

Report on the Radio Testing
For
Cad-Capture Group Limited
on
OccupEye Sensor
Report no. TRA-029955-01-47-01A
16th February 2016

RF915 3.0

Report Number: TRA-029955-01-47-01A
Issue: A

REPORT ON THE RADIO TESTING OF A
Cad-Capture Group Limited
OccupEye Sensor
WITH RESPECT TO SPECIFICATION
FCC 47CFR 15.247

TEST DATE: 7th - 15th January 2016

Written by: D Winstanley

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Radio Senior Test Engineer

Approved by:

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Department Manager - Radio

Date: 16th February 2016

Disclaimers:

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

RF915 3.0

1 Revision Record

<i>Issue Number</i>	<i>Issue Date</i>	<i>Revision History</i>
A	16th February 2016	Original

2 Summary

TEST REPORT NUMBER:	TRA-029955-01-47-01A
WORKS ORDER NUMBER	TRA-029955-01
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):	47CFR15.247
EQUIPMENT UNDER TEST (EUT):	OccupEye Sensor
FCC IDENTIFIER:	2AHC7OES01
EUT SERIAL NUMBER:	Not Applicable
MANUFACTURER/AGENT:	Cad-Capture Group Limited
ADDRESS:	Barnfield House Accrington Road Blackburn BB1 3NY United Kingdom
CLIENT CONTACT:	Simon Watts ☎ 01254 504400 ✉ simon.watts@cadcap.co.uk
ORDER NUMBER:	Not Applicable
TEST DATE:	7th - 15th January 2016
TESTED BY:	D Winstanley 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 checked="" type="checkbox"/>	Pass
Occupied bandwidth		15.247(a)(2)	<input checked="" type="checkbox"/>	Pass
Conducted carrier power	Peak	15.247(b)(3)	<input type="checkbox"/>	Pass
	Max.		<input checked="" type="checkbox"/>	
Conducted / radiated RF power out-of-band		15.247(d)	<input checked="" type="checkbox"/>	Pass
Power spectral density, conducted		15.247(e)	<input checked="" type="checkbox"/>	Pass
Calculation of duty correction		15.35(c)	<input type="checkbox"/>	N/A
Radiated Emissions Unintentional Radiations / receiver emissions		15.109	<input checked="" type="checkbox"/>	Pass

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-029955-01-47-01A presents the results of the Radio testing on a Cad-Capture Group Limited, OccuEye Sensor to specification 47CFR15 Radio Frequency Devices.

The testing was carried out for Cad-Capture Group Limited by Element, at the address(es) detailed below.

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

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
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: OccupEye Sensor
- Serial Number: Not Applicable
- Model Number: Sensor
- Software Revision: Not Applicable
- Build Level / Revision Number: Production

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.

EUT is a Battery powered Standalone device

7.3 EUT Mode of Operation

7.3.1 Transmission

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

The EUT was set to the highest or lowest operating frequency transmitting a modulated carrier at maximum power.

7.3.2 Reception

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

The EUT was set to receive mode on the highest and lowest operating frequency as required.

7.4 EUT Radio Parameters

7.4.1 General

Frequency of operation:	910.5 MHz – 918.1 MHz
Modulation type(s):	FSK
Occupied channel bandwidth(s):	625 kHz
Channel spacing:	112.5 kHz
ITU emission designator(s):	F1D625k0
Declared output power(s):	5dBm (Conducted)
Nominal Supply Voltage:	+3Vdc
Duty cycle:	0.3

7.4.2 Antennas

Type:	Linx ANT-916-HETH Helical Antenna
Frequency range:	865 to 965 MHz
Impedance:	50 Ohms
SWR:	<2.0 typical at centre
Gain:	<2.4 dBi
Polarisation:	N/a
Beam width:	Not Stated
Connector type:	PCB Through Hole
Length:	25.4 mm
Weight:	Not stated
Environmental limits:	-40 to 80 Centigrade
Mounting:	Through hole

7.5 EUT Description

The EUT is part of an occupancy monitoring system. The EUT covered in this report is a sensor operating on frequencies between 910.5 MHz - 918.1MHz in the 902 MHz - 928 MHz band.

8 Modifications

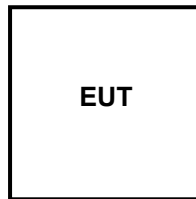
No modifications were performed during this assessment.

9 EUT Test Setup

9.1 Block Diagram

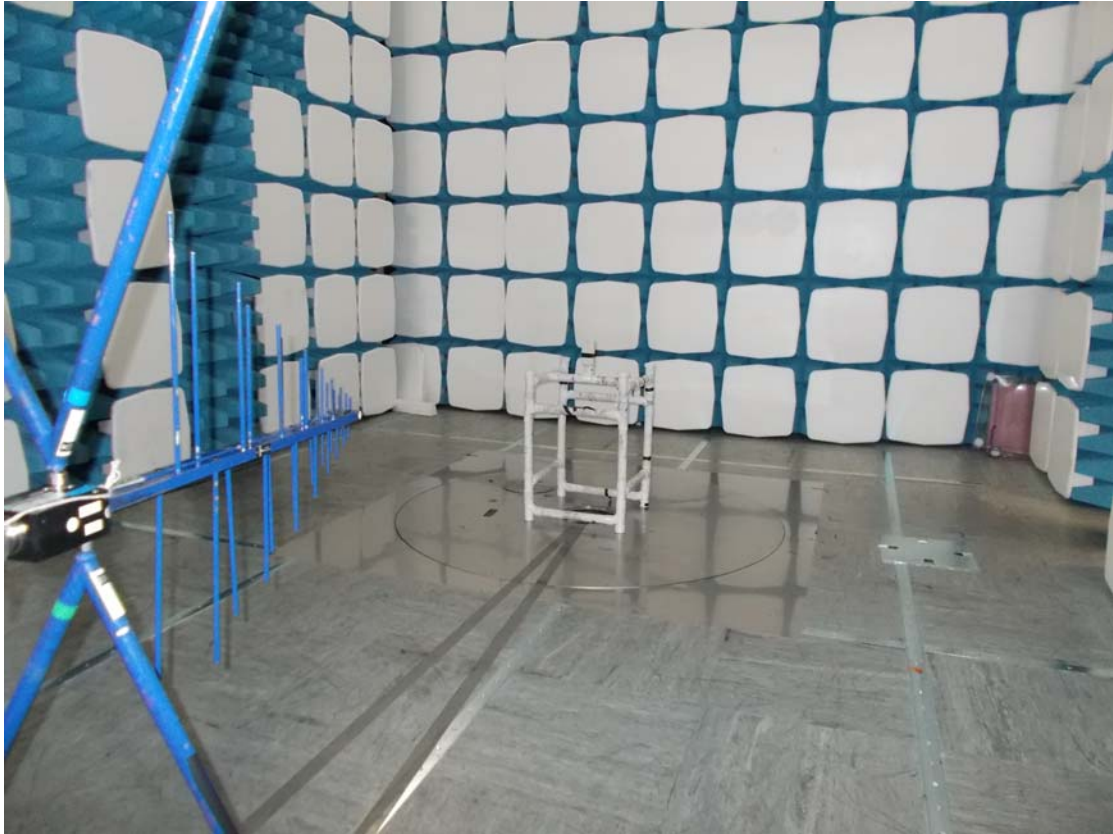
The following diagram shows basic EUT interconnections with cable type and cable lengths identified:

EUT is a standalone, battery powered device



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. 3V dc from alkaline batteries.

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 type="checkbox"/>	Mains	110 V ac +/-2 %	85 % and 115 %
<input checked="" type="checkbox"/>	Battery	New battery	N/A
<input type="checkbox"/>	Other	+12Vdc	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 Skelmersdale
Test Chamber:	Radio Chamber (REF940)
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Channels / Frequencies Measured:	Low / High
EUT Channel Bandwidths:	> 500 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: 22 °C	+15 °C to +35 °C (as declared)
Humidity: 44 % RH	20 % RH to 75 % RH (as declared)
Supply: +3Vdc	+3Vdc (as declared)

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

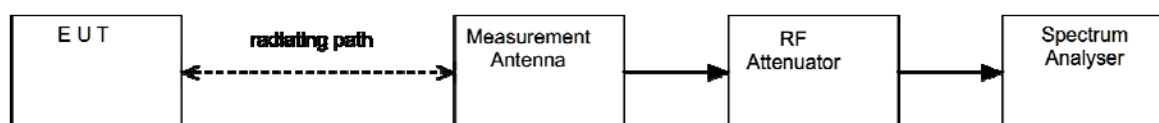
PA is the pre-amplifier gain in dB (where used);

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



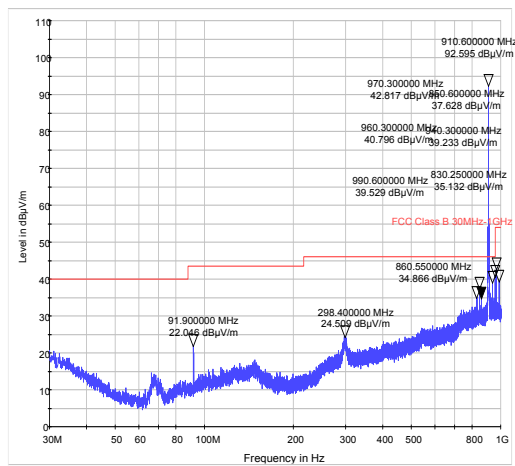
11.5 Test Set-up Photograph

11.6 Test Equipment

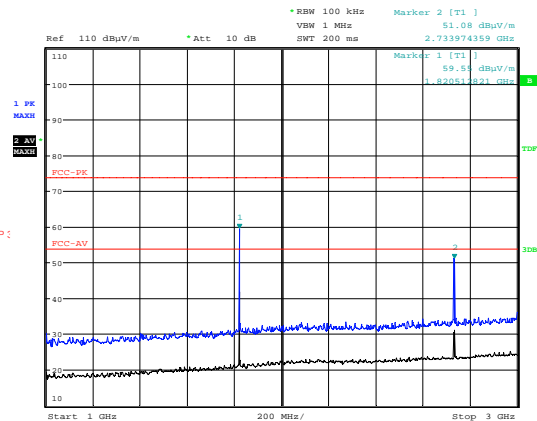
<i>Type of Equipment</i>	<i>Maker/Supplier</i>	<i>Model Number</i>	<i>Element Number</i>	<i>Calibration Due Date</i>	<i>Calibration Interval</i>
Spectrum Analyser	Rhode & Schwarz	FSU46	REF909	13/02/2016	12
Receiver	Rhode & Schwarz	ESVS10	TRL317	26/02/2016	12
Pre Amplifier	Agilent	8449B	L572	10/02/2016	12
Horn Antenna	EMCO	3115	L139	25/09/2017	24
Log Periodic Antenna	Chase	CBL611/A	UH191	26/02/2017	24

11.7 Test Results

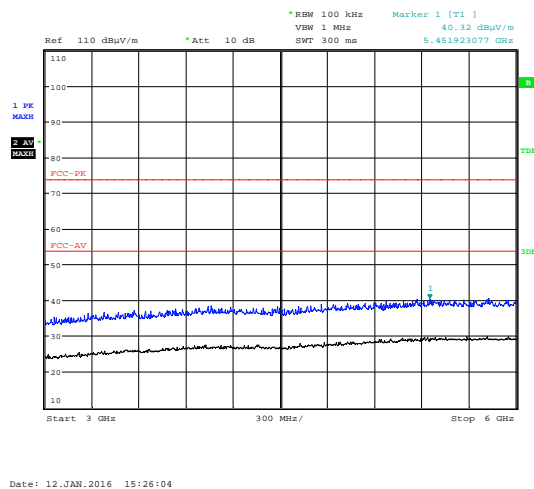
Low Channel										
Detector	Freq. (MHz)	Meas'd Emission (dBμV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Duty Cycle Corr'n (dB)	Distance Extrap'n Factor (dB)	Field Strength (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
QP	960.3	9.47	4.16	24	N/A	-	-	37.63	76.12	500
QP	960.6	9.71	4.16	24	N/A	-	-	37.87	78.25	500
QP	970.3	11.09	4.18	24.19	N/A	-	-	39.46	93.97	500
QP	970.6	11.58	4.18	24.17	N/A	-	-	39.93	99.20	500
QP	990.3	8.51	4.22	23.89	N/A	-	-	36.62	67.76	500
QP	990.6	8.72	4.22	23.87	N/A	-	-	36.81	69.26	500
Av	2730.76	39.81	4.2	29	36.12	-	-	36.89	69.90	500
Pk	2730.76	58.31	3.60	29.00	36.12	-	-	54.79	548.91	5012



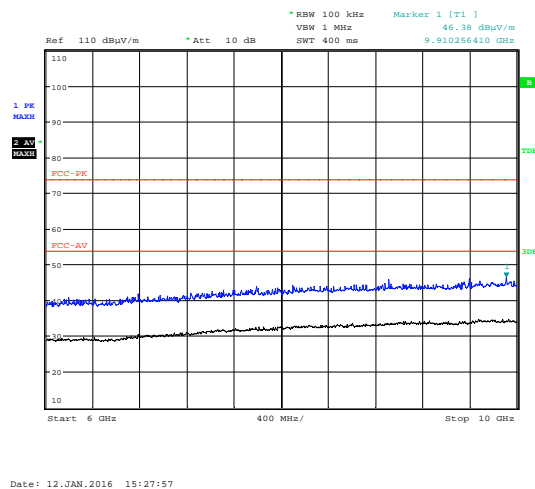
30MHz – 1GHz



1GHz – 3GHz

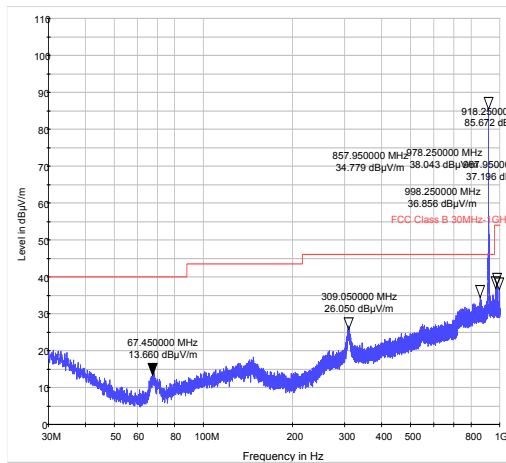


3GHz – 6GHz

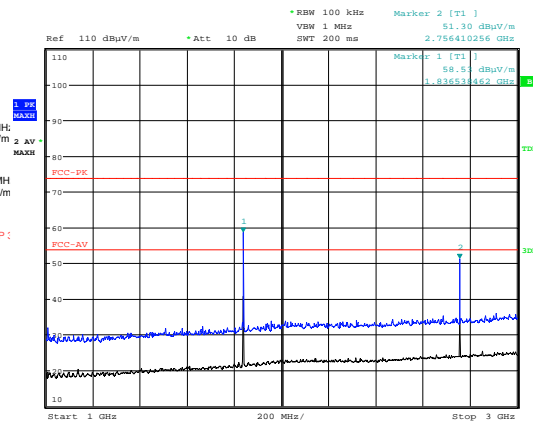


6GHz – 10GHz

High Channel										
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)
QP	967.95	10.49	4.17	24.1	N/A	-	-	38.76	86.70	500
QP	968.2	9.25	4.17	24.1	N/A	-	-	37.53	75.25	500
QP	977.95	12.25	4.19	24.1	N/A	-	-	40.54	106.41	500
QP	978.25	12.35	4.19	24.1	N/A	-	-	40.64	107.65	500
QP	997.95	7.45	4.23	23.8	N/A	-	-	35.48	59.43	500
QP	998.25	8.90	4.23	23.8	N/A	-	-	36.94	70.31	500
Pk	2753.75	60.82	3.70	29.1	36.11	-	-	57.51	750.76	5012
Av	2753.75	53.79	3.70	29.1	36.11	-	-	50.48	334.20	500

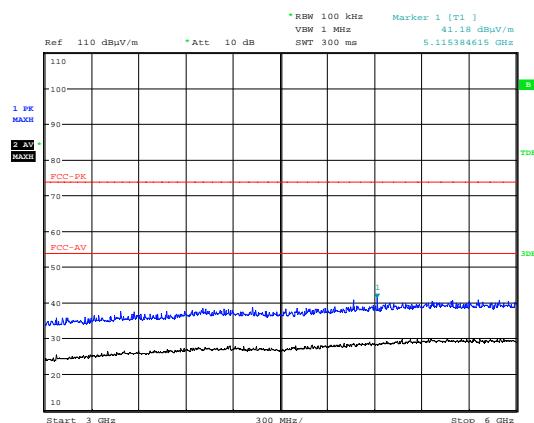


30MHz – 1GHz



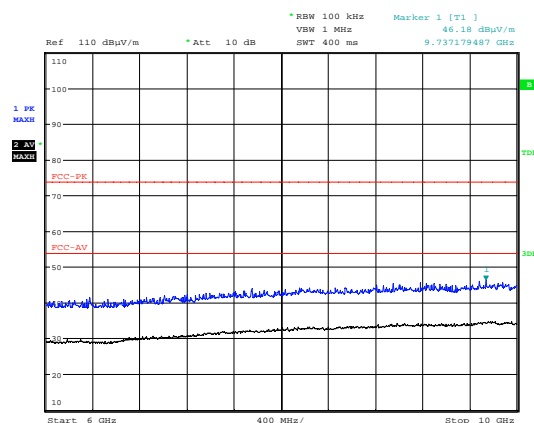
Date: 12.JAN.2016 15:00:56

1GHz – 3GHz



Date: 12.JAN.2016 15:02:53

3GHz – 6GHz



Date: 12.JAN.2016 15:09:15

6GHz – 10GHz

12 Occupied Bandwidth

12.1 Definition

The emission bandwidth (-6 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 6 dB below the maximum in-band spectral density of the modulated signal.

12.2 Test Parameters

Test Location:	Element North West
Test Chamber:	Radio Lab
Test Standard and Clause:	IC: ANSI C63.10-2013, Clause 6.9 FCC: ANSI C63.10-2013, Clause 11.8
EUT Channels / Frequencies Measured:	Low / High
EUT Channel Bandwidths:	> 500 kHz
EUT Test Modulations:	GFSK
Deviations From Standard:	None
Measurement BW:	
(IC requirement: 1% to 5% OBW;	100 kHz
FCC requirement: 100 kHz)	
Spectrum Analyzer Video BW:	300 kHz
(requirement at least 3x RBW)	
Measurement Span:	5 MHz
(requirement 2 to 5 times OBW)	
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 °C to +35 °C (as declared)
Humidity: 47 % RH	20 % RH to 75 % RH (as declared)
Supply: +3Vdc	+3Vdc (as declared)

12.3 Test Limit

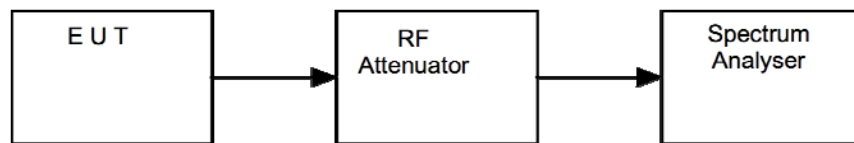
The minimum -6 dB bandwidth shall be at least 500 kHz.

12.4 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

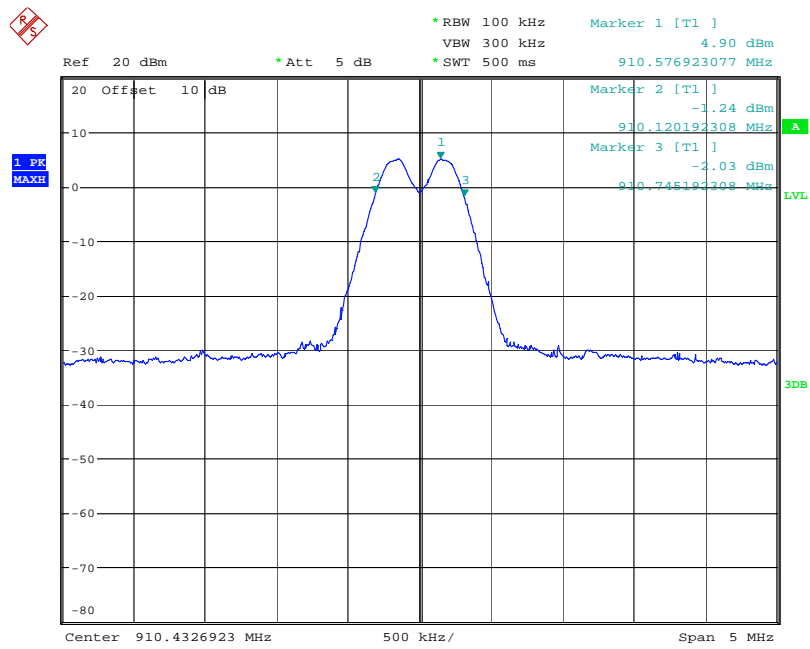


12.5 Test Equipment

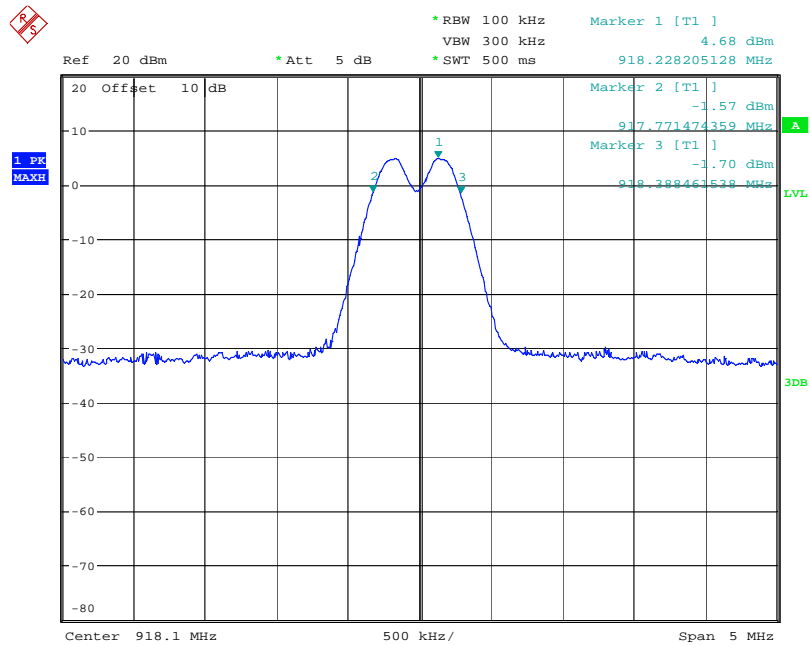
<i>Type of Equipment</i>	<i>Maker/Supplier</i>	<i>Model Number</i>	<i>Element Number</i>	<i>Calibration Due Date</i>	<i>Calibration Interval</i>
Spectrum Analyser	Rhode & Schwarz	FSU46	U281	24/04/2016	12

12.6 Test Results

<i>Channel Frequency (MHz)</i>	<i>F_L (MHz)</i>	<i>F_H (MHz)</i>	<i>6dB Bandwidth (kHz)</i>	<i>Result</i>
910.5	910.1201923	910.7451923	625.00	PASS
918.1	917.7714744	918.3884615	616.98	PASS



Date: 12.JAN.2004 13:26:09



Date: 12.JAN.2004 13:30:53

13 Maximum peak conducted output power

13.1 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.

The maximum conducted output power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level.

13.2 Test Parameters

Test Location:	Element North West
Test Chamber:	Radio Lab
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.9.1
EUT Channels / Frequencies Measured:	Low / High
EUT Channel Bandwidths:	> 500 kHz
Deviations From Standard:	None
Measurement BW:	1 MHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	3 MHz
Measurement Detector:	Peak
Voltage Extreme Environment Test Range:	+3Vdc

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 °C to +35 °C (as declared)
Humidity: 47 % RH	20 % RH to 75 % RH (as declared)

13.3 Test Limit

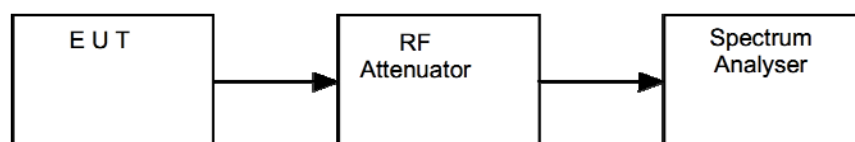
For systems employing digital modulation techniques operating in the bands 902 to 928 MHz, 2400 to 2483.5 MHz and 5725 to 5850 MHz, the maximum peak conducted output power shall not exceed 1 W.

13.4 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



13.5 Test Equipment

<i>Type of Equipment</i>	<i>Maker/Supplier</i>	<i>Model Number</i>	<i>Element Number</i>	<i>Calibration Due Date</i>	<i>Calibration Interval</i>
Spectrum Analyser	Rhode & Schwarz	FSU46	U281	24/04/2016	12

13.6 Test Results

<i>Channel Frequency (MHz)</i>	<i>Analyzer Level (dBm)</i>	<i>Cable loss (dB)</i>	<i>Power (mW)</i>	<i>Result</i>
910.5	-5.18	10.00	3.03	PASS
918.1	-5.22	10.00	3.01	PASS

14 Out-of-band and conducted spurious emissions

14.1 Definition

Out-of-band emission.

Emission on a frequency or frequencies immediately outside the necessary bandwidth that results from the modulation process but excluding spurious emissions.

Spurious emission.

Emission on a frequency or frequencies that 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.

14.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Lab
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.11
EUT Channels / Frequencies Measured:	Low / High
EUT Channel Bandwidths:	> 500 kHz
Deviations From Standard:	None
Measurement BW:	100 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	300kHz
Measurement Detector:	Peak
Measurement Range:	30 MHz to 10 GHz

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 °C to +35 °C (as declared)
Humidity: 48 % RH	20 % RH to 75 % RH (as declared)
Supply: +3Vdc	+3Vdc (as declared)

14.3 Test Limit

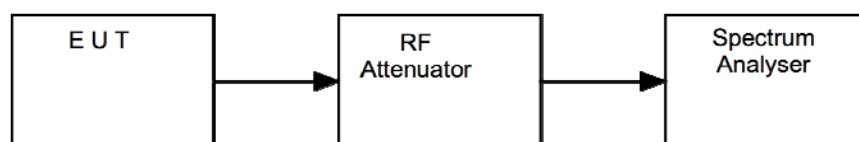
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in FCC 47CFR15.209 is not required.

14.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure v, the emissions from the EUT were 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 v Test Setup

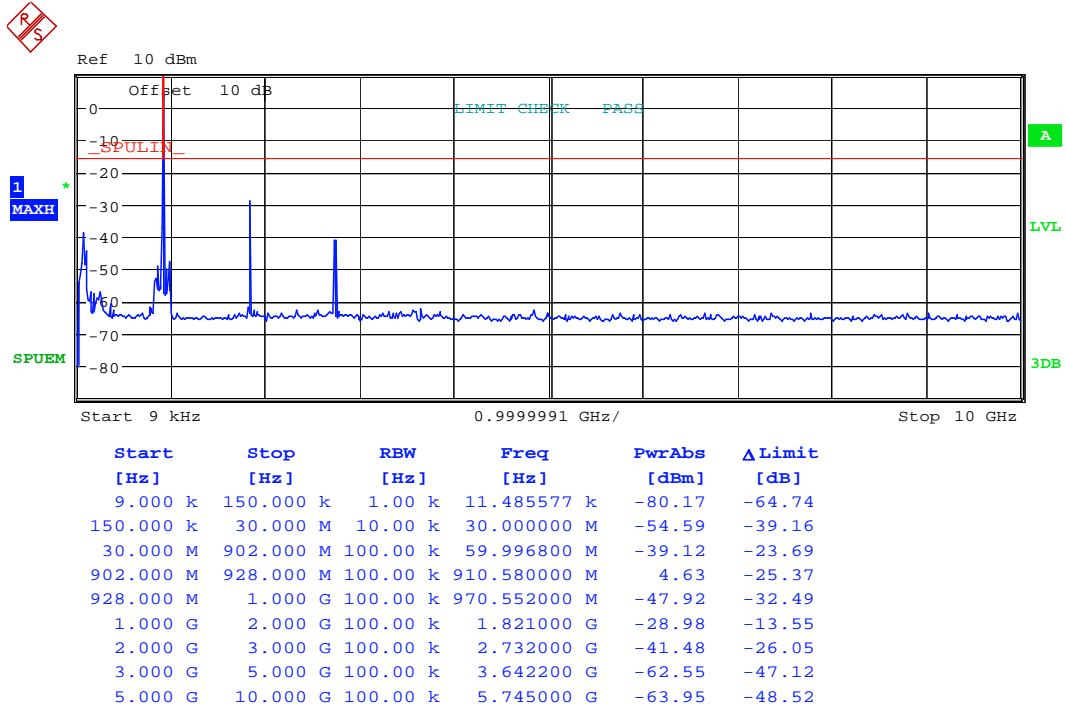


14.5 Test Equipment

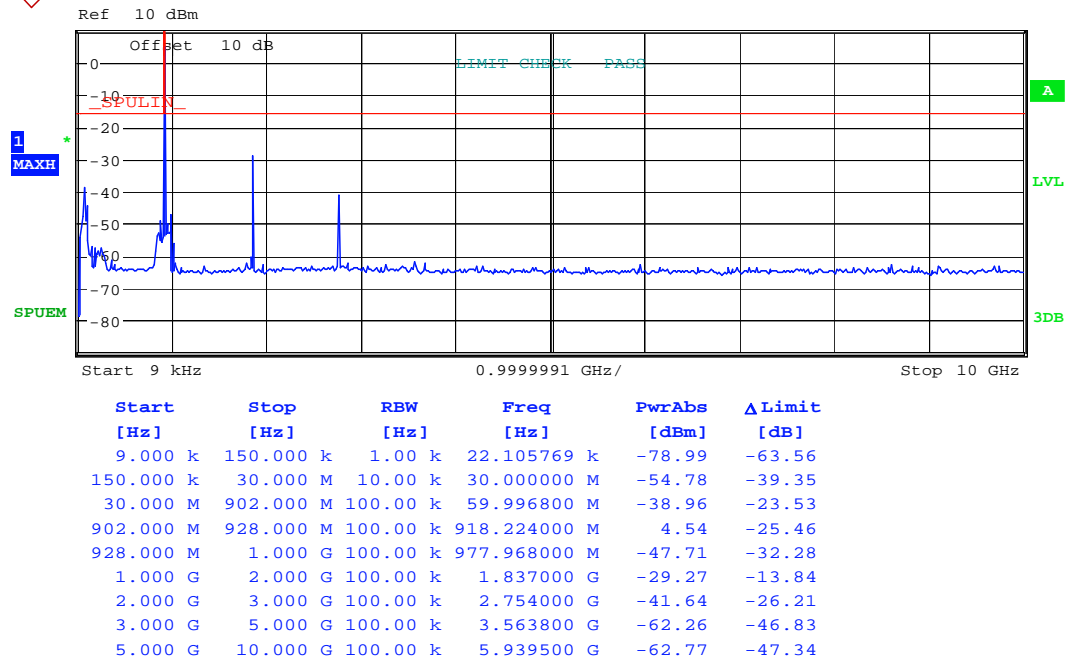
<i>Type of Equipment</i>	<i>Maker/Supplier</i>	<i>Model Number</i>	<i>Element Number</i>	<i>Calibration Due Date</i>	<i>Calibration Interval</i>
Spectrum Analyser	Rhode & Schwarz	FSU46	U281	24/04/2016	12

14.6 Test Results

Low Frequency						
Channel Frequency (MHz)	Emission Frequency (MHz)	Analyzer Level (dBm)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
No Significant Emissions Within 20 dB of the Limit						PASS



Low Frequency						
Channel Frequency (MHz)	Emission Frequency (MHz)	Analyzer Level (dBm)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
No Significant Emissions Within 20 dB of the Limit						PASS



15 Power spectral density

15.1 Definition

The power per unit bandwidth.

15.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Lab
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.10
EUT Channels / Frequencies Measured:	Low / High
EUT Channel Bandwidths:	> 500kHz
Deviations From Standard:	None
Measurement BW:	100 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	300 kHz
Measurement Span: (requirement 1.5 times Channel BW)	3 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 24 °C	+15 °C to +35 °C (as declared)
Humidity: 48 % RH	20 % RH to 75 % RH (as declared)
Supply: +3Vdc	+3Vdc (as declared)

15.3 Test Limit

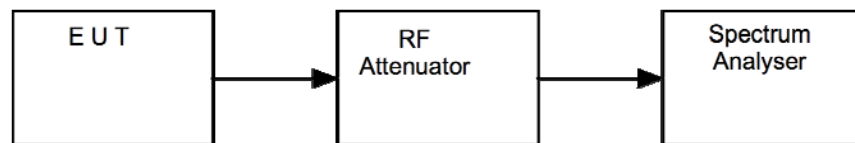
The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

15.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure vi, the peak emission of the EUT was measured on a spectrum analyser, with path losses taken into account.

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



15.5 Test Equipment

<i>Type of Equipment</i>	<i>Maker/Supplier</i>	<i>Model Number</i>	<i>Element Number</i>	<i>Calibration Due Date</i>	<i>Calibration Interval</i>
Spectrum Analyser	Rhode & Schwarz	FSU46	U281	24/04/2016	12

15.6 Test Results

<i>Channel Frequency (MHz)</i>	<i>Analyzer Level (dBm)</i>	<i>Cable loss (dB)</i>	<i>Power (dBm)</i>	<i>Result</i>
910.5	-5.43	10.00	4.57	PASS
918.1	-5.43	10.00	4.57	PASS

16 Radiated emissions – unintentional radiation / receiver emissions

16.1 Definitions

Receiver spurious emissions

The radio frequency signals generated within the receiver, which may cause interference to other equipment. This includes the period during which the equipment is scanning or switching channels.

Unintentional radiator

A device that generates RF energy which is not intended to be radiated for reception by a radio receiver.

16.2 Test Parameters

Test Location:	Element Skelmersdale
Test Chamber:	Radio Chamber (REF940)
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Channels / Frequencies Measured:	Low / High
EUT Channel Bandwidths:	> 500 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: Peak

Environmental Conditions (Normal Environment)

Temperature: 22 °C	+15 °C to +35 °C (as declared)
Humidity: 47 % RH	20 % RH to 75 % RH (as declared)
Supply: +3Vdc	+3Vdc (as declared)

16.3 Test Limit

Note:

Only radio communication receivers operating in stand-alone mode within the band 30 to 960 MHz, as well as scanner receivers, are subject to requirements, as described above. All other receivers are exempted from any certification, testing, labelling and reporting requirements.

However, all receivers in all frequency bands shall comply with the limits set forth in FCC 47CFR15B / IC RSS-Gen even in cases where testing, reporting and/or certification are not required.

Receiver Radiated Limits

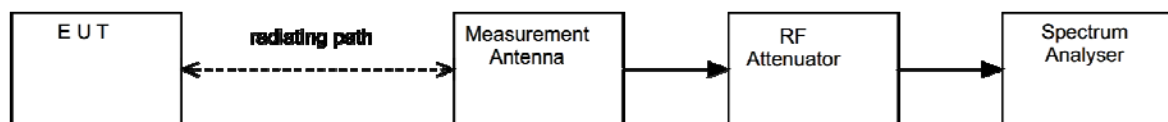
<i>Frequency (MHz)</i>	<i>Field Strength (μV/m at 3 m)</i>
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

16.4 Test Method

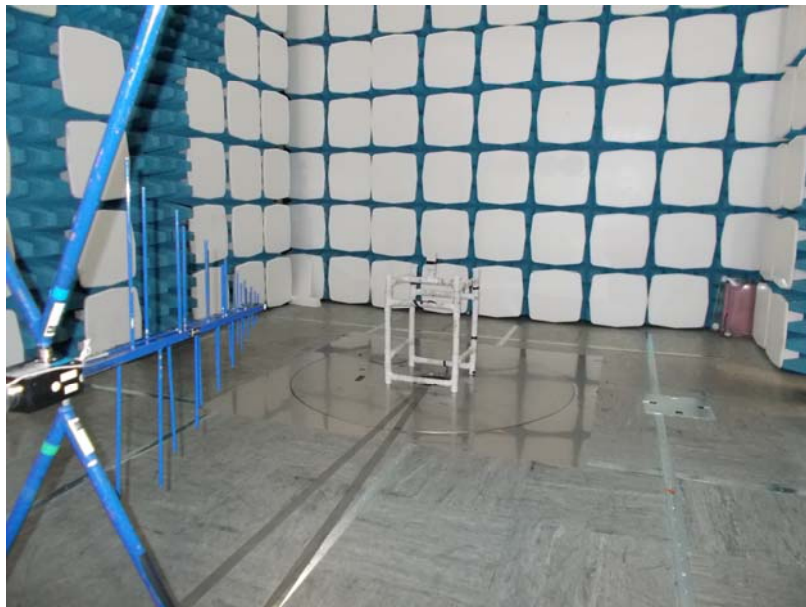
With the EUT setup as per section 9 of this report and connected as per Figure viii, the emissions from the EUT were measured on a spectrum analyzer / EMI receiver. The EUT was rotated in three orthogonal planes and the measurement antenna height scanned (below 1 GHz, from 1 to 4 m; above 1 GHz as necessary) in order to maximise emissions.

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 at each frequency. Pre-scan plots are shown with a peak detector and 100 kHz RBW.

Figure viii Test Setup



Test Setup Photograph(s)



16.5 Test Equipment

Type of Equipment	Maker/Supplier	Model Number	Element Number	Calibration Due Date	Calibration Interval
Spectrum Analyser	Rhode & Schwarz	FSU46	REF909	13/02/2016	12
Receiver	Rhode & Schwarz	ESVS10	TRL317	26/02/2016	12
Pre Amplifier	Agilent	8449B	L572	10/02/2016	12
Horn Antenna	EMCO	3115	L139	25/09/2017	24
Log Periodic Antenna	Chase	CBL611/A	UH191	26/02/2017	24

16.6 Test Results

Detector	Freq. (MHz)	Measured Emission (dBμV/m)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Field Strength (dBμV/m)	Extrap'n Factor (dB)	Field Strength (μV/m)	Limit (μV/m)
No Significant Emissions									

17 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] Power spectral density

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