

Report on the Radio Testing

For

Rentokil Initial 1927 plc

on

2G / 3G Control Panel

Report no. TRA-033559-45-03A

28th September 2017

RF916 7.0

Report Number: TRA-033559-45-03A
Issue: A

REPORT ON THE RADIO TESTING OF A
Rentokil Initial 1927 plc
2G / 3G Control Panel
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.247 & IC RSS-247

TEST DATE: 16-9-2017

Written by: A Wong

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Radio Test Engineer

Approved by:

J. Charters
Department Manager

Date: 28th September 2017

Disclaimers:

RF9167.0

- [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

1 Revision Record

<i>Issue Number</i>	<i>Issue Date</i>	<i>Revision History</i>
A	28th September 2017	Original

2 Summary

TEST REPORT NUMBER: TRA-033559-45-03A

WORKS ORDER NUMBER: TRA-033559-21

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): 47CFR15.247 & RSS-247

EQUIPMENT UNDER TEST (EUT): 2G / 3G Control Panel

FCC IDENTIFIER: 2AK3PGSD-500349
IC: 22407-GSD500349

EUT SERIAL NUMBER: N / A

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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ORDER NUMBER: G009450

TEST DATE: 16-9-2017

TESTED BY: A. L. Y. Wong
Element

2.1 Test Summary

Test Method and Description	Requirement Clause		Applicable to this equipment	Result / Note
	RSS	47CFR15		
Radiated spurious emissions (restricted bands of operation and cabinet radiation)	Gen, 8.10	15.205	<input checked="" type="checkbox"/>	PASS
AC power line conducted emissions	Gen, 8.8	15.207	<input type="checkbox"/>	NOTE1
Carrier frequency separation	247, 5.1 (2)	15.247(a)(1)	<input type="checkbox"/>	NOTE1
Number of hopping channels	247, 5.1 (3), (4) and (5)	15.247(a)(1) (i), (ii) and (iii)	<input type="checkbox"/>	NOTE1
Average time of occupancy	247, 5.1 (3), (4) and (5)	15.247(a)(1) (i), (ii) and (iii)	<input type="checkbox"/>	NOTE1
Maximum peak conducted output power	247, 5.4 (1), (2) and (3)	15.247 (a)(1), (b)(1) and (b)(2)	<input type="checkbox"/>	NOTE1
20dB emission bandwidth	247, 5.1 (1)	15.247(a)(1) (i) and (ii)	<input type="checkbox"/>	NOTE1
Out-of-band emissions	247, 5.5	15.247(d)	<input type="checkbox"/>	NOTE1

Notes:

NOTE 1: 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-033559-45-03A presents the results of the Radio testing on a Rentokil Initial 1927 plc, Control Panel to specification 47CFR15 Radio Frequency Devices and RSS-247 Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.

The testing was carried out for Rentokil Initial 1927 plc by Element, at the address(es) 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.

IC Registration Number(s):

Element Hull	3483A
Element North West	3930B

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.
- Industry Canada RSS-247, Issue 1, May 2015 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
- 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
ERP	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
NA	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: Control Panel
- Serial Number: N / A
- Model Number: Control Panel
- Software Revision: N / A
- 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.

Personal Computer and ac power adapter.

7.3 EUT Mode of Operation

7.3.1 Transmission

The mode of operation for transmit tests was as follows.

Using a PC installed with TeraTerm, connected via USB to the EUT, relevant commands was sent to set the transmitter power and channels.

7.3.2 Reception

The mode of operation for receive tests was as follows.

Not applicable to this test report.

7.4 EUT Radio Parameters

7.4.1 General

Frequency of operation:	915-928 MHz
Modulation type(s):	TDMA
Occupied channel bandwidth(s):	200 kHz
Channel spacing:	200 kHz
ITU emission designator(s):	125K1DEX
Declared output power(s):	10 dBm
Warning against use of alternative antennas in user manual (yes/no):	Yes
Nominal Supply Voltage:	6 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:	Soldered to PCB

7.4.3 Product specific declarations

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

7.5 EUT Description

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

a

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 the adaptor, 110 V ac, 60 Hz, from the mains.

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
<input checked="" type="checkbox"/>	Mains	110 V ac +/-2 %	85 % and 115 %
<input type="checkbox"/>	Battery	New battery	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 Laboratory 2
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Channels / Frequencies Measured:	Low / Mid / High
EUT Channel Bandwidths:	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: 37 % RH	20 % RH to 75 % RH (as declared)
Supply: 6 V dc	

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 ($\mu\text{V/m}$ 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:

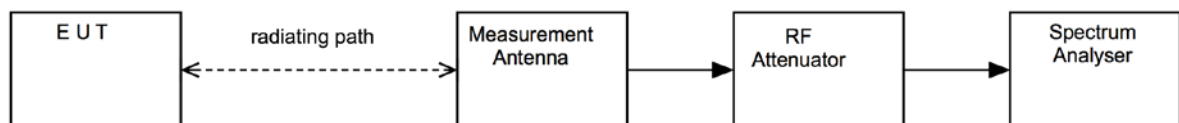
$$FS = PR + CL + AF - PA + DC - CF$$

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

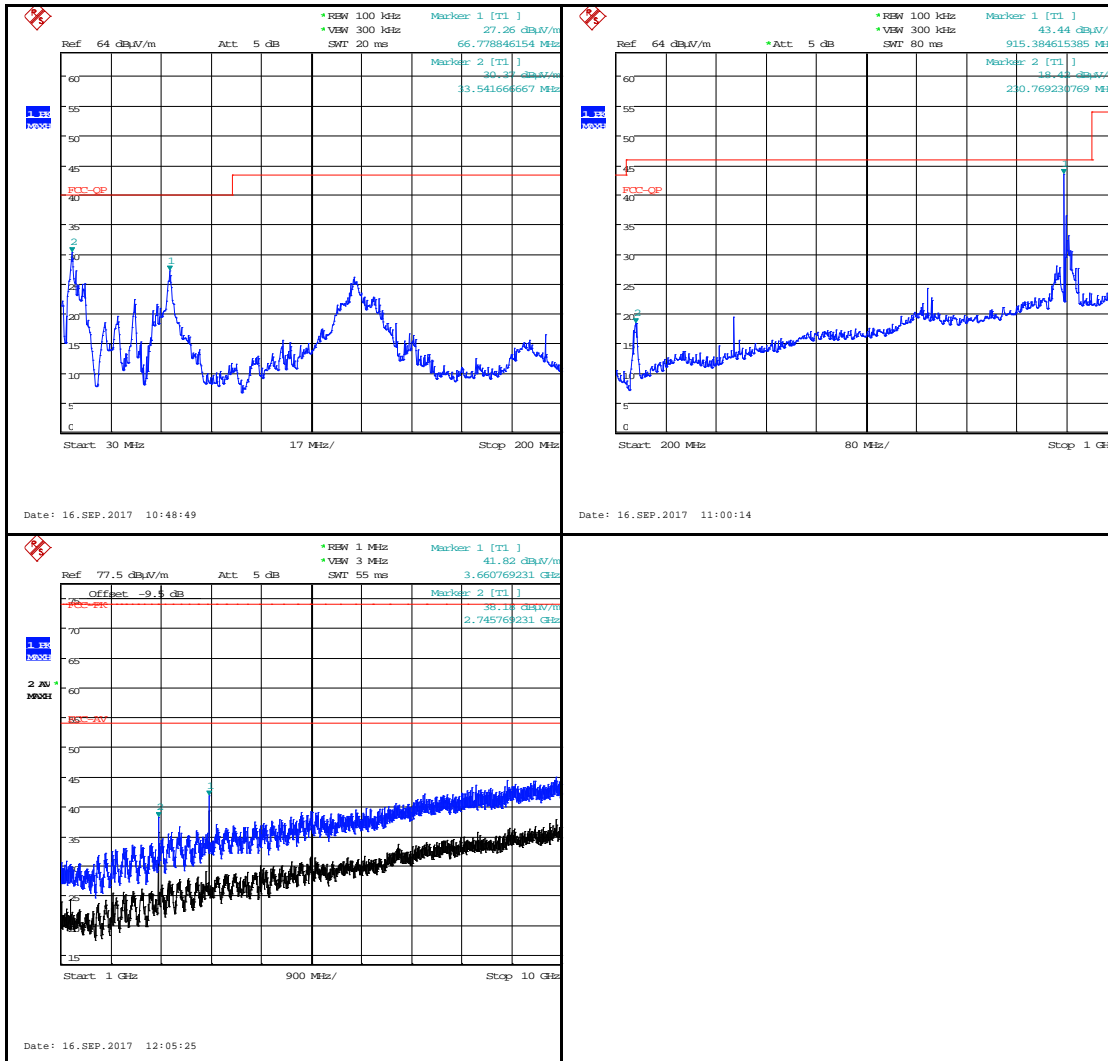


11.6 Test Equipment

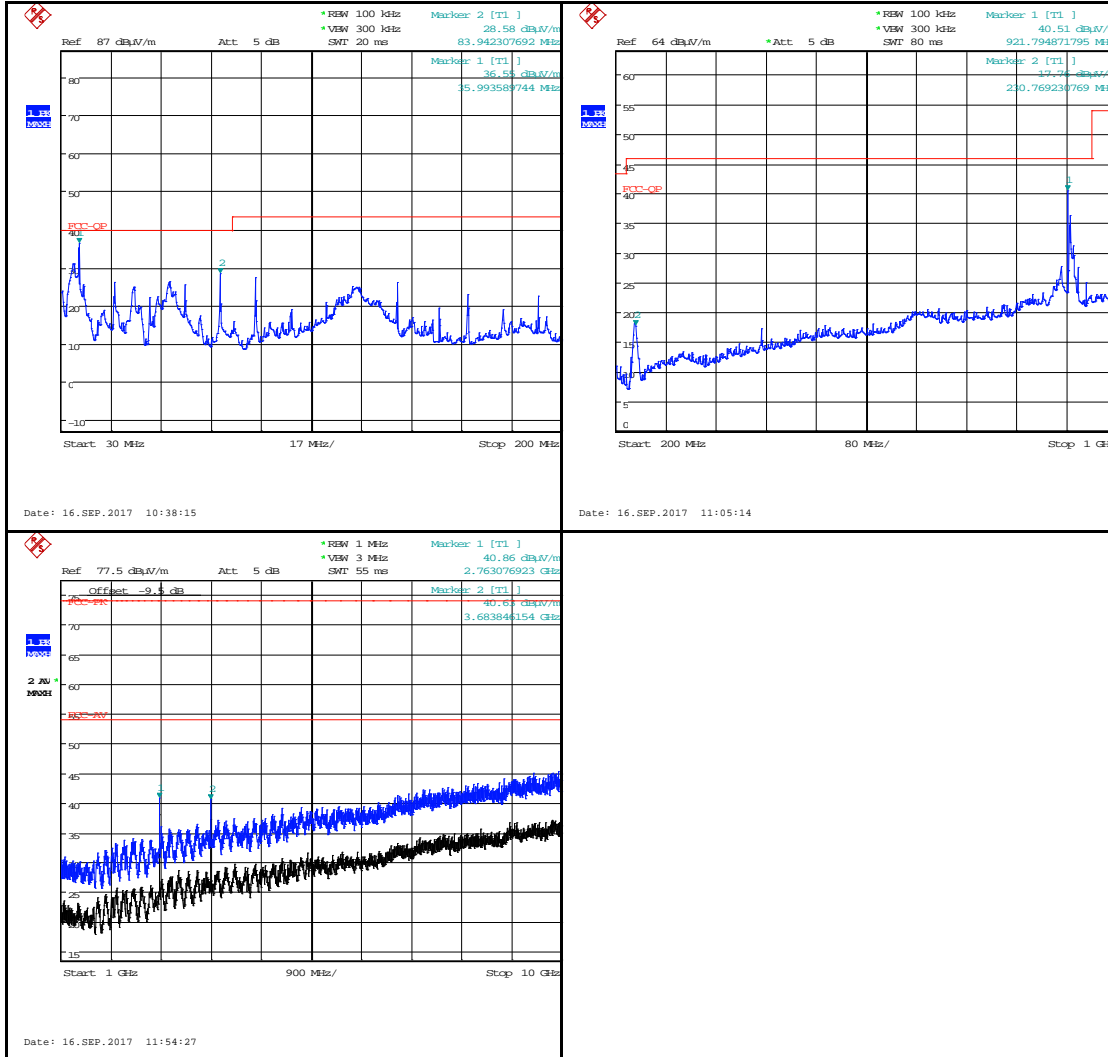
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Cable	Unknown	N-Type RF coaxial cable	REF881	05/12/2017
Cable	Unknown	N-Type RF coaxial cable	REF882	05/12/2017
Cable	Unknown	N-Type RF coaxial cable	REF885	05/12/2017
Cable	AtlanTec	Short SMA RF Cable	REF2166	26/09/2017
Cable	Unknown	N-Type RF coaxial cable	REF884	05/12/2017
FSU26	R&S	Spectrum Analyser	REF909	08/05/2018
3109	EMCO	Biconical Antenna	RFG095	17/05/2019
3115	EMCO	Horn Antenna	RFG129	09/02/2018
3146	EMCO	Log Periodic Antenna	RFG191	17/05/2019
310	Sonoma	Pre-Amp (9kHz – 1GHz)	REF927	30/06/2018
8449B	Agilent	Pre-Amp (1 – 26.5GHz)	REF913	02/02/2018
Cable	Teledyne	K-Type RF coaxial cable	REF2184	27/03/2018
Cable	Teledyne	K-Type RF coaxial cable	REF2185	27/03/2018

11.7 Test Results

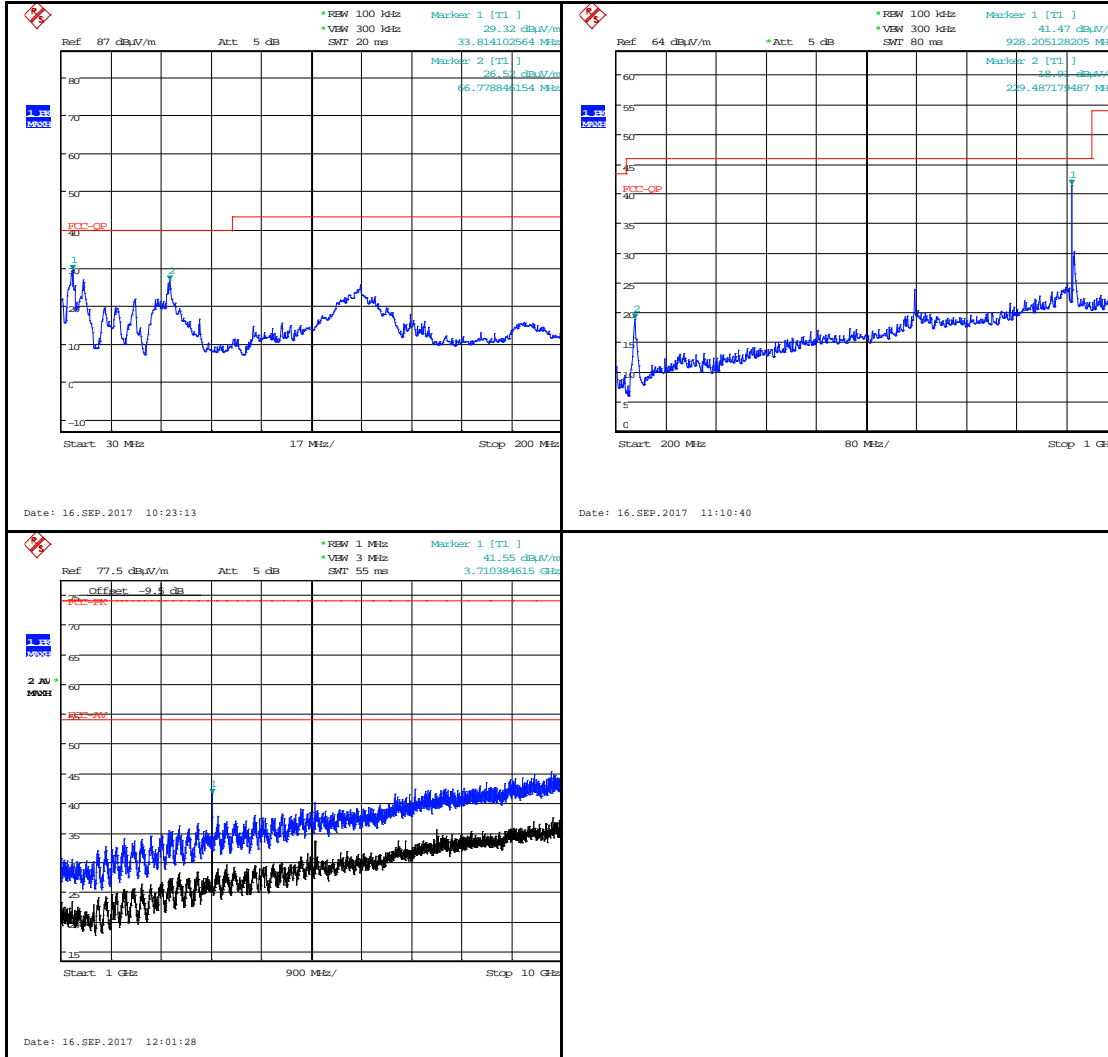
Power Setting: 0x0C; Channel: 915 MHz										
Detector	Freq. (MHz)	Meas'd Emission (dBμV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Duty Cycle Corr'n (dB)	Distance Extrap'n Factor (dB)	Field Strength (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
No significant emission was detected										



Power Setting: 0x0C; Channel: 921 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)
No significant emission was detected										



Power Setting: 0x0C; Channel: 928 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)
No significant emission was detected										



12 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 %**