571-45-03A
WORKS ORDER NUMBER:	TRA-041571-02
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.
TEST SPECIFICATION(S):	47CFR15.249
EQUIPMENT UNDER TEST (EUT):	Paxton 10 Wireless Connector
FCC IDENTIFIER:	USE010592
EUT SERIAL NUMBER:	5909470
MANUFACTURER/AGENT:	Paxton Access Ltd
ADDRESS:	Paxton House Home Farm Road Brighton East Sussex BN1 9HU
CLIENT CONTACT:	Brett Glass ☎ 01273 811016 ✉ brett.glass@paxton-access.co.uk
ORDER NUMBER:	176518
TEST DATE:	2018-10-17 to 2018-10-18
TESTED BY:	D Garvey Element

2.1 Test Summary

Test Method and Description	*Requirement Clause* *47CFR15*	*Applicable to this equipment*	*Result / Note*
Radiated spurious emissions	15.249(d)	☒	*PASS*
AC power line conducted emissions	15.207	☐	*PASS*
Occupied bandwidth	15.215(c)	☒	*PASS*
Field strength of fundamental	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).

3 Contents

4 Introduction

This report TRA-041571-45-03A presents the results of the Radio testing on a Paxton Access Ltd, Paxton 10 Wireless Connector to specification 47CFR15 Radio Frequency Devices.

The testing was carried out for Paxton Access Ltd by Element, at the address 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

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: Paxton 10 Wireless Connector
- Serial Number: 5909470
- Model Number: 010-592
- Software Revision: Not Applicable
- Build Level / Revision Number: Not Applicable

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.

Name: Paxton10 Wireless Connector
Model Number: 010-687
Serial Number: None given
Exercising / Monitoring: Acting as dummy load for the EUT's RS485 output port
Brief Description: Wireless connector unit configured to act as dummy load.

Name: Dell Support Laptop
Model Number: Vostro 15
Serial Number: JK17362
Exercising / Monitoring: Using Chrome on the desktop of the support laptop to enable the different functions of the EUT, Bluetooth, Z-Wave and the RS485 dummy load.
Brief Description: Support laptop.

Name: Intel Next Unit of Computing (NUC)
Model Number: DC3217IYE
Serial Number: 3401555
Exercising / Monitoring: Acting as a server for the laptop support unit.
Brief Description: Mini PC acting as a server.

Name: TP-Link Router
Model Number: TL-WR840N
Serial Number: 214A106007889
Exercising / Monitoring: Used for Ethernet for the PoE switch.
Brief Description: 300 Mbps Wireless N Router.

Name: Netgear PoE Switch
Model Number: SG305P
Serial Number: 4YJ176DVA08E4
Exercising / Monitoring: PoE switch providing power to EUT and Ethernet traffic between the NUC and laptop.
Brief Description: PoE switch used for testing (Used for testing other than AC power line conducted emissions)

Name: TP-Link PoE Switch
Model Number: TL-SF1008P
Serial Number: 2151819001955
Exercising / Monitoring: PoE switch providing power to EUT and Ethernet traffic between the NUC and laptop.
Brief Description: PoE switch used only for AC power line conducted emissions.

7.3 EUT Mode of Operation

7.3.1 Transmission

The mode of operation for Tx tests was as follows. The EUT was powered from the Wireless Controller support unit (itself receiving power from the PoE switch). Once the unit was powered, the support laptop was used to initialise the Z-Wave radio.

The EUT was set to power setting 16.

7.4 EUT Radio Parameters

7.4.1 General

Frequency of operation:	908.4 MHz, 908 42MHz, 916.0 MHz
Modulation type(s):	GFSK
Declared output power(s):	4 dBm
Nominal Supply Voltage:	PoE
Location of notice for license exempt use:	Label / user manual / both.

7.4.2 Antennas

Type:	Z-Wave
Frequency range:	902 MHz – 928 MHz
Impedance:	50 Ohm
Gain:	1.4 dBi
Polarisation:	Linear

7.5 EUT Description

The EUT is a wireless connector that supports BLE and Z-Wave devices in order to provide the latest control in building integration. Acting as a Z-Wave controller in home and building automation, it will provide sensing and control functions. The EUT has been designed with BLE to provide an integration path for Paxton10 Paxlock devices. The EUT shall extend the wireless range to ensure total coverage throughout a building. The EUT utilises the standard Paxton RJ45 connector and will allow cascading of three Wireless Connectors.

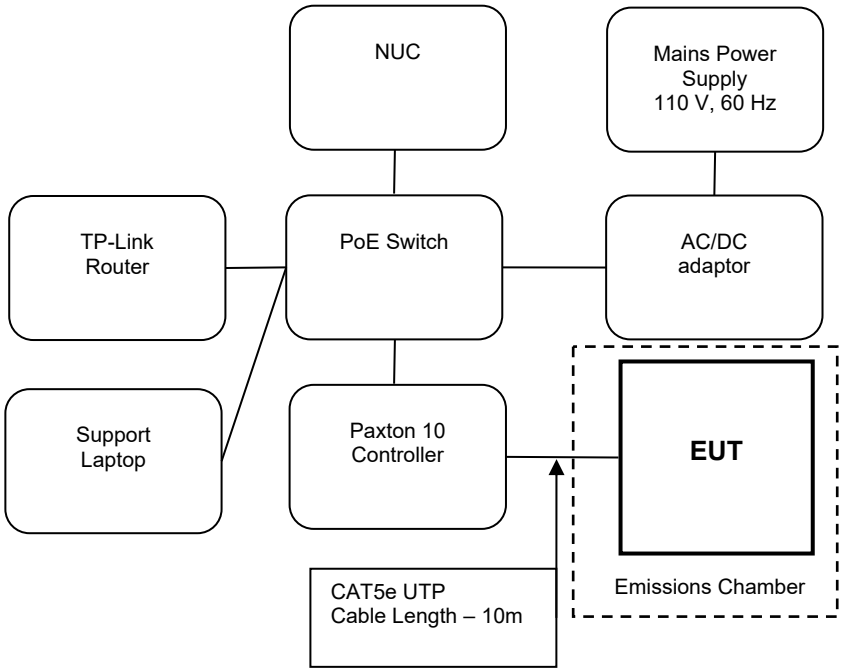
8 Modifications

No modifications were performed during this assessment.

9 EUT Test Setup

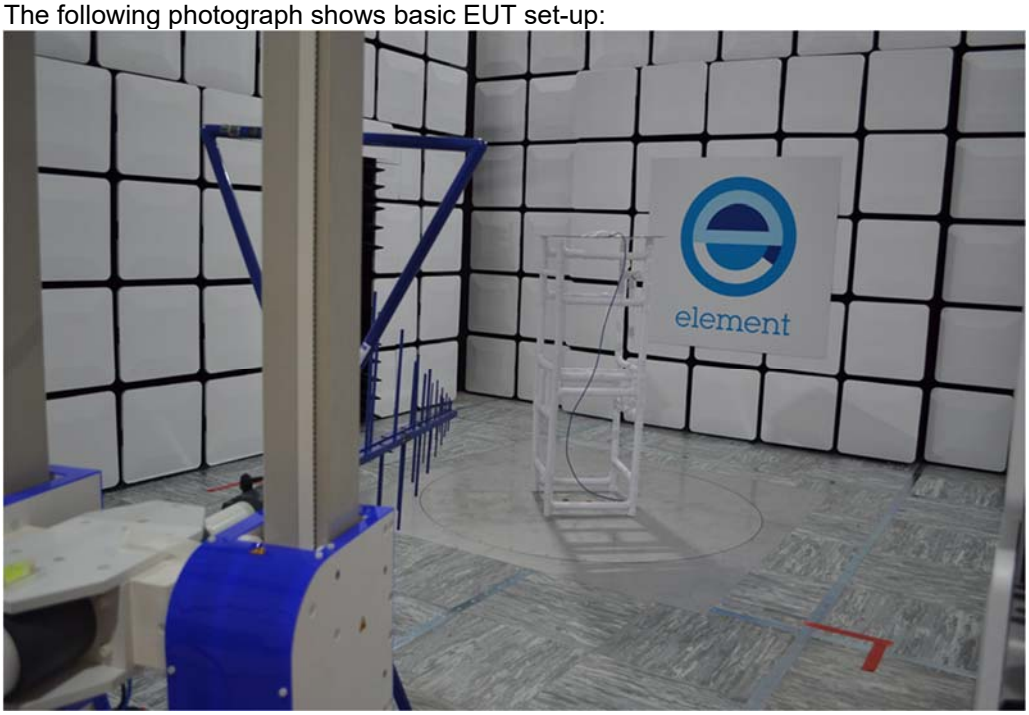
9.1 Block Diagram

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 PoE from the Paxton 10 Controller.

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
☒	PoE	48V	N/A

11 Radiated emissions

11.1 Definitions

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 Hull
Test Chamber:	Wireless Lab 3
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
Frequencies Measured:	908.4 MHz / 916.0 MHz / 908.42MHz
EUT Channel Bandwidths:	Wideband
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: 20 °C	+15 ºC to +35 ºC (as declared)
Humidity: 50 % RH	20 % RH to 75 % RH (as declared)
Supply: PoE	

11.3 Test Limit

Unwanted emissions that fall within the restricted frequency bands shall comply with the limits specified:

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

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

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:

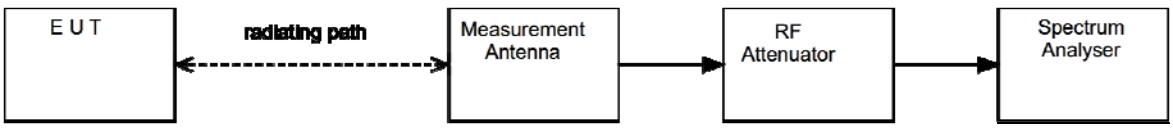
$$FS = PR + CL + AF – PA + DC – CF$$

Where,

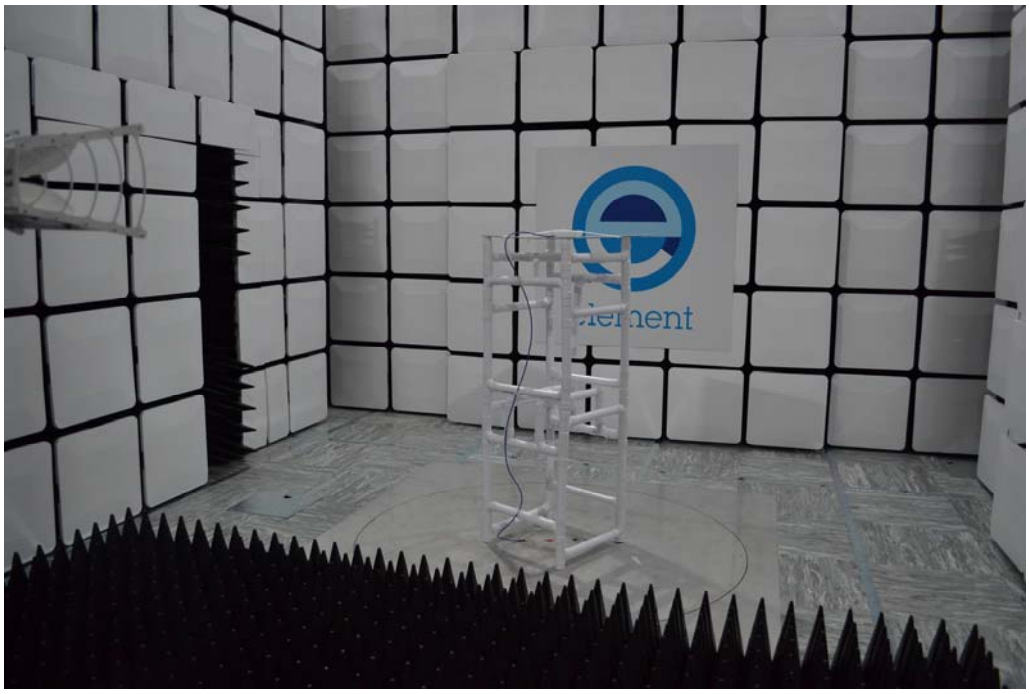
PR is the power recorded on the receiver / spectrum analyzer in dBµV;
CL is the cable loss in dB;
AF is the test antenna factor in dB/m;
PA is the pre-amplifier gain in dB (where used);
DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);
CF is the distance factor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

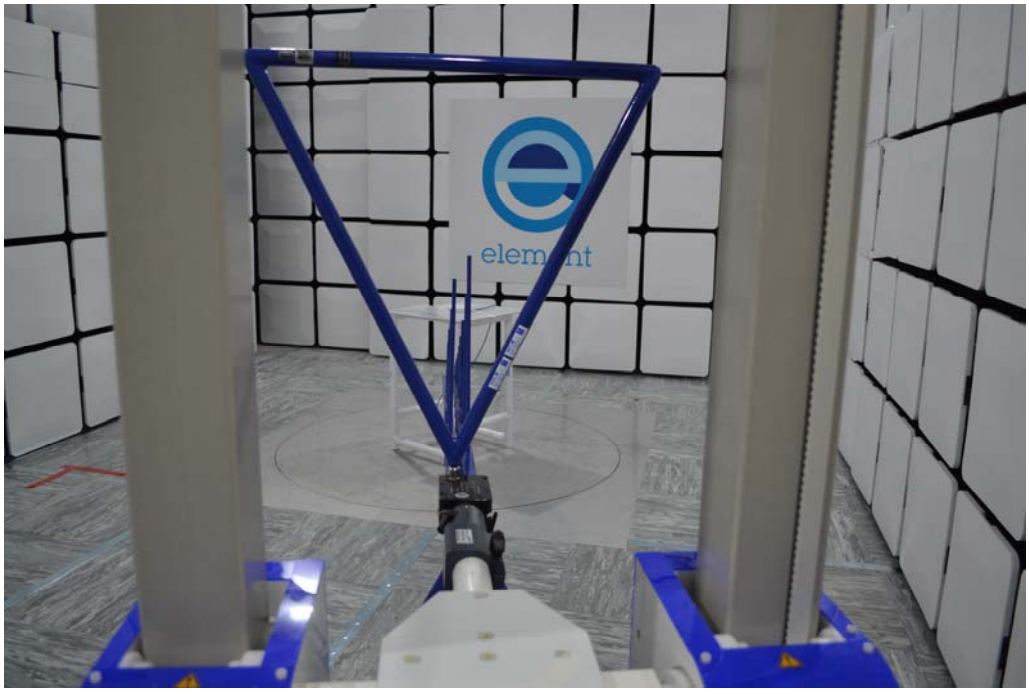
This field strength value is then compared with the regulatory limit.

Figure i Test Setup



11.5 Test Set-up Photograph





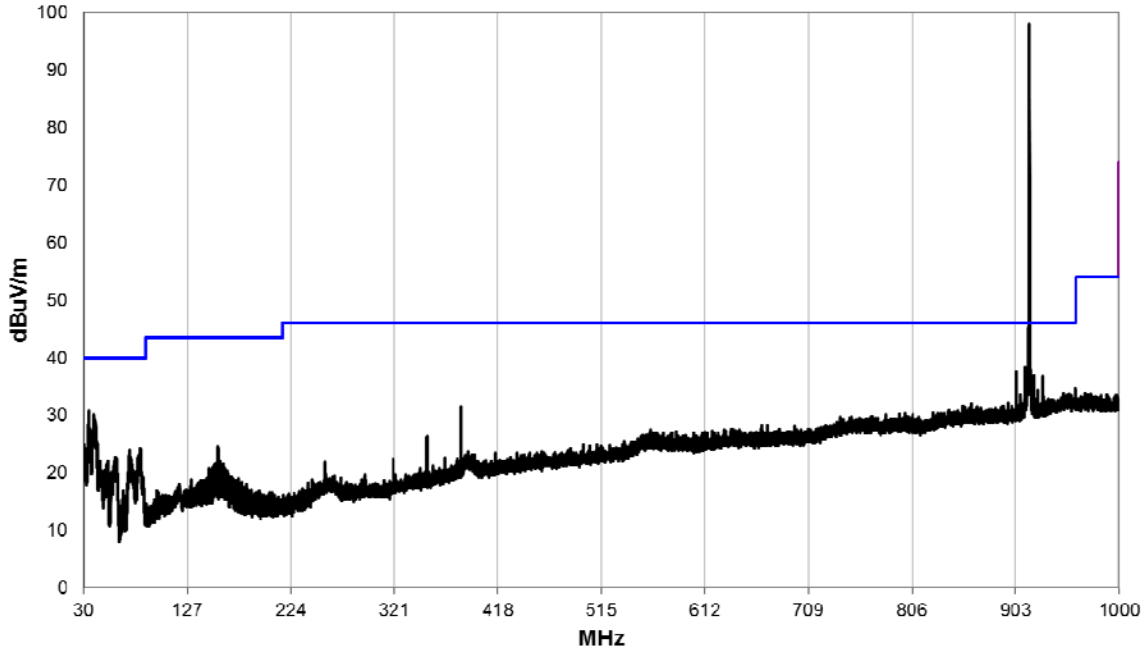
11.6 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Ferrite Lined Chamber	Rainford	Chamber	REF2259	2020-08-03
Receiver	R&S	ESU40	RFG701	2018-11-20
Pre-Amp (9kHz – 1GHz)	Sonoma	310	REF927	2019-05-22
Pre-Amp (1 – 26.5GHz)	Agilent	8449B	REF913	2019-02-07
Bilog Antenna	Chase	CBL6111B	REF2218	2019-11-06
Horn Antenna	A Info Inc	LB-10180-NF	REF2241	2020-07-13

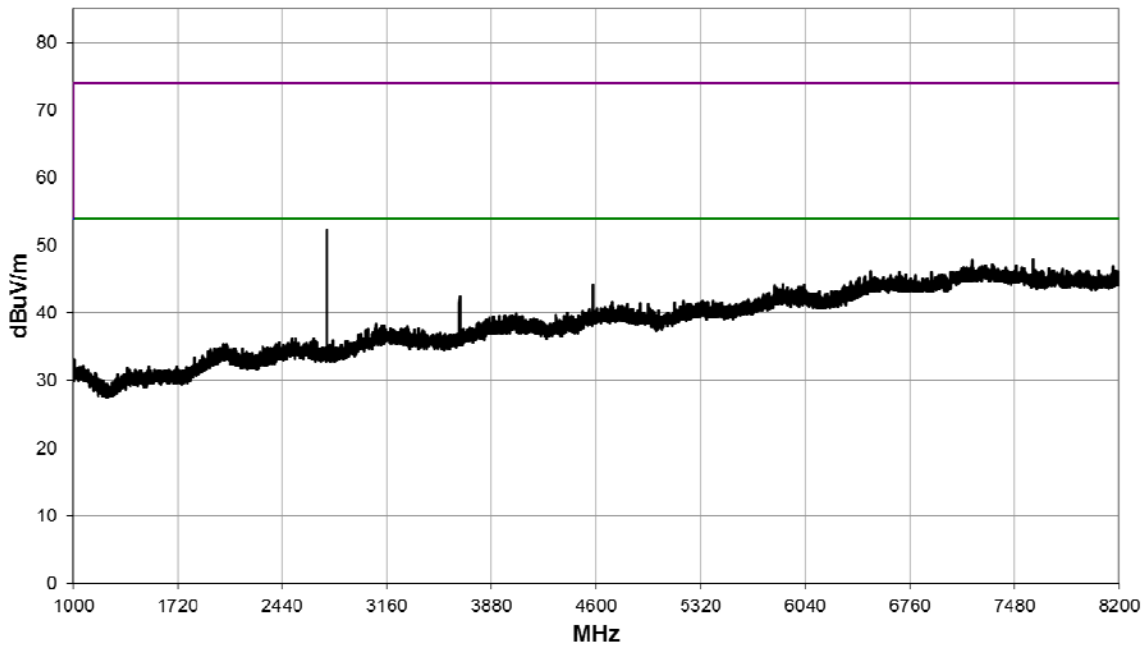
11.7 Test Results

Frequency: 916 MHz; Data Rate: 100 kbps										
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)***
AV	2748.0	54.2	3.9	28.9	35.3	0	0	51.7	384.6	500
PK	2748.0	56.2	3.9	28.9	35.3	0	0	53.7	484.2	5000

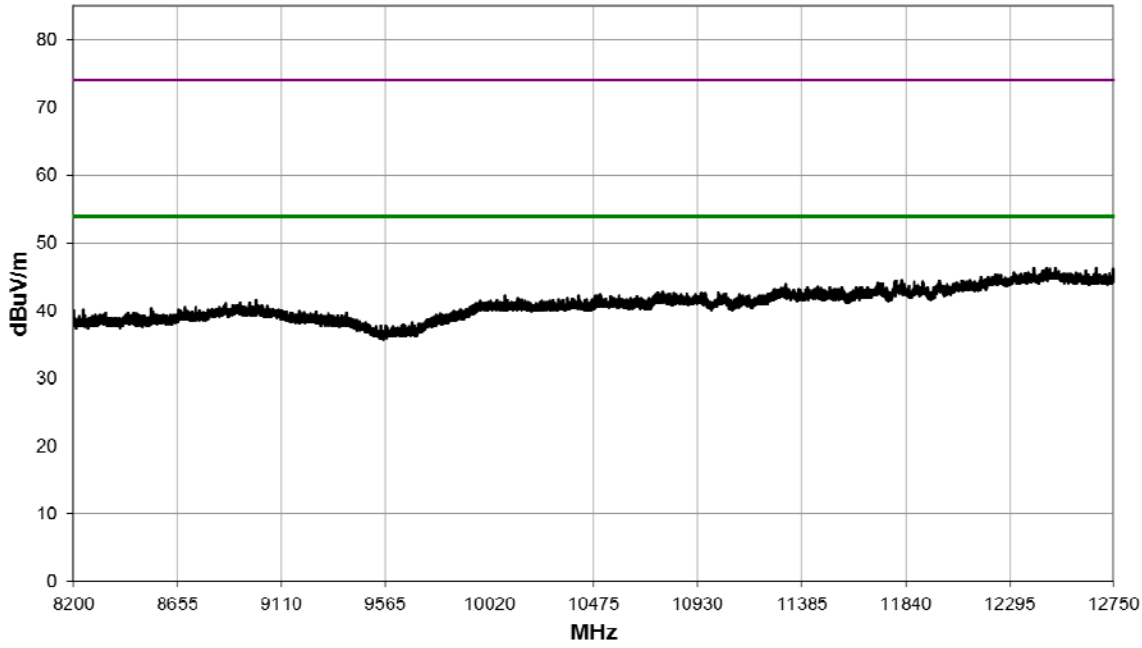
30 MHz to 1 GHz



1 GHz to 8.2 GHz

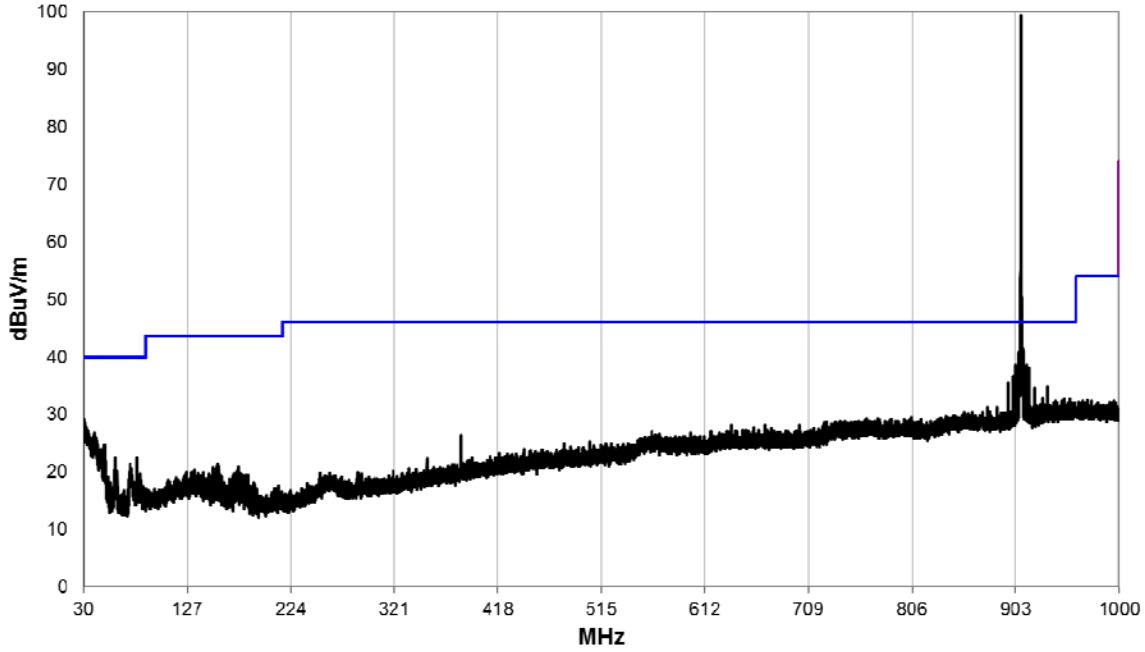


8.2 GHz to 12.75 GHz

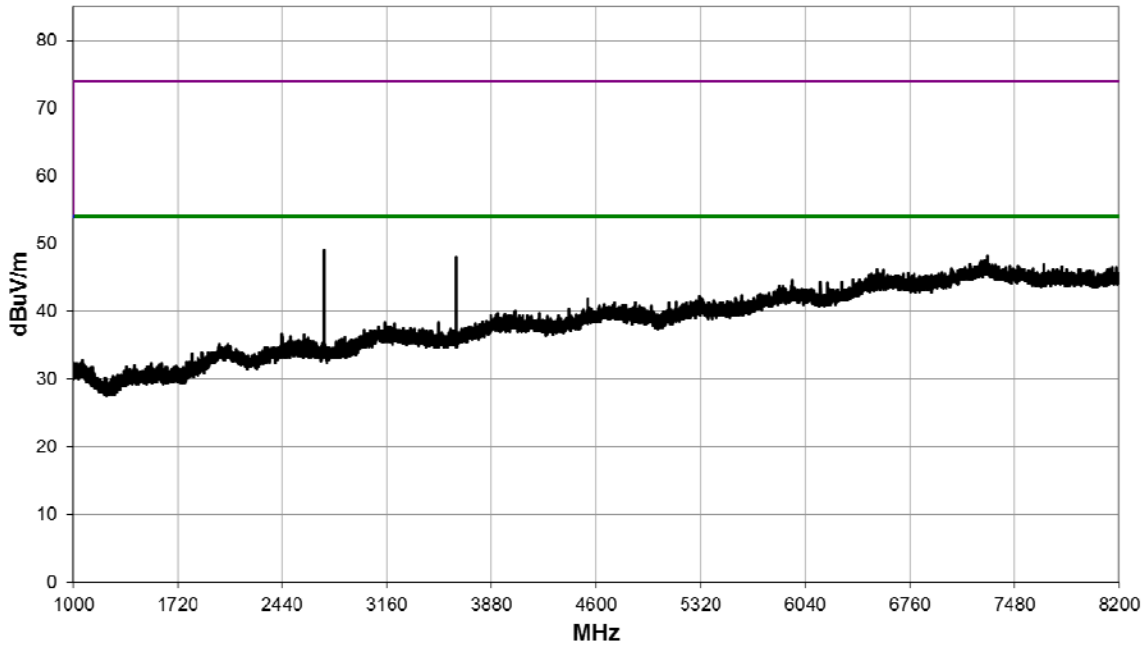


Frequency: 908.42 MHz; Data Rate: 9.6 kbps										
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Cable Loss (dB)***	***Antenna Factor (dB/m)***	***Pre-amp Gain (dB)***	***Duty Cycle Corr'n (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
AV	2725.0	54.3	3.9	28.9	35.3	0	0	51.8	389.0	500
PK	2725.1	55.4	3.9	28.9	35.3	0	0	52.9	441.6	5000

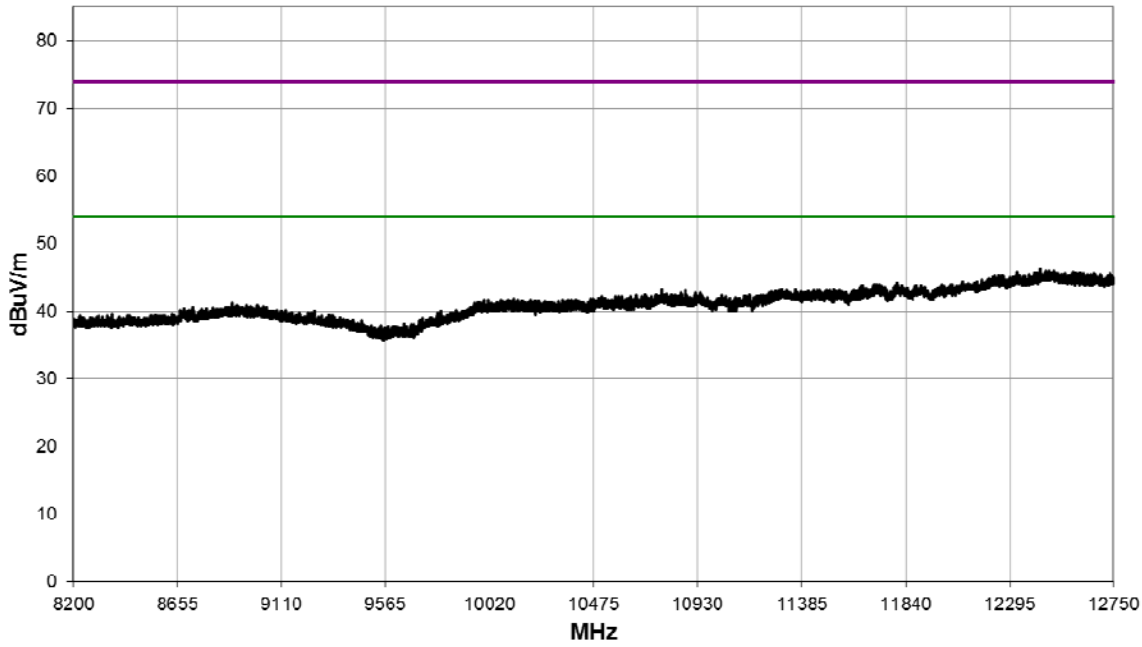
30 MHz to 1 GHz



1 GHz to 8.2 GHz

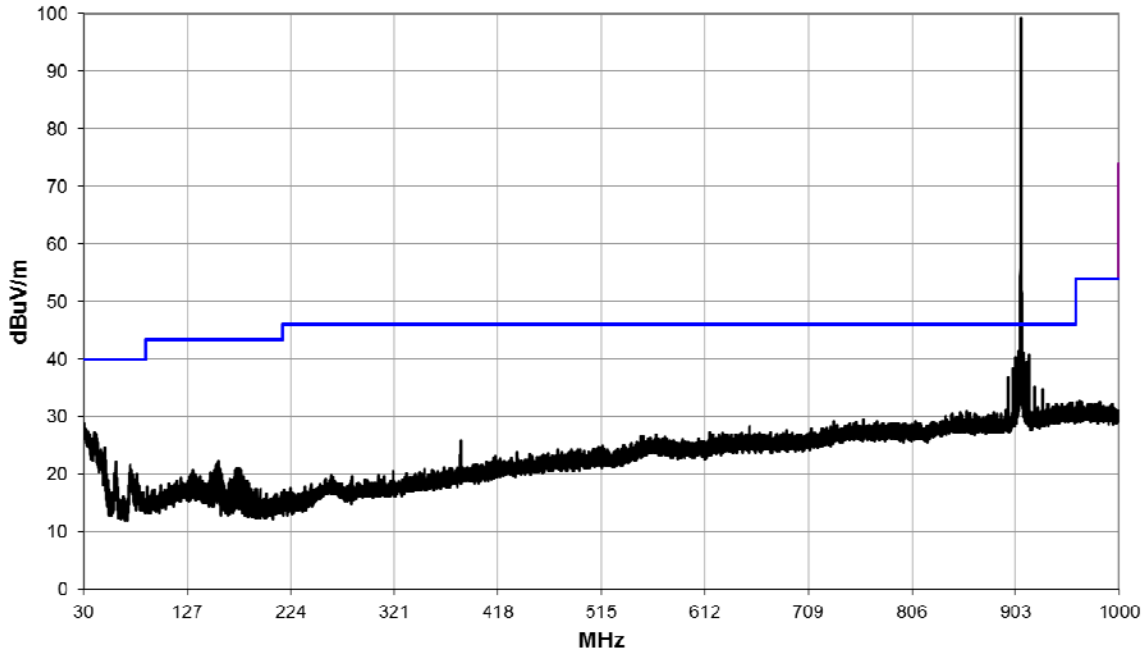


8.2 GHz to 12.75 GHz

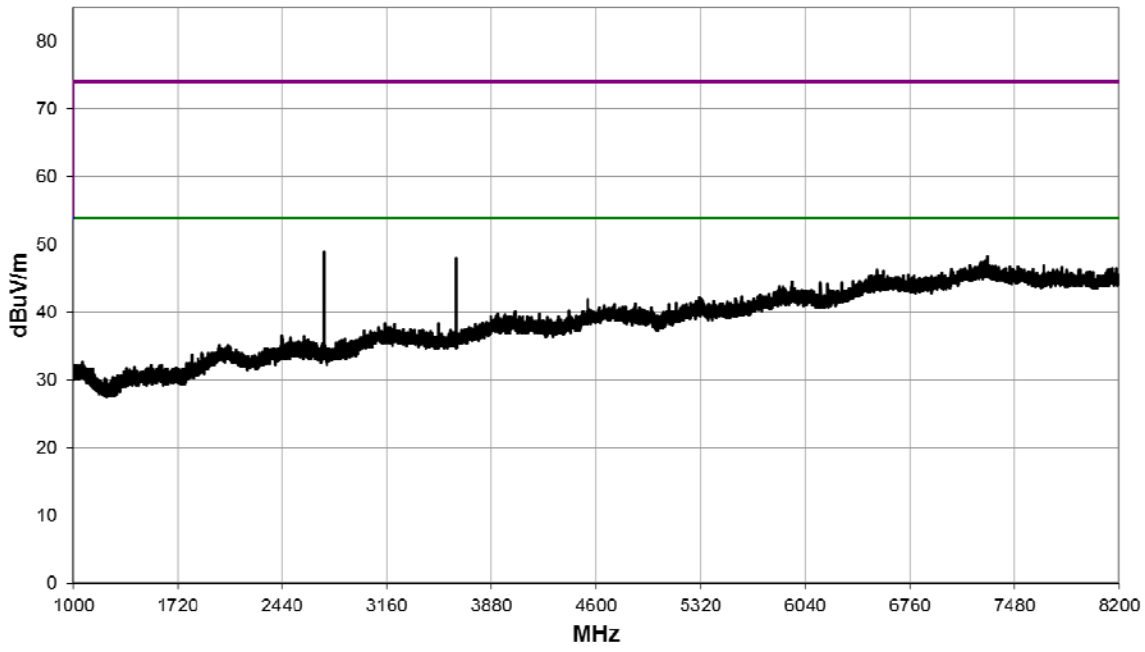


Frequency: 908.4 MHz; Data Rate: 40 kbps										
Detector	***Freq. (MHz)***	***Meas'd Emission (dBµV)***	***Cable Loss (dB)***	***Antenna Factor (dB/m)***	***Pre-amp Gain (dB)***	***Duty Cycle Corr'n (dB)***	***Distance Extrap'n Factor (dB)***	***Field Strength (dBµV/m)***	***Field Strength (µV/m)***	***Limit (µV/m)***
AV	2725.2	51.4	3.9	28.9	35.3	0	0	48.9	278.6	500
PK	2725.2	53.9	3.9	28.9	35.3	0	0	51.4	371.5	5000
AV	3633.6	46.5	4.6	30.9	35.4	0	0	46.6	213.8	500
PK	3633.6	50.3	4.6	30.9	35.4	0	0	50.4	331.1	5000

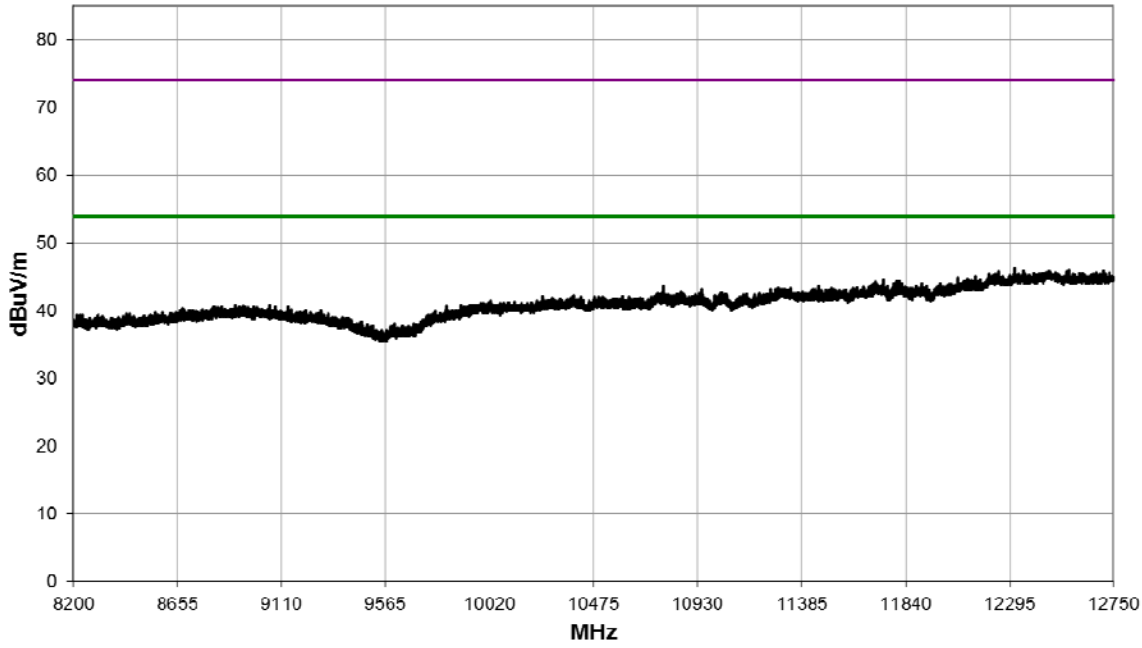
30 MHz to 1 GHz



1 GHz to 8.2 GHz



8.2 GHz to 12.75 GHz



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 Hull
Test Chamber:	Lab 7 (Screen Room 1)
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.2
EUT Frequencies Measured:	908.42
EUT Modulation:	GFSK
Deviations From Standard:	None
Measurement BW:	9 kHz
Measurement Detectors:	Quasi-Peak and Average

Environmental Conditions (Normal Environment)

Temperature: 21 °C	+15 ºC to +35 ºC (as declared)
Humidity: 50 % RH	20 % RH to 75 % RH (as declared)
Supply: 120 V ac	120 V ac ±10% (as declared)

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.

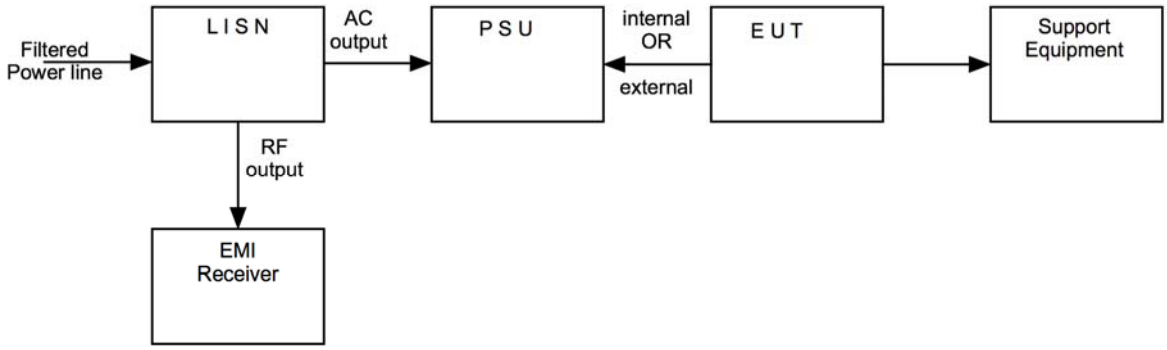
12.4 Test Method

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

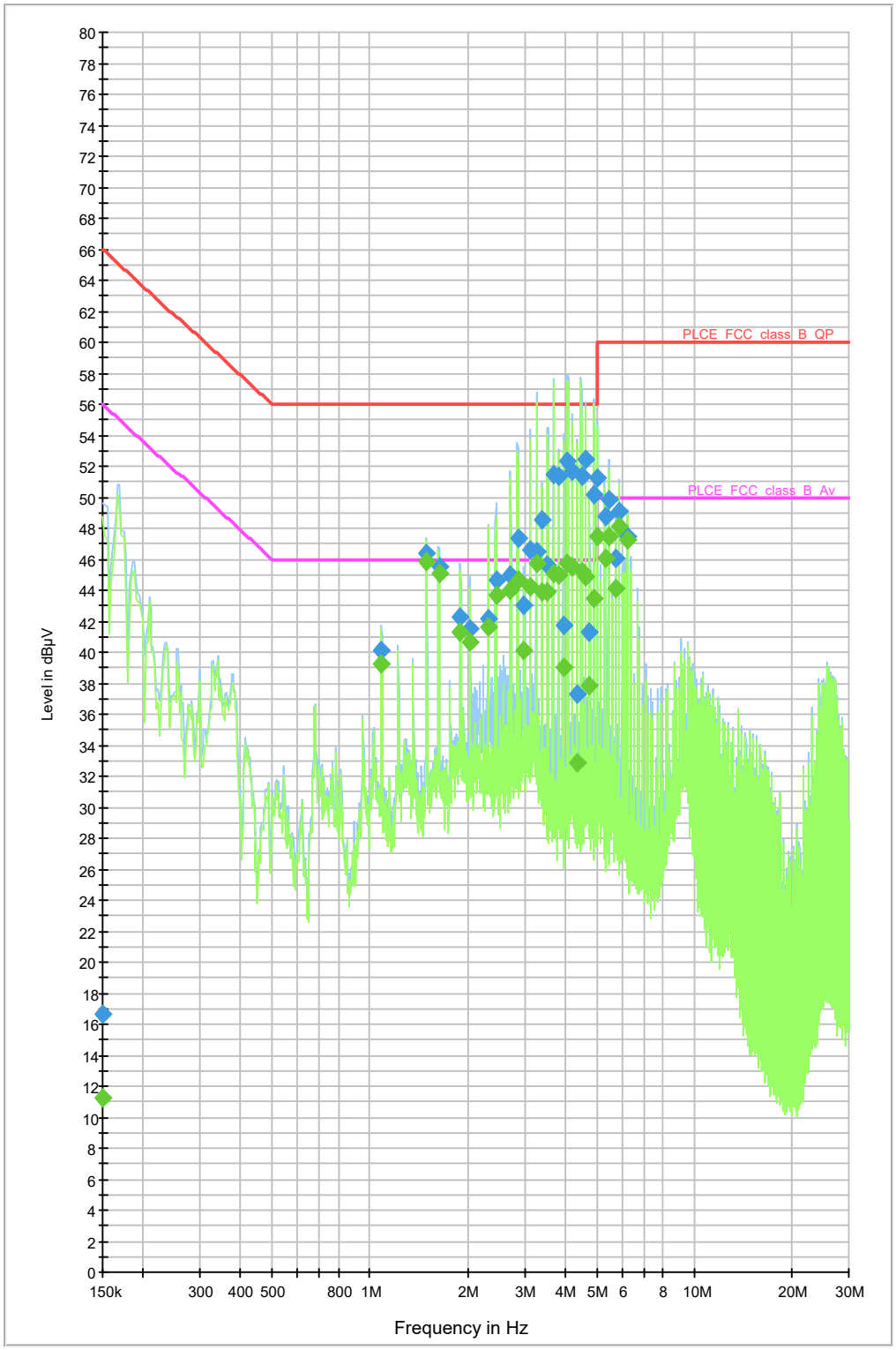
12.6 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
ESCI7	R&S	Measuring Receiver	RFG715	2019-01-03
ESH3-Z5	R&S	LISN	RFG732	2019-05-22

12.7 Test Results

Frequency (MHz)	Quasi-Peak (dBuV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	16.6	15000.0	0.200	GND	N	10.1	49.4	66.0
1.087550	40.2	15000.0	9.000	GND	L1	10.3	15.8	56.0
1.497375	46.4	15000.0	9.000	GND	N	10.3	9.6	56.0
1.633175	45.6	15000.0	9.000	GND	L1	10.3	10.4	56.0
1.903200	42.3	15000.0	9.000	GND	L1	10.4	13.7	56.0
2.040575	41.5	15000.0	9.000	GND	L1	10.4	14.5	56.0
2.314600	42.2	15000.0	9.000	GND	L1	10.4	13.8	56.0
2.450400	44.7	15000.0	9.000	GND	L1	10.4	11.3	56.0
2.722000	45.0	15000.0	9.000	GND	L1	10.4	11.0	56.0
2.857800	47.3	15000.0	9.000	GND	L1	10.4	8.7	56.0
2.995175	43.1	15000.0	9.000	GND	N	10.4	12.9	56.0
3.129400	46.6	15000.0	9.000	GND	L1	10.5	9.4	56.0
3.267625	46.5	15000.0	9.000	GND	L1	10.5	9.5	56.0
3.401000	48.5	15000.0	9.000	GND	L1	10.5	7.5	56.0
3.536800	45.6	15000.0	9.000	GND	L1	10.5	10.4	56.0
3.675025	51.5	15000.0	9.000	GND	L1	10.5	4.5	56.0
3.809250	51.4	15000.0	9.000	GND	N	10.5	4.6	56.0
3.948200	41.7	15000.0	9.000	GND	L1	10.5	14.3	56.0
4.082425	52.3	15000.0	9.000	GND	L1	10.5	3.7	56.0
4.218225	51.7	15000.0	9.000	GND	L1	10.5	4.3	56.0
4.354025	37.3	15000.0	9.000	GND	L1	10.5	18.7	56.0
4.492250	51.4	15000.0	9.000	GND	L1	10.6	4.6	56.0
4.625625	52.4	15000.0	9.000	GND	L1	10.6	3.6	56.0
4.763850	41.3	15000.0	9.000	GND	L1	10.6	14.7	56.0
4.899650	50.2	15000.0	9.000	GND	L1	10.6	5.8	56.0
5.034000	51.2	15000.0	9.000	GND	L1	10.6	8.8	60.0
5.306500	48.7	15000.0	9.000	GND	L1	10.6	11.3	60.0
5.441500	49.8	15000.0	9.000	GND	L1	10.6	10.2	60.0
5.714000	46.1	15000.0	9.000	GND	L1	10.7	13.9	60.0
5.851500	49.1	15000.0	9.000	GND	N	10.7	10.9	60.0
6.259000	47.4	15000.0	9.000	GND	N	10.7	12.6	60.0

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	11.2	15000.0	0.200	GND	N	10.1	44.8	56.0
1.087550	39.2	15000.0	9.000	GND	L1	10.3	6.8	46.0
1.497375	45.9	15000.0	9.000	GND	N	10.3	0.1	46.0
1.633175	45.1	15000.0	9.000	GND	L1	10.3	0.9	46.0
1.903200	41.3	15000.0	9.000	GND	L1	10.4	4.7	46.0
2.040575	40.7	15000.0	9.000	GND	L1	10.4	5.3	46.0
2.314600	41.6	15000.0	9.000	GND	L1	10.4	4.4	46.0
2.450400	43.7	15000.0	9.000	GND	L1	10.4	2.3	46.0
2.722000	44.0	15000.0	9.000	GND	L1	10.4	2.0	46.0
2.857800	44.6	15000.0	9.000	GND	L1	10.4	1.4	46.0
2.995175	40.2	15000.0	9.000	GND	N	10.4	5.8	46.0
3.129400	44.2	15000.0	9.000	GND	L1	10.5	1.8	46.0
3.267625	45.7	15000.0	9.000	GND	L1	10.5	0.3	46.0
3.401000	43.9	15000.0	9.000	GND	L1	10.5	2.1	46.0
3.536800	43.9	15000.0	9.000	GND	L1	10.5	2.1	46.0
3.675025	45.1	15000.0	9.000	GND	L1	10.5	0.9	46.0
3.809250	45.0	15000.0	9.000	GND	N	10.5	1.0	46.0
3.948200	39.1	15000.0	9.000	GND	L1	10.5	6.9	46.0
4.082425	45.7	15000.0	9.000	GND	L1	10.5	0.3	46.0
4.218225	45.5	15000.0	9.000	GND	L1	10.5	0.5	46.0
4.354025	32.8	15000.0	9.000	GND	L1	10.5	13.2	46.0
4.492250	45.2	15000.0	9.000	GND	L1	10.6	0.8	46.0
4.625625	44.9	15000.0	9.000	GND	L1	10.6	1.1	46.0
4.763850	37.9	15000.0	9.000	GND	L1	10.6	8.1	46.0
4.899650	43.5	15000.0	9.000	GND	L1	10.6	2.5	46.0
5.034000	47.5	15000.0	9.000	GND	L1	10.6	2.5	50.0
5.306500	46.1	15000.0	9.000	GND	L1	10.6	3.9	50.0
5.441500	47.5	15000.0	9.000	GND	L1	10.6	2.5	50.0
5.714000	44.1	15000.0	9.000	GND	L1	10.7	5.9	50.0
5.851500	48.1	15000.0	9.000	GND	N	10.7	1.9	50.0
6.259000	47.3	15000.0	9.000	GND	N	10.7	2.7	50.0


PLCE_FCC_class_B_QP
PLCE_FCC_class_B_Av
Level in dBµV
Frequency in Hz
150k
300
400
500
800
1M
2M
3M
4M
5M
6
8
10M
20M
30M

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 Hull
Test Chamber:	Wireless Laboratory 1
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.9
EUT Frequencies Measured:	908.4 MHz (40 kbps), 908.42 MHz (9.6kbps), 916.0 MHz (100 kbps)
EUT Test Modulations:	GFSK
Deviations From Standard:	None
Measurement BW: (requirement: 1 % to 5 % OBW)	3 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	10 kHz
Measurement Span: (requirement 2 to 5 times OBW)	300 kHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 21 °C	+15 ºC to +35 ºC (as declared)
Humidity: 40 % RH	20 % RH to 75 % RH (as declared)
Supply: PoE	

13.3 Test Limit

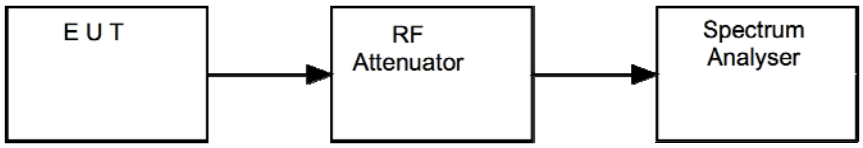
Federal Communications Commission:
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise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

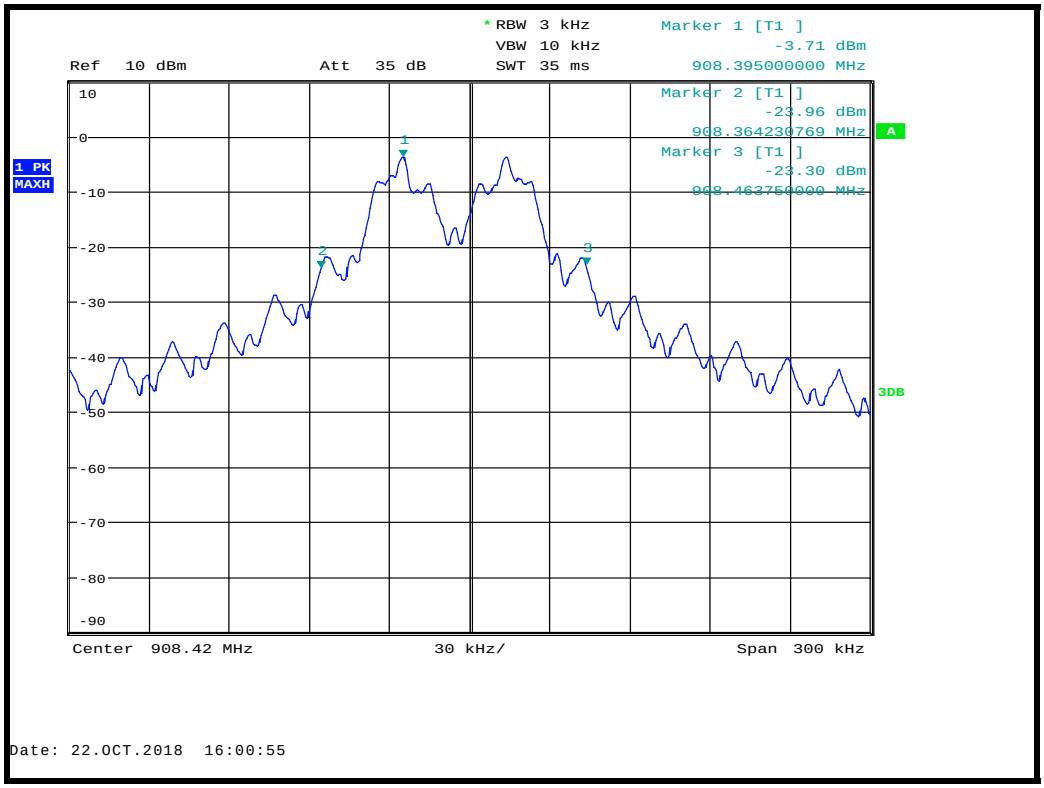


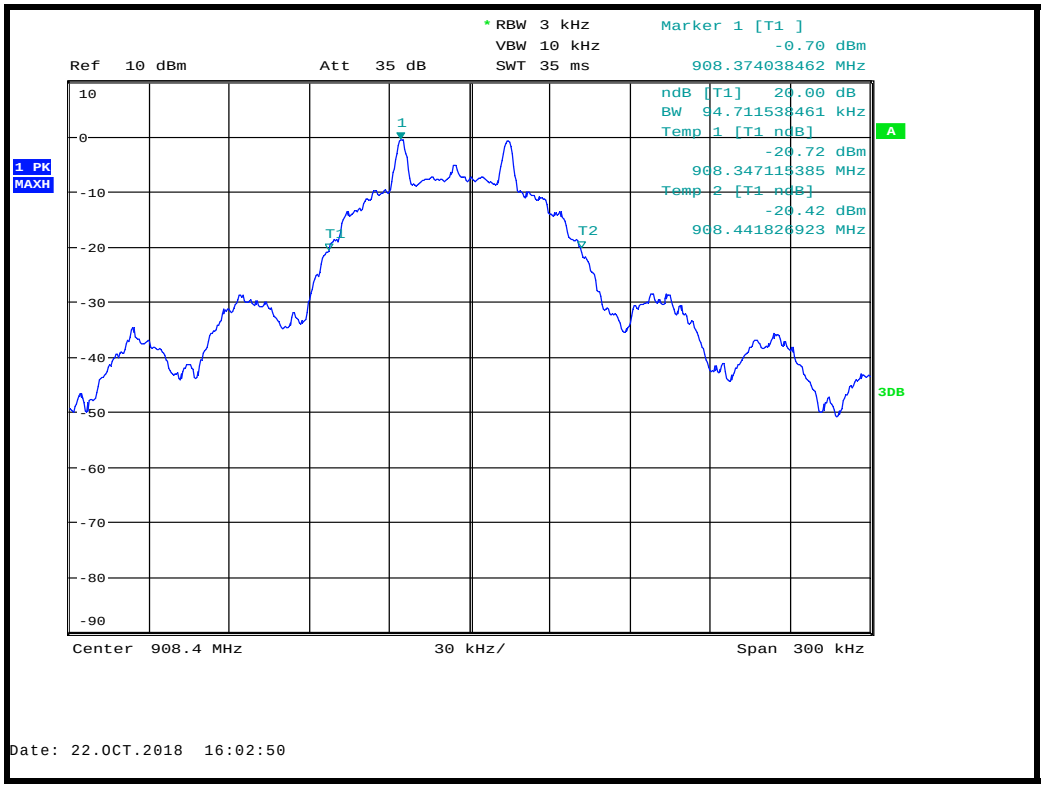
13.5 Test Equipment

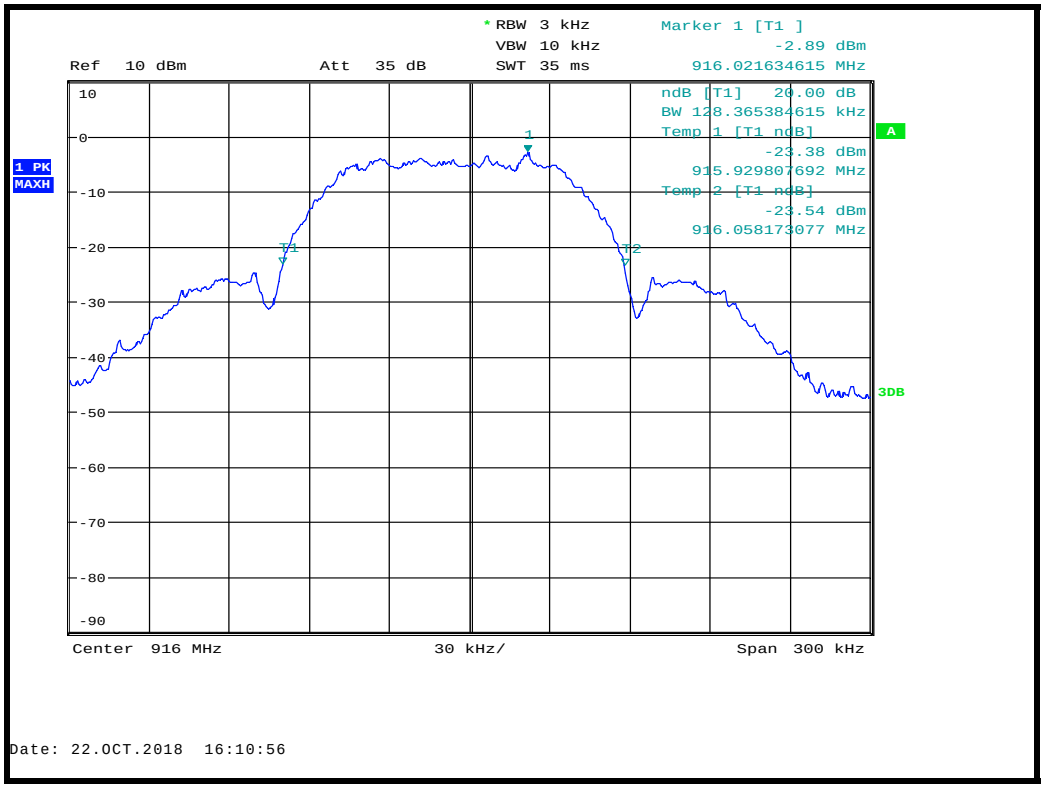
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU26	R&S	Spectrum Analyser	REF909	2019-06-15

13.6 Test Results

FCC 15.249. Modulation: Z-wave; Data rate: 908.42 MHz – 9.6 kbps / 908.42 MHz – 40 kbps / 916 MHz – 100 kbps				
Channel Frequency (MHz)	**F_L (MHz)**	**F_H (MHz)**	**20dB Bandwidth (kHz)**	**Result**
908.42 (9.6 k)	908.364230769	908.463750000	99.519231000	PASS
908.40 (40 k)	908.347115385	908.441826923	94.711538461	PASS
916.00 (100 k)	915.929807692	916.058173077	128.365384615	PASS




RBW 3 kHz
VBW 10 kHz
SWT 35 ms
Marker 1 [T1]
-0.70 dBm
908.374038462 MHz
Ref 10 dBm
Att 35 dB
ndB [T1] 20.00 dB
BW 94.711538461 kHz
Temp 1 [T1 ndB]
-20.72 dBm
908.347115385 MHz
Temp 2 [T1 ndB]
-20.42 dBm
908.441826923 MHz
1 PK
MAXH
A
3DB
Center 908.4 MHz
30 kHz/
Span 300 kHz
Date: 22.OCT.2018 16:02:50


RBW 3 kHz
VBW 10 kHz
SWT 35 ms
Marker 1 [T1]
-2.89 dBm
916.021634615 MHz
Ref 10 dBm
Att 35 dB
ndB [T1] 20.00 dB
BW 128.365384615 kHz
Temp 1 [T1 ndB]
-23.38 dBm
915.929807692 MHz
Temp 2 [T1 ndB]
-23.54 dBm
916.058173077 MHz
1 PK
MAXH
A
3DB
Center 916 MHz
30 kHz/
Span 300 kHz
Date: 22.OCT.2018 16:10:56

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 Hull
Test Chamber:	Wireless Lab 3
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 / 6.6
EUT Frequencies Measured:	908.42 MHz / 908.4 MHz / 916 MHz
Deviations From Standard:	None
Measurement BW:	120 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	300 kHz
Measurement Detector:	Up to 1 GHz: Quasi-peak Above 1 GHz: Average RMS and Peak
Voltage Extreme Environment Test Range:	POE

Environmental Conditions (Normal Environment)

Temperature: 20 °C	+15 ºC to +35 ºC (as declared)
Humidity: 50 % 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

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

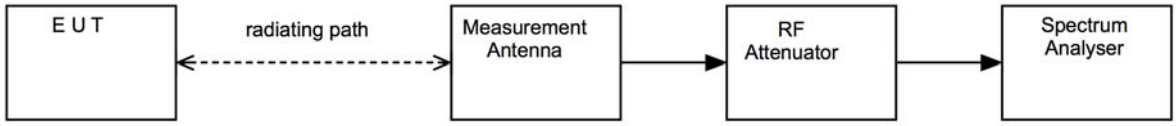
n.b. per FCC 47CFR15.249(e) peak limit is 20 dB above average.

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
Ferrite Lined Chamber	Rainford	Chamber	REF2259	2020-08-03
ESW26	R&S	EMI Test Receiver	REF2235	2019-07-23
Pre-Amp (9kHz – 1GHz)	Sonoma	310	REF927	2019-05-22
Bilog Antenna	Chase	CBL6111B	REF2218	2019-11-06

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	908.42	92.0	4.4	28.3	31.8	0	0	92.9	44.2	50
QP	908.4	91.9	4.4	28.3	31.8	0	0	92.8	43.7	50
QP	916.0	89.6	4.4	28.7	31.7	0	0	91.0	35.5	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 %**

16 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 to 6 GHz and test separation distance of 20mm, the

SAR Test Exclusion Threshold will be determined as follows

SAR Exclusion Threshold (SARET)

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

NT	=	Numeric Threshold (3.0 for 1-g SAR and 7.5 for 10-g SAR)
MP	=	Max Power of channel (mW) (inc tune up)
TSD^{A}	=	Min Test separation Distance or 50mm (whichever is lower) = 20
f_{GHz}	=	Transmit frequency (or 100MHz if lower) = 0.916

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.

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

SARET = $(NT \times TSD^{A}) / \sqrt{f_{GHz}}$
SARET = $(3.0 \times 20) / \sqrt{0.916}$
SARET = 62.69 mW

The maximum calculated output power is 0.58 mW (eirp) is less than the Lowest SAR Exclusion Threshold of 62.69 mW, at 20mm 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.