

Report on the Radio Testing
For
Rentokil Initial 1927 plc
on
4G Control Panel
Report no. TRA-033559-45-04B
25 June 2019

RF916 7.0

Report Number: TRA-033559-45-04B
Issue: B

REPORT ON THE RADIO TESTING OF A
Rentokil Initial 1927 plc
4G Control Panel
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.247

TEST DATE: 7-5-2019

Written by:



D. Garvey
Radio Test Engineer

Approved by:

Date: 25 June 2019

J. Charters
Department Manager

Disclaimers:

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

RF916 7.0

1 Revision Record

<i>Issue Number</i>	<i>Issue Date</i>	<i>Revision History</i>
A	23 rd May 2019	Original
B	25 th June 2019	Added conducted output power test results

2 Summary

TEST REPORT NUMBER: TRA-033559-45-04B

WORKS ORDER NUMBER: TRA-033559-21

PURPOSE OF TEST: Certification

TEST SPECIFICATION: 47CFR15.247

EQUIPMENT UNDER TEST (EUT): 4G Control Panel

FCC IDENTIFIER: 2AK3PGSD-500349

EUT SERIAL NUMBER: 9951700000003

MANUFACTURER/AGENT: Rentokil Initial 1927 plc

ADDRESS: Marketing and Innovation
Riverbank
Meadows Business Park
Camberley
GU17 9AB
United Kingdom

CLIENT CONTACT: Ning Pan
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✉ ning.pan@rentokil-initial.com

WORKS ORDER NUMBER: G025937

TEST DATE: 7-5-2019

TESTED BY: D. Garvey
Element

2.1 Test Summary

Test Method and Description	Requirement Clause	Applicable to this equipment	Result / Note
	47CFR15		
Radiated spurious emissions (restricted bands of operation and cabinet radiation)	15.205	<input checked="" type="checkbox"/>	PASS
AC power line conducted emissions	15.207	<input type="checkbox"/>	NOTE1
Carrier frequency separation	15.247(a)(1)	<input type="checkbox"/>	NOTE1
Number of hopping channels	15.247(a)(1) (i), (ii) and (iii)	<input type="checkbox"/>	NOTE1
Average time of occupancy	15.247(a)(1) (i), (ii) and (iii)	<input type="checkbox"/>	NOTE1
Maximum peak conducted output power	15.247 (a)(1), (b)(1) and (b)(2)	<input checked="" type="checkbox"/>	PASS
20dB emission bandwidth	15.247(a)(1) (i) and (ii)	<input type="checkbox"/>	NOTE1
Out-of-band emissions	15.247(d)	<input type="checkbox"/>	NOTE1

Notes:

NOTE1: Not quoted for work.

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-033559-45-04B presents the results of the Radio testing on a Rentokil Initial 1927 plc, 4G Control Panel to specification 47CFR15 Radio Frequency Devices.

The testing was carried out for Rentokil Initial 1927 plc by Element, at the address detailed below.

<input checked="" type="checkbox"/>	Element Hull Unit E South Orbital Trading Park Hedon Road Hull HU9 1NJ UK	<input type="checkbox"/>	Element Skelmersdale 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 1GHz.

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

Only the following test was performed as per client's request.

- Radiated spurious emissions (restricted bands of operation and cabinet radiation).

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: 4G Control Panel
- Serial Number: 9951700000003
- Model Number: 4G Control Panel
- 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.

Computer and ac power adapter.
USB to serial connector.

7.3 EUT Mode of Operation

7.3.1 Transmission

The mode of operation for Tx tests was as follows;
Using a PC installed with TeraTerm, connected via USB to the EUT, relevant commands were sent to set the transmitter power and channels.

7.3.2 Reception

The mode of operation for Rx tests was as follows;

Not applicable to this test report.

7.4 EUT Radio Parameters

7.4.1 General

Frequency of operation:	915.25 MHz - 927.5 MHz
Modulation type:	TDMA
Occupied channel bandwidth:	200 kHz
Channel spacing:	200 kHz
ITU emission designator:	125G1DEX
Declared output power:	10 dBm
Warning against use of alternative antennas in user manual (yes/no):	Yes
Nominal Supply Voltage:	5 V dc
Location of notice for license exempt use:	Label / user manual / both.
Method of prevention of use on non-US / non-Canadian frequencies:	Software Locked
Duty cycle:	< 10 %

7.4.2 Antennas

Type:	Fixed
Frequency range:	915-928 MHz
Impedance:	50Ω
SWR:	Unknown
Gain:	6 dBi
Polarisation:	Linear
Beam width:	Unknown
Connector type:	SMA

7.4.3 Product specific declarations

Multiple antenna configuration(s), e.g. MIMO:	<i>Single antenna Only</i>
Fixed pt-pt operations (yes/no):	<i>No</i>
Installation manual advice on pt-pt operational restrictions (yes/no):	<i>N / A</i>
Fixed pt-mpt operations (yes/no):	<i>No</i>
Simultaneous tx (yes/no):	<i>No</i>

7.5 EUT Description

The EUT is a LoRa module installed in a Control Panel and pest traps to monitor trap operation.

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 EUT was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was 5 V dc from the adaptor, connected to 110 Vac, 60 Hz mains.

10.2 Varying Test Conditions

Not applicable.

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 Laboratory 3
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
Frequencies Measured:	915.25 MHz / 921.25 MHz / 927.5 MHz
EUT Channel Bandwidth:	125 kHz
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 °C to +35 °C (as declared)
Humidity: 40 % RH	20 % RH to 75 % RH (as declared)
Supply: 110 V ac	

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

<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

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 dB μ V/m at the regulatory distance, using:

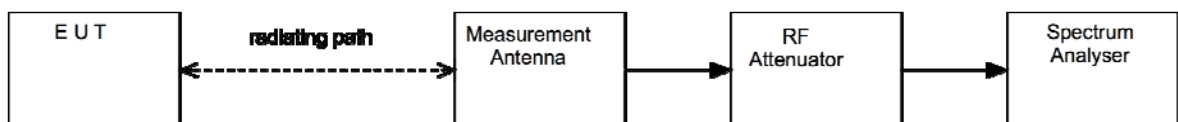
$$FS = PR + CL + AF - PA + DC - CF$$

Where,

PR is the power recorded on the receiver / spectrum analyzer in dB μ 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 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



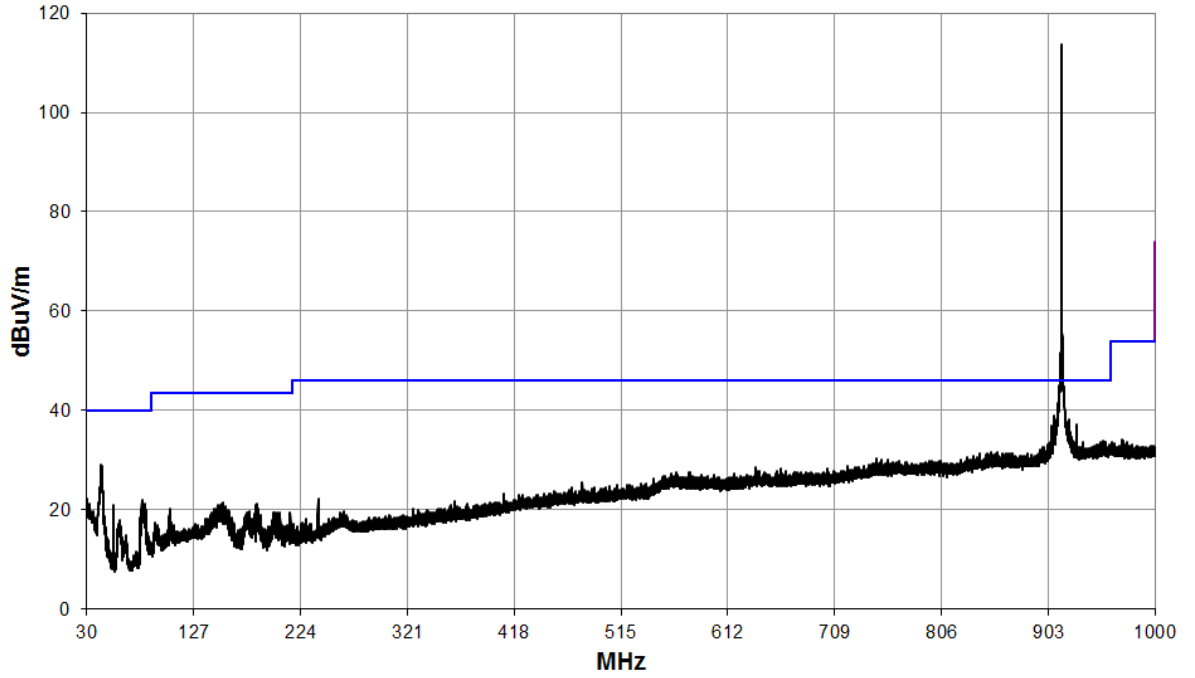
11.6 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Ferrite Lined Chamber	Rainford	Chamber	REF2259	2020-08-03
EMI Test Receiver	R&S	ESW26	REF2235	2019-07-23
Bilog Antenna	Chase	CBL6111B	REF2218	2019-11-06
Horn Antenna	A Info Inc	LB-10180-NF	REF2241	2020-07-13
Horn Antenna	A Info Inc	LB-90-25-C2-SF	REF2243	2020-07-16
Pre-Amp (9kHz – 1GHz)	Sonoma	310	REF927	2019-05-22
Pre-Amp (1 – 26.5GHz)	Agilent	8449B	REF913	2020-02-06

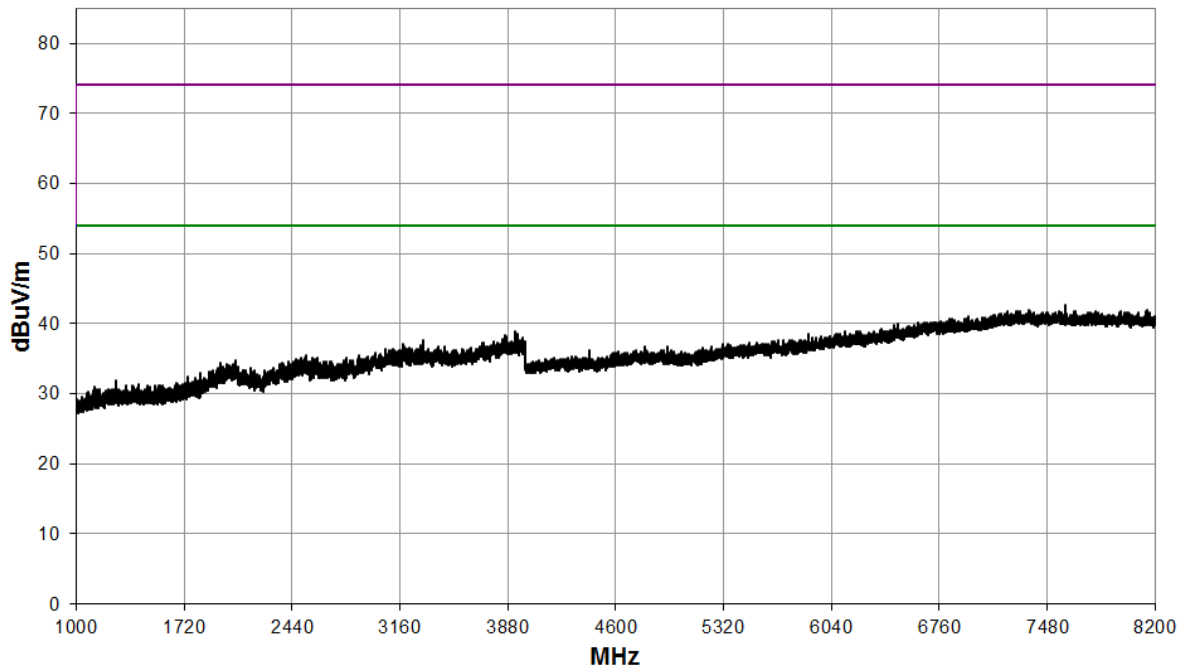
11.7 Test Results

Power Setting: 0x0F; Channel: 1; Frequency: 915.25 MHz										
Detector	Freq. (MHz)	Meas'd Emission (dB μ V)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Duty Cycle Corr'n (dB)	Distance Extrap'n Factor (dB)	Field Strength (dB μ V/m)	Field Strength (μ V/m)	Limit (μ V/m)
Average	9152.4	0.7	6.5	27.1	0	0	0	34.3	51.8	500

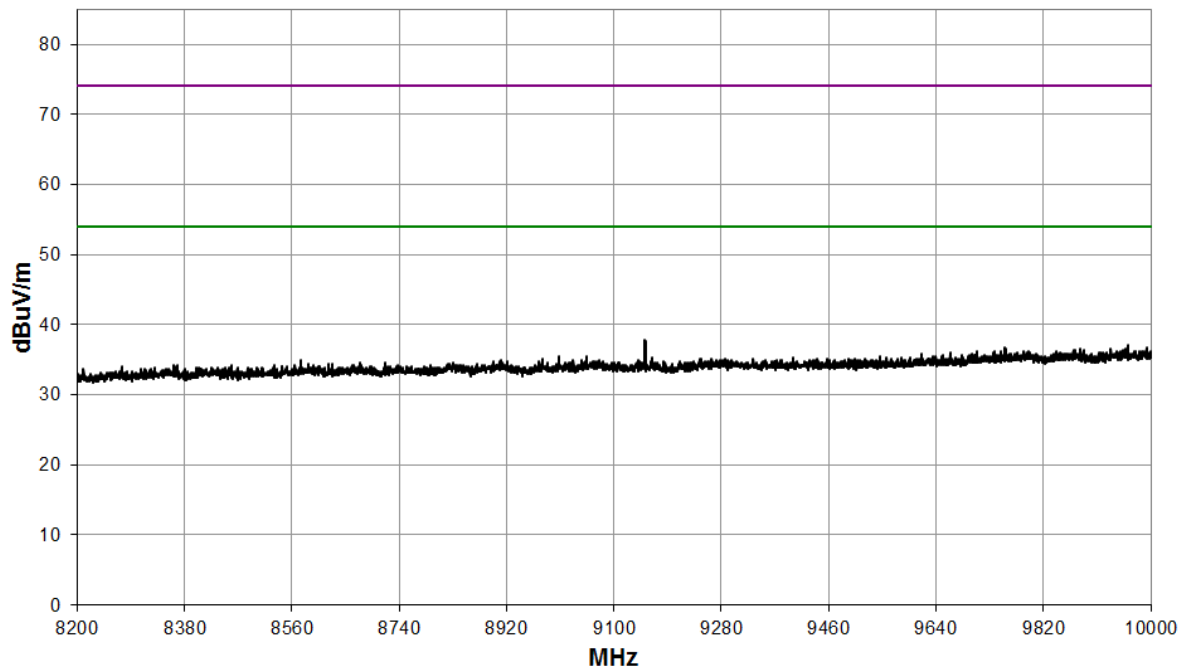
30 MHz to 1 GHz



1 GHz to 8.2 GHz

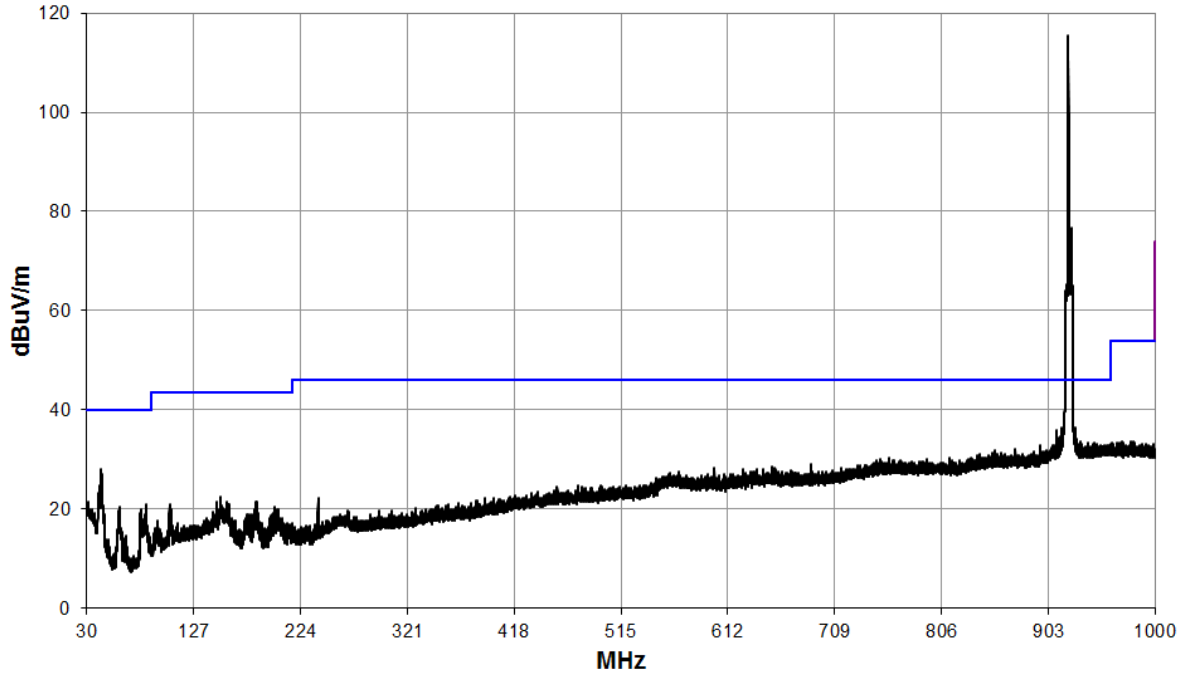


8.2 GHz to 10 GHz

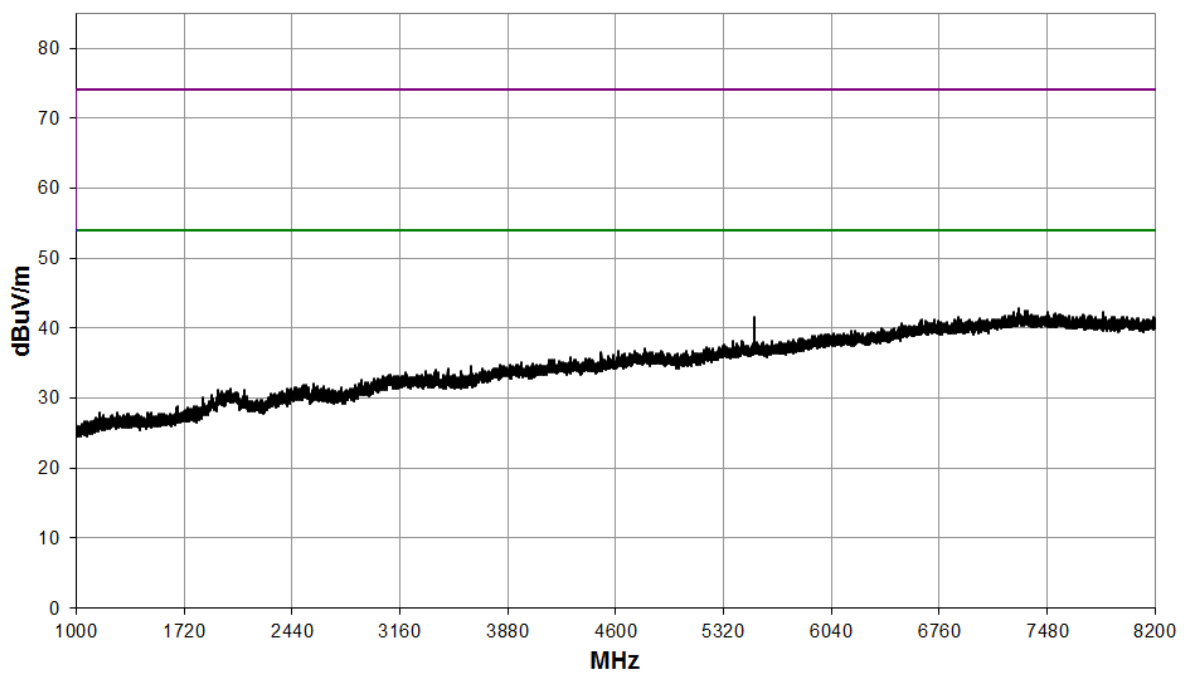


Power Setting: 0x0F; Channel: 25; Frequency: 921.25 MHz										
Detector	Freq. (MHz)	Meas'd Emission (dB μ V)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Duty Cycle Corr'n (dB)	Distance Extrap'n Factor (dB)	Field Strength (dB μ V/m)	Field Strength (μ V/m)	Limit (μ V/m)
Average	5527.5	35.8	5.6	34.9	35.4	0	0	40.9	110.9	500
Average	9212.5	0.7	6.5	27.0	0	0	0	34.2	51.3	500

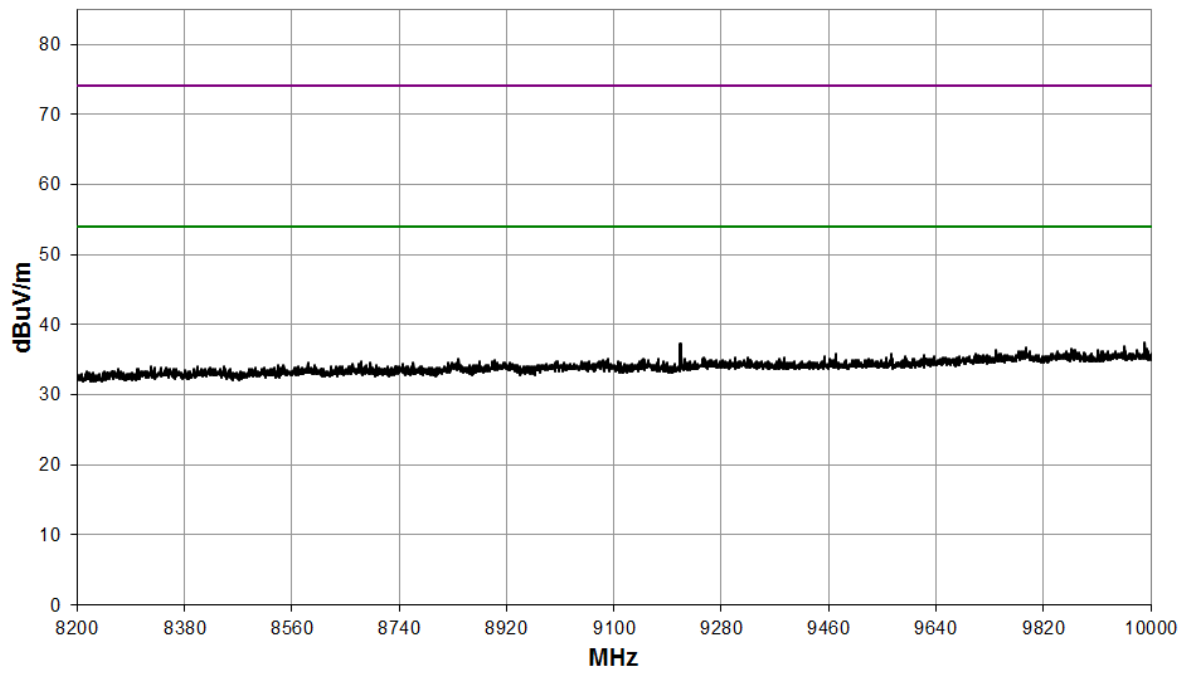
30 MHz to 1 GHz



1 GHz to 8.2 GHz

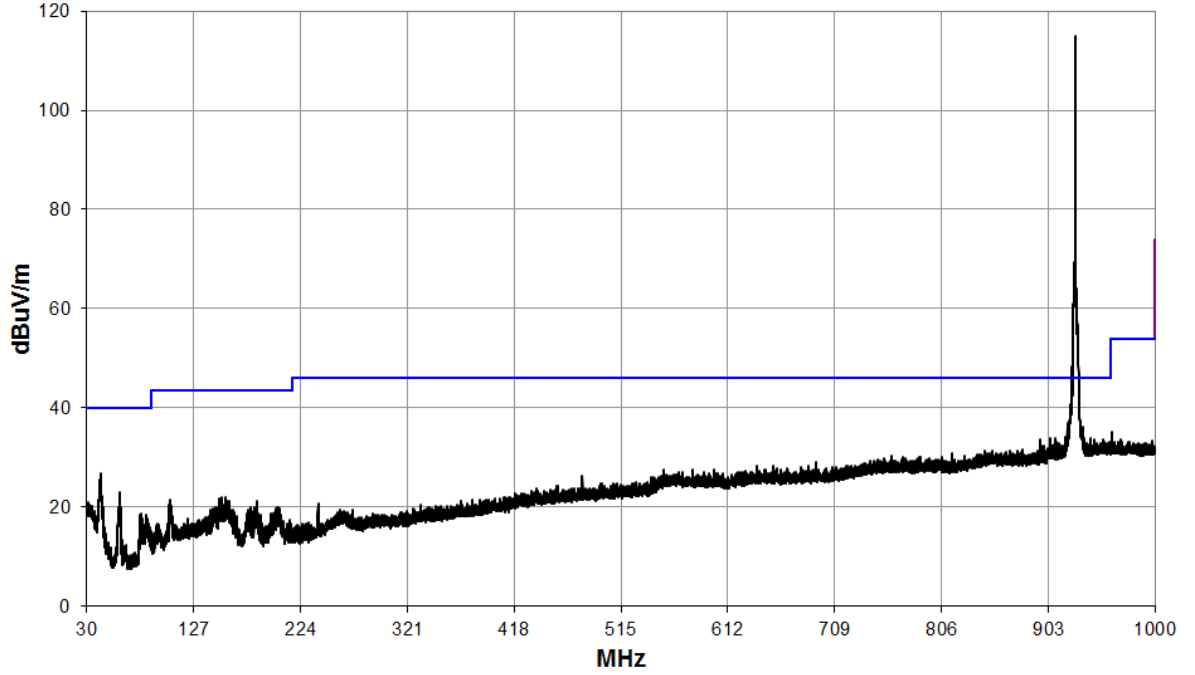


8.2 GHz to 10 GHz

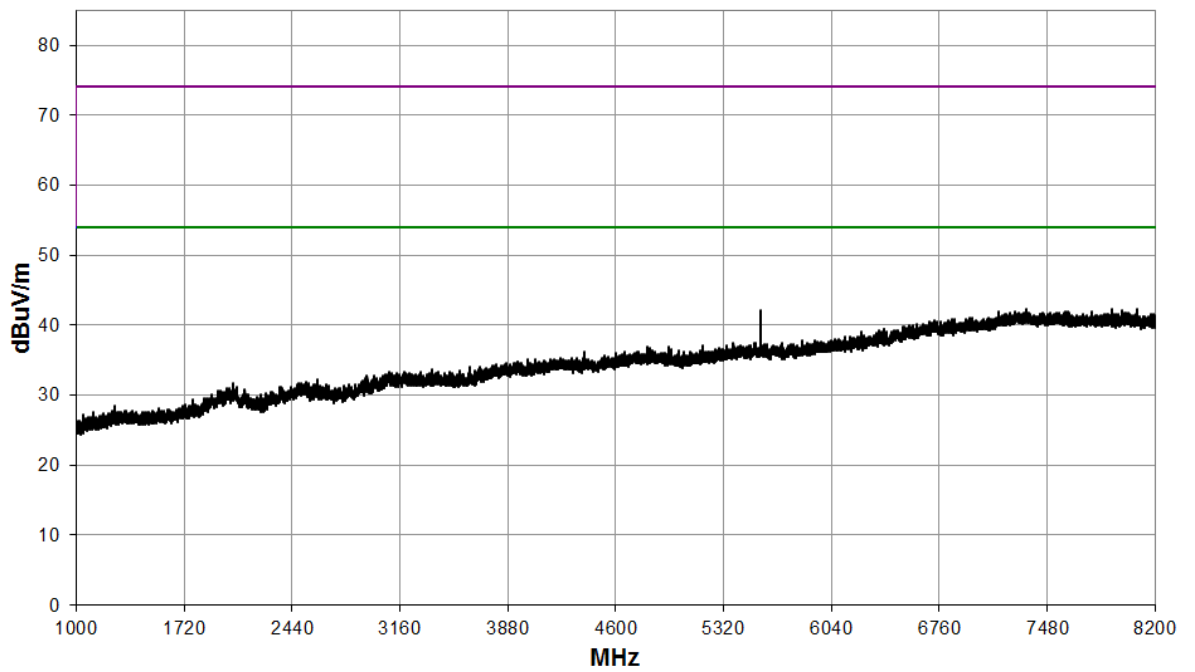


Power Setting: 0x0F; Channel: 50; Frequency: 927.5 MHz										
Detector	Freq. (MHz)	Meas'd Emission (dBμV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Duty Cycle Corr'n (dB)	Distance Extrap'n Factor (dB)	Field Strength (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
Average	5564.9	33.6	5.6	34.9	35.4	0	0	38.7	86.1	500
Average	9274.9	0.9	6.6	27.1	0	0	0	34.6	53.7	500

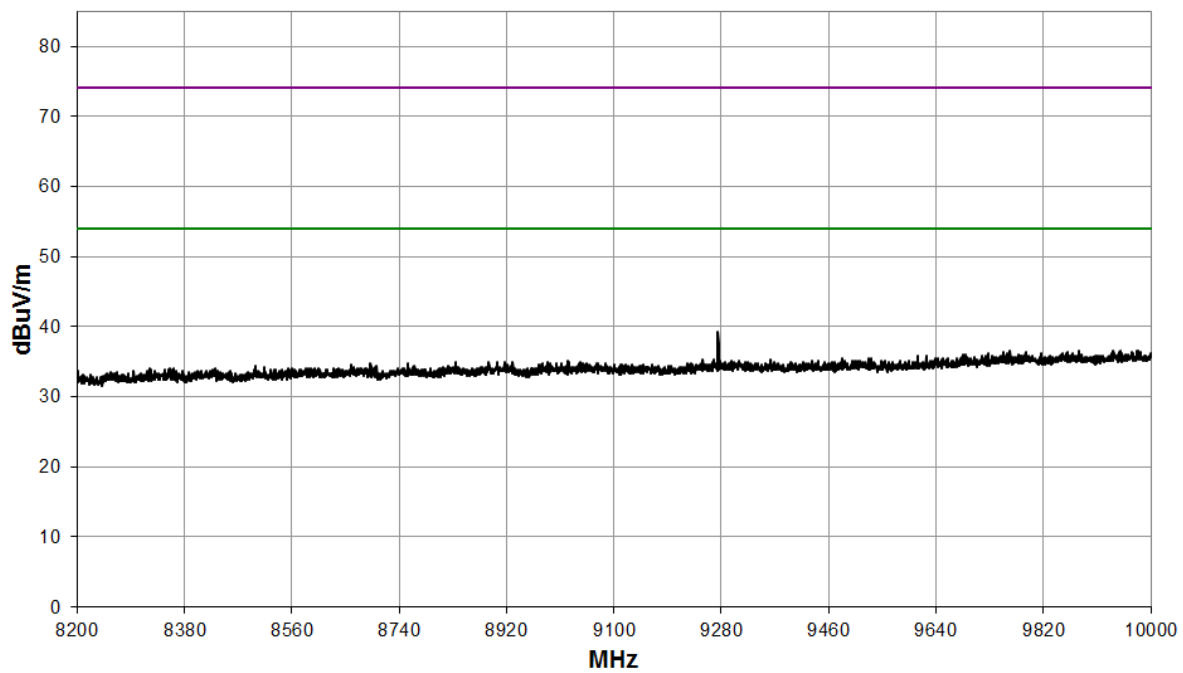
30 MHz to 1 GHz



1 GHz to 8.2 GHz



8.2 GHz to 10 GHz



12 Maximum peak conducted output power

12.1 Definition

The maximum peak conducted output power is defined as the maximum power level measured with a peak detector using a filter with width and shape of which is sufficient to accept the signal bandwidth.

12.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Wireless Lab 3
Test Standard and Clause:	ANSI C63.10-2013, Clause 7.8.5
EUT Channels / Frequencies Measured:	Low / Mid / High – hopping disabled.
EUT Channel Bandwidths:	125 kHz
Deviations From Standard:	None
Measurement BW:	3 kHz
Spectrum Analyzer Video BW:	10 kHz
Measurement Detector:	RMS
Voltage Extreme Environment Test Range:	Mains Power = 85 % and 115 % of Nominal (FCC only requirement); Battery Power = new battery.

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 °C to +35 °C (as declared)
Humidity: 45 % RH	20 % RH to 75 % RH (as declared)

12.3 Test Limit

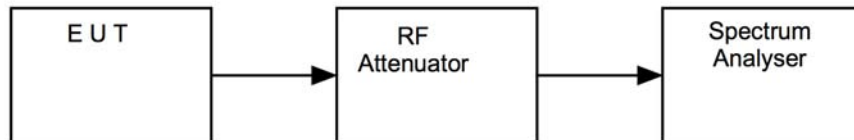
- For frequency hopping systems operating in the band 902 to 928 MHz, the maximum peak conducted output power shall not exceed 1 W, and the e.i.r.p. shall not exceed 4 W, if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W, and the e.i.r.p. shall not exceed 1 W, if the hopset uses less than 50 hopping channels.
- For frequency hopping systems operating in the band 2400 to 2483.5 MHz and employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W. The e.i.r.p. shall not exceed 4 W.
- For frequency hopping systems operating in the band 5725 to 5850 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W.
- Point-to-point systems in the bands 2400-2483.5 MHz and 5725 to 5850 MHz are permitted to have an e.i.r.p. higher than 4 W provided that the higher e.i.r.p. is achieved by employing higher gain directional antennas and not higher transmitter output powers.

12.4 Test Method

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



12.5 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
EMI Test Receiver	R&S	ESW26	REF2235	2019-07-23

12.6 Test Results

<i>Modulation: LoRa; Data rate: LoRa; Power setting: 0x0F</i>						
<i>Channel Frequency (MHz)</i>	<i>Analyzer Level (dBm)</i>	<i>Cable loss (dB)</i>	<i>Maximum peak conducted output power (W)</i>	<i>Antenna gain (dBi)</i>	<i>E.I.R.P. (W)</i>	<i>Result</i>
915.25	22.14	0	0.16368	6 (max)	0.65162	PASS
921.00	22.35	0	0.17179	6 (max)	0.68391	PASS
927.50	22.41	0	0.17418	6 (max)	0.69342	PASS

Antennas used by all three products covered by this report were < 6 dBi gain, 6 dBi was used as a worst case to cover all products.

Measurements were made using the AVGSA-1 method detailed in 558074 D01 DTS Meas Guidance v04

13 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 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**

[2] AC power line conducted emissions

Uncertainty in test result = **3.4 dB**

[3] Occupied bandwidth

Uncertainty in test result = **15.5 %**

[4] Conducted carrier power

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

[5] Conducted / radiated RF power out-of-band

Uncertainty in test result – up to 8.1 GHz = **3.31 dB**

Uncertainty in test result – 8.1 GHz to 15.3 GHz = **4.43 dB**

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

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

[6] Frequency separation

Uncertainty in test result (Spectrum Analyser) = **3.6 kHz**

[7] Accumulated channel occupancy time

Uncertainty in test result = **7.98 %**